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# First Annual Review

of the

# Copper Mining Industry of Lake Superior.



**Mining Journal Company, Limited,**  
**Publishers,**  
**Marquette, Michigan.**

**1899.**

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# FIRST ANNUAL REVIEW

OF THE

# COPPER MINING INDUSTRY OF LAKE SUPERIOR.

CONTAINING A CAREFULLY AND CONCISELY WRITTEN ACCOUNT  
OF EARLY EXPLORATIONS AND DISCOVERIES IN THE LAKE  
SUPERIOR COPPER REGION; A VALUABLE PAPER ON THE  
GEOLOGICAL FORMATION OF THE COPPER RANGES;  
STATISTICS OF PRODUCTION, ETC.; AN ACCURATE  
MAP OF THE COPPER BELT, AND A FULL AND  
COMPLETE DESCRIPTION OF THE PRODUC-  
ING PROPERTIES AND THOSE NOW IN  
PROGRESS OF DEVELOPMENT.

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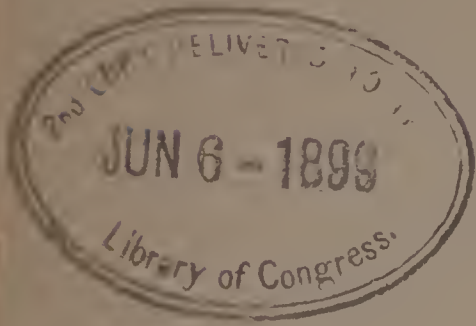
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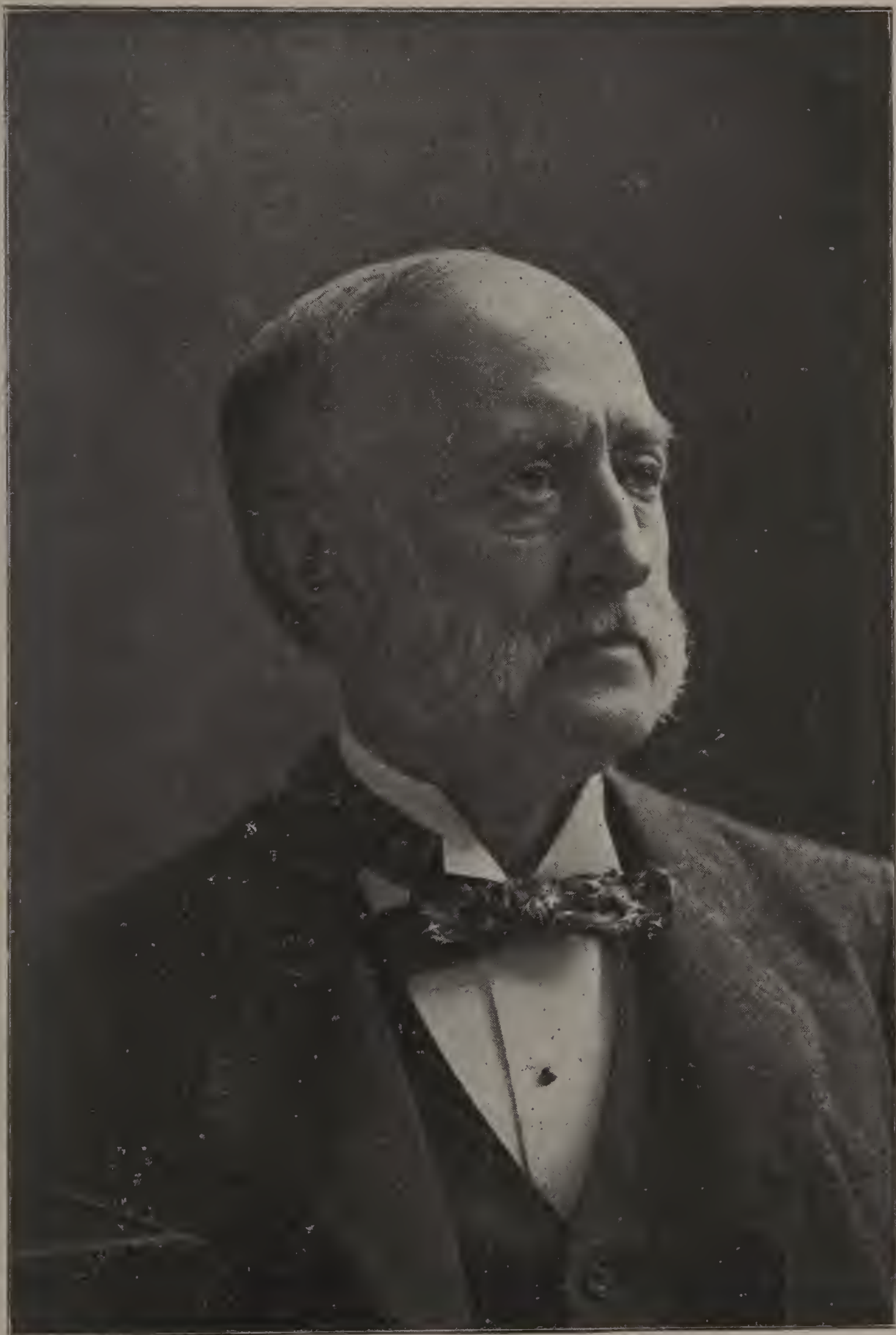
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**JOHN STANTON,**  
OF NEW YORK,  
*Secretary and Statistician American Copper Producers' Association.*



# Historical Review

• • of the • •

## Lake Superior • • • • • Copper Mining Industry.

By Horace J. Stevens.

•••••

### Early Discoveries and Explorations.

**S**TRETCHING from the southern mainland well toward the north shore of Lake Superior is a gigantic thumb of land, known as the Keweenaw Peninsula. This comparatively small area contains one of the richest repositories of mineral wealth known to man, and from it have been taken incalculable treasures in copper and silver. The date of its exploitation by white men is comparatively modern, the first actual mining of importance having been begun during the middle of the present century; but more than one hundred years ago attempts were made to open the copper mines on the banks of the Ontonagon river, not far distant from the properties now known as the Michigan and Victoria mines. To the Jesuit fathers of the seventeenth century, those intrepid explorers who faced peril by land and sea and risked death at the hands of the savage aborigines, the modern world is indebted for the first knowledge of the mineral wealth of the district. Ancient as seem the exploratory voyages of Marquette, La Salle, Allouez, Mesnard and Du Luth, the copper mines of Lake Superior had been worked in ages so far preceding them that forest trees requiring centuries to gain their maturity had grown from seedlings upon the ancient workings, flourished for other centuries as monarchs of the forest, and, dying from old age, had been succeeded by generations of other forests. To fix even an approximate date for the era in which the copper mines were worked by that strange, pre-historic race known vaguely to us as the Mound Builders, is a task that has foiled the keenest research of the trained archæolo-

gist. The most that can be said, within the bounds of truth, is that the ancient miners searched for copper at a date certainly many centuries, perhaps many thousands of years, ago.

The pits of the Mound Builders have been found in the three counties of Keweenaw, Houghton and Ontonagon, in which copper mines are now worked, but mainly in the latter county, which has been most prolific of the three in heavy masses of copper. Latter-day copper mines operating in the Lake district divide their mineral product into three classes, known at the mines as mass, barrel and stamp copper. The masses are sometimes of enormous size, two having been found which weighed over five hundred tons each, and were worth at the time of their discovery nearly half a million dollars each. The barrel work consists of small masses of copper weighing from a few pounds upward to a size rendering the pieces too large for the barrels, and are then called masses. The stamp copper varies from nuggets of some little size to microscopic flakes so light that they float upon water and are lost in the tailings of the stamp mills because their minute size renders them apparently independent of the laws of gravitation. The ancient miners did not attempt either stamping or smelting, but confined their operations to the search for masses of native copper of sufficient size to hammer into weapons and rude utensils. While they were lacking in the technical education and the powerful machinery which enable the nineteenth century miners to descend a full mile below the earth's crust, and stamp thousands of tons of solid rock into sand daily in a single mill, the Mound Builders knew copper when they saw it, and it is a matter of record that wherever one of their old pits was located a modern mine has been opened. Several of the large mines of Ontonagon county are opened upon the shallow pits dug centuries—or mayhap thousands of years—before by the original discoverers of Lake Superior copper.

Float copper, torn by glaciers from the outcroppings of the Keweenawan lodes and dropped in moraines hundreds of miles distant, is occasionally found in many localities east of the Mississippi and north of the Ohio rivers. These pieces of native copper are occasionally of several hundred pounds weight and have given rise to various wild mining schemes on the part of the finders. That such pieces of float copper were occasionally found and utilized by the ancients it is but reasonable to presume; but the extent of the ancient workings in Ontonagon county can leave no doubt that the bulk of the copper supply of the Mound Builders came from Lake Superior mines, which were regularly and painstakingly wrought for very long periods of time. One of the interesting relics of the race which disappeared from the continent of America before the white man first put foot on it was discovered in Ontonagon county, where a large

mass of copper, several tons in weight, was found mined from its native bed and reposing on stone skids several feet above the hole from which it was taken; a portion of the mass had been chiseled away, and about the pit were found various stone and copper tools. What accident, or disaster of war, famine or pestilence prevented the return of the old miners to their copper mass affords conjecture for the ethnologist and archaeologist, who have labored strenuously, though with but scant success, to reconstruct for modern eyes the primeval race that performed this work.

Interesting finds of hardened copper tools and weapons have been made in many mounds throughout the eastern and northern states, and at the old copper mines of the Ontonagon district. There are various collections of these relics, corroded and covered with green carbonate of copper from the action of the elements, the most complete collections being located in the Smithsonian and National museums at Washington, and at the Michigan College of Mines, Houghton. The ancient workmen possessed the secret of hardening copper, now one of the lost arts, but at their best the copper tools were sadly inferior to the keen cutting blades and instruments of steel and its alloys employed by those who live in modern days.

But we must leave that ancient race, whose name and tongue and habits will ever remain a mystery to us, but whose gigantic mounds testify to a comparatively high degree of civilization, and whose abandoned mines have so often formed the starting point of far greater mines in this later age. The southern shore of Lake Superior from Sault St. Marie, on the rapids of the lake's outlet, to Duluth, at the extreme head of the great fresh-water sea, was populated by the Chippewa Indians, from the time the first white man gazed upon the inland ocean until the advance of the white race shouldered the poor aborigines into the nooks and corners yet occupied by the remnants of an Indian tribe once among the most populous in America, and which, despite abuse and trickery, has always remained the white man's friend—a tribe which, until goaded by systematic villainy and robbery to revolt at Leech Lake, in Minnesota, in the late fall of 1898, never raised a weapon in war against the white race. The existence of copper was known from early times to the Chippewas, but their legends do not reach back to the time of the Mound Builders, who may have disappeared before the advent of the Chippewas, or traditions regarding whom may have been gradually lost in the gloom of centuries. The Indians knew of the existence of copper at various points along the southern shore of Lake Superior and on Michipicoten island, but did not make use of the metal, contenting themselves with picking up an occasional small copper nugget, which was regarded with awe as pertaining to a strong and troublesome Manitou, who was possess-

ed of a bad temper, consequently worthy of all respect, but not a desirable acquaintance at close range. One of the Chippewa legends relates to copper found on Michipicoten island, which lies some sixty miles north of Sault St. Marie, and bore a bad name among the aborigines as the abode of a crabbed deity named Missibizzi, an amphibious god who had small liking for the Red men, and whose habit it was to paddle his island from point to point on the waters, occasionally anchoring his several hundred square miles of marine real estate near the mainland, while at other times his fancy would be to locate it many leagues from shore in the blue waters of the lake.

The misanthropical nature of the owner and the erratic habits of the island gave the latter an ill repute among the Indians, who rarely landed there except in stress of weather. The evil reputation of the island was made worse by the experience of four Chippewa braves who landed upon it in a fog, many generations before the advent of Pere Claude Allouez, in the middle of the seventeenth century, and to whom the story of the unfortunate quartet was told. The Indians landed on the island from their birch-bark canoes in a dense fog, which detained them there for some hours. Becoming hungry, they caught some fish and cooked them in the usual manner. A fire was built on the sandy beach, stones were heated in it and then transferred to a birch bark trough containing water and the fish. The hot stones soon brought the water to a boil and thus cooked the fish. The stones which they used for cooking were of ruddy color and very heavy. The Indians decided to take these peculiar stones home for their children, and when the fog lifted a trifle embarked in their canoes for the mainland. They had proceeded but a short distance when Missibizzi appeared on the island, at the spot which they had just left, and demanded in thunder tones who were the robbers who had stolen the playthings of his children. Missibizzi did not pursue the unwitting robbers, but one of them was so badly frightened that he died before landing and a second expired as the canoe touched shore. The survivors started for the Indian settlement, but one died on the way. The fourth and last man reached the tribe and told the story, exhibiting the ruddy copper as corroboration, and himself died a little later; after which time the island of Michipicoten, Missibizzi and copper, were revered and shunned by the savages as most potent and dangerous medicine. It is not difficult to get at the truth of this apparently improbable tale, and the pious Allouez, who possessed great store of native shrewdness, furnishes an explanation which seems highly plausible. The savages cooked their food with heated copper nuggets. Partial oxidation of the copper, which had doubtless been long exposed to the elements, caused a poisonous chemical product which killed the Indians a few hours after eating the fish. A



thunder storm upon the island furnished the supernatural voice, and the sickness and terror of the Indians gave rise to the exaggerated tale of the survivor.

Even as late as fifty years ago the Chippewas regarded copper with superstitious awe. Reposing in the National museum at Washington there is a mass of native copper of something like two tons in weight. This mass lay for centuries on the banks of the Ontonagon river and was shown to several of the early missionaries by their Chippewa proselytes. The existence of such a copper boulder was known to the natives and rumored among the pioneers who first reached Ontonagon in the early forties. Among these hardy explorers was James K. Paull, a Virginian, known to all the older mining men of the copper country as hunter, trapper, miner and hotel keeper—a staunch friend and a very uncomfortable enemy. Paull reached the shore of Lake Superior with a yoke of oxen, which he drove from southern Wisconsin through several hundred miles of wilderness, both the cattle and Paull reaching their goal, emaciated but full of pluck, in the spring of 1842. Paull learned of the mass of copper and decided that it should be his. Getting into the good graces of a petty Indian chief, he secured a promise from the latter to guide him to the location of the mass of native metal. Accompanied by one white friend, Nick Miniclear, and carrying rope and tackle to remove the boulder from its bed beside the stream, Paull followed the Chippewa guide, taking along his trusty muzzle-loading rifle, in case they should run across a deer, for venison was as steady an article of diet with the pioneers of Lake Superior as mutton is today with the shepherds upon the South American Pampas. As the little party neared the site of the mysterious mass of metal the guide became perceptibly nervous and ill at ease. Paull became suspicious, and would not allow the Indian to leave his sight. Finally the guide explained that it was absolutely necessary that he be allowed to consult his Manitou upon the business in hand; and he was allowed ten minutes for the conference, with the stipulation that he remain in plain sight. At the end of the allotted period the Indian announced that his Manitou had peremptorily refused to allow the white man to see his copper treasure; whereupon Paull leveled his rifle at the Indian's breast, and announced that he also had been in consultation with the white man's Manitou, and that the latter had given the most imperative orders that the rock be located within a quarter of an hour, failing which a blood sacrifice would be demanded forthwith. The big copper boulder was speedily found around the next bend of the stream, and was displaced and loaded on a raft, with much labor. It was floated to the mouth of the river, at the village of Ontonagon, where it was confiscated by one Julius Eldred, in the name of the government.

Eldred took the boulder to Washington and presented it to the government as his little contribution to science, and it was received with deep gratitude, where to this day it stands with the name of Julius Eldred as the munificent donor. Jim Paull and the Chippewa guide had their labor for their pains.

The first knowledge given Europeans of the existence of native copper on the far-distant shores of Lake Superior was conveyed in the book published by one La Garde, at Paris, in 1636. The work contained a narration of journeys taken among the Indians of the new world by the author. Although containing much matter of value, and many facts previously unknown in France, the work is marred by a variety of fairy tales which lead the reader to suspect that the author either embellished his story with many details not warranted by the facts, or got much of his material second-hand from untrustworthy sources; and perhaps La Garde was guilty of both offenses. But let his shortcomings be forgiven, for his was the first information given the civilized world that there was copper on the shores of Lake Superior; and he lived in a credulous age, and where the mingling of superficial European learning with aboriginal tradition could but give rise to some remarkable tales.

In the "Relacion de ce qui s'est passe dans le pays des Hurons", published at Paris in 1660, appears the first mention by the Jesuits of Lake Superior copper, which is rather vague and evidently from hearsay, for the early Jesuit fathers who explored the Northwest were wise men, versed in worldly knowledge, and, while endeavoring to lead the natives to the cross, took keen account of the geography, soil and minerals of the far countries they traversed. In a later volume of the "Relacion" there is a chapter contributed by Father Claude Allouez, the second white man to see the native copper deposits, and certainly the first to write about them with even an approximation to the truth, unless the reports of Pere Rene Mesnard, of doubtful authenticity, are taken into consideration. Father Mesnard left Quebec in the fall of 1660, wintered on Keweenaw Bay in the vicinity of the present village of L'Anse, and in the following spring, presumably in April, started for Chequamegon Bay, on which the city of Ashland now fronts. His Chippewa guide reported that he wandered from the trail in making the two-mile portage between Portage Lake and Lake Superior, and it is certain that he was never seen again. It has been surmised that he was murdered by his guide, but the uniformly friendly relations existing between the Jesuits and the Chippewas, since the day of the first missionary two hundred and fifty years ago, render it probable that the Indian told the truth. Pere Claude Allouez was the second missionary to view the country now known as the Lake copper district, and he pushed his

journey further, reaching LaPointe, on Chequamegon bay, founding there in 1665 the Jesuit mission which is still in existence. Following Allouez came Fathers James Marquette and Claude D'Ablon, who founded the mission at La Sault de Sainte Marie. The bones of Marquette rest in the little churchyard at St. Ignace, not far from the Sault and facing upon the blue expanse of the Straits of Mackinac, which connect the waters of Lakes Michigan and Huron. A fine statue by Trentanove stands in Statuary hall of the capital at Washington, donated by the state of Wisconsin in memory of the intrepid explorer who did so much for future generations, and a fine bronze replica of the same statue stands in the city of Marquette, overlooking the fresh blue waters upon which the missionary-explorer voyaged in his birch bark canoe more than two hundred years ago—worthy mementos of a good man.

A French nobleman, the Baron Le Houtan, explored the southern shore of Lake Superior in the latter part of the seventeenth century, and published a book upon his voyage, in which reference is made to the copper deposits in such manner as to render it certain that the author himself saw and handled the metal where it was found, though the worthy gentleman made the mistake, still much too common, of calling that ore which was in truth virgin copper. De Charlevoix visited Lake Superior in 1721, in the course of his extensive explorations, which included almost the entire length of the Mississippi river, and wrote shrewdly and with truth of the native copper which he saw along the shore and in the hands of the Chippewas, who hoarded it, and regarded the copper nuggets with superstitious reverence, without attempting to make practical use of the metal.

To one Capt. Jonathan Carver is due the credit of stimulating the first attempt to develop the copper wealth of Lake Superior. The worthy captain met with many strange adventures in the Northwest, in the course of a three years' journey, beginning at Green Bay in 1765, and comprising a return trip, during which he coasted along the southern shore of Lake Superior, and found native copper at the mouth of the Ontonagon river. The captain seems to have been a versatile and genial gentleman, and one who was untrammelled by false modesty or too high regard for the truth, judging from the volume published by him in London in 1770—or perhaps he “syndicated” the story, and the Grub-street hack who wrote it put in the high lights with which the volume is lurid. At any rate it is safe to say that the captain saw many things in many strange lands, and whoever wrote his book lied about them prodigiously. The captain's literary reputation might not have suffered shipwreck so soon had not his tales of marvelous mineral wealth led to the formation of a copper

mining company in London, organized to exploit the copper of the Ontonagon district.

Meanwhile, one Alexander Henry, an Englishman by birth, adventuresome, and a pioneer hunter, trapper and explorer by choice, visited the mouth of the Ontonagon river in 1765 and again during the following year. There was at that time a considerable Chippewa village there, perhaps the largest on the lake to the westward of Sault Ste. Marie. Henry, on the occasion of his second visit, was shown the big copper boulder which Jim Paull later took from the Indians, to have it in turn taken from him by Julius Eldred. Henry estimated the weight of the metal at five tons, all native copper; and he, by dint of much labor, contrived to cut from the parent mass a slab of copper of nearly a hundredweight, which he took back with him to Sault Ste. Marie. In 1771 there appeared at the Sault a party of "miners" sent over by the London company, armed with royal letters patent and all other things needful to coax the ruddy metal from its primal bed. Henry was an old trapper, versed in the Indian tongues, and had himself seen and even brought away with him the metal for which the London company longed. He was forthwith engaged to assist in the enterprise, and took the entire party to the Ontonagon in a sloop of forty tons, which he had built the preceding season—the first covered-deck vessel ever sailing the waters of the great lake. The "miners" worked during the winter of 1771-2 on an adit driven from the Ontonagon river just above high water level and near the copper boulder referred to. With the spring thaw the clay through which the tunnel was driven collapsed, filling the adit and discouraging the workmen so that the project was abandoned, no attempt being made to even secure the five-ton mass of native copper, which merely required cutting up and carrying away. As the tunnel would have had to pass through red sandstone for about a mile before reaching the copper formation, the wisdom of abandoning the enterprise at so early a stage is fully apparent at this later date.

Nearly three-quarters of a century elapsed between the ill-starred English attempt at copper mining and the making of another attempt in developing mines, the latter proving successful, as it was undertaken with a better understanding of the situation. In passing, it may be remarked that succeeding English attempts at Lake Superior copper mining have invariably resulted in the same unsuccessful manner as the first, though English miners from Cornwall have opened nearly every one of the successful copper mines of the Lake district. The trouble with the English corporations seems to be just the same in the nineteenth century as it was in the eighteenth century—confiding capitalists place their funds in the hands of incompetent

people and the money is frittered away. With millions of pounds looking for investment, and with Cornish miners opening paying properties in every quarter of the world, it seems both strange and pitiable that our English cousins have naught to show for Lake Superior copper investments but a few musty maps, old reports, and a store of worthless stock certificates, made in the highest style of the engraver's art.

During the unsettled period between the War of Independence and the War of 1812, little was heard of the copper measures of Lake Superior. The voyageurs of the Hudson Bay company traversed the district frequently, but they were after furs and copper had no attraction for them. Then came John Jacob Astor, but he was after furs also, and his employees cared for peltry only. There died in 1898, at L'Anse, a man who came to the Lake Superior district in 1822, and resided continuously at L'Anse until his death, more than three-quarters of a century later. Peter Crebassa settled in L'Anse as resident agent and buyer for John Jacob Astor in 1822, and lived there for a quarter of a century before the first copper mine was opened. It seems deplorable indeed that his recollections were not garnered, before his death, by some conscientious historian; for with his demise there passed away much knowledge of early days which can never be replaced. The history of modern copper mining in Michigan really dates from 1830, for it was in that year that Dr. Douglass Houghton first visited Lake Superior, in company with Gen. Lewis Cass. In the early years of the century Ohio and Michigan both claimed the few hundred square miles now comprising Lucas county, Ohio, in which is located the thriving city of Toledo. Ohio was the older and more powerful commonwealth; hence the disputed territory was awarded that state, despite much vapping on the part of Michigan partisans, during the course of which war with all its horrors was semi-officially declared on several occasions, by patriotic Michiganders. As a recompense to the aggrieved residents of Michigan, who had perhaps the best claim to the territory in dispute, the eighteen-thousand-mile tract of land now comprising the upper peninsula of Michigan was generously donated to that state by the federal government. The people of Michigan protested against the gift, saying bitterly that the district was worthless. However, they finally accepted it, and it is now the richest portion of the state.

Dr. Douglass Houghton is regarded by all loyal residents of the Michigan copper and iron districts much as George Washington is thought of by the country as a whole, for it was the genius, the ability and the remarkable foresight of Dr. Houghton, carried to fruition by indefatigable effort, which gave the world its first true idea of the mineral wealth of the lake district. Dr. Houghton was one of the

early mayors of the city of Detroit and a man in whom scientific attainments were happily balanced by the soundest sense and a pre-science truly remarkable. Later scientists, following in his steps, have carried forward the scientific development of the district far beyond where he left it when cut off by accident in his prime, but his work, so far as done, has never required doing over; and it is along the lines laid down by him that progress has been achieved since his death. The village of Houghton, the financial and intellectual center of the great Lake Superior copper country, owes it to the zealous scientist for whom it was named to erect a suitable monument in enduring bronze to the man to whom the district is so much indebted.

The first visit of Dr. Houghton to Lake Superior determined the trend of his future life. He was fascinated by the possibilities of the district, geologically and commercially. In the following year, 1831, he returned to the district with the Schoolcraft expedition, and visited the copper boulder in the Ontonagon river, from which he chiseled several large pieces of copper, one of which remains in the possession of his brother, Jacob Houghton, now of Detroit. The Schoolcraft expedition, sent out by the general government to determine the source of the Mississippi river, was unsuccessful in the main object of its search, but gathered much valuable information regarding a portion of the union about which much less was then known than is now on record regarding our far northern territory of Alaska. Dr. Houghton, whose standing in the young state was of the highest, succeeded in awakening sufficient interest in the upper peninsula to secure a small appropriation from the legislature for a geological survey, at a time when but for his efforts the plan would have been laughed at as the project of a visionary. Even as it was, the appropriation was a pitifully small one; but every dollar was made to do double duty, for the work was a labor of love with Dr. Houghton, and he rallied around him as able and devoted a body of lieutenants as ever seconded a great general in battle. Among them were his younger brother, still living, Jacob Houghton, of Detroit; William A. Burt, the inventor of the solar, or dip, compass, an instrument invaluable to geologists, and of especial use in the iron formations of the district; C. C. Douglass, Bela Hubbard, S. W. Hill and others. The initial work of the survey was successfully performed under the most adverse conditions, but the first report to the legislature was not made until 1841, when Dr. Houghton was able to lay before the citizens of the state indisputable evidence of the great mineral wealth existing in a region which had been generally regarded by even the well informed men of that time much as the desert of Sahara is thought of today—a large expanse of territory containing little or nothing of value, and incapable of affording sustenance to civilized man. From 1840 dates the first gen-

eral interest in the Lake Superior copper region, which is in many respects the greatest and richest mineral district of the world. Private capital began to make inquiries regarding opportunities for investment, and was given the fullest information at the command of the geological survey—for the work of Dr. Houghton was that of the scientist and patriot; all that he learned was at the command of the world, and no attempts were ever made by him to secure for himself any portion of the riches which he laid bare to the gaze of all who cared to look.

### **The First "Soo" Canal.**

In the year 1840 the federal government was called on to assist the state of Michigan in the development of the Lake Superior region, and the United States donated 100,000 acres of land to the state of Michigan to assist in the building of a ship canal around the rapids of St. Mary's river, the outlet of the lake, where an eighteen-foot fall effectually impeded navigation for anything larger than the batteaux of the French voyageurs, for which a small canal had been dug on the Canadian side of the river by the Hudson Bay company, early in the century. While this bill was before the senate, Henry Clay took occasion to refer to the measure in facetious terms, stating that the proposed canal would reach to regions "beyond the remotest range of settlement in the United States, or the moon". Another Kentuckian, nearly a third of a century later, immortalized both himself and a Lake Superior town, then a hamlet but now a great and growing city, in a speech both satirical and eloquent, wherein he described the future destiny of "the Zenith City of the unsalted seas". Proctor Knott lived to be féted by the citizens of Duluth, and to witness with his own eyes the realization of the prophecies which he had made a quarter of a century before in an ironical spirit. The earlier and greater Kentuckian died before the "region beyond the moon" had more than fairly given promise of future greatness; but even before his death the point of his satire had been turned from the far-distant region toward himself.

The first ship canal, toward which the government gave the lands, was completed in 1857. It was a stupendous work for the poor and newly-settled commonwealth of Michigan to undertake, but never was money better invested. A second and larger canal was completed by the government some twenty years ago, and the third and greatest canal was opened to commerce in August, 1896. The tonnage passing through the Sault canal is now the heaviest in the world, far surpassing that of the famed Suez canal, built at such cost of life and treasure through the sands of Egypt. Henry Clay was perhaps a great statesman, but certainly a poor prophet.

## Geological Surveys.

In 1844, Dr. Houghton was engaged by the general government to combine a linear survey of the lands on the southern shore of Lake Superior with the geological and topographical survey then in progress for the state. This allowed the opening of mines, for before the surveying of the lands by the government no title could be given to lands desired by settlers or miners. Great progress had been made in this work when Dr. Houghton met with an untimely end, in October, 1845. While off the Keweenaw peninsula, on the great lake, his small boat was overtaken by a sudden squall and all on board but one man were drowned. Dr. Houghton's corpse was recovered in the following spring, and the body now lies buried in Detroit. The work which he had begun and carried to partial completion was conscientiously pursued by his successors, chosen from among his assistants, but his death was a great loss to science and to the state and district.

A geological survey by the Federal government was begun in the year after Dr. Houghton's death, under direction of Dr. Jackson, who was succeeded in the work two years later by Messrs. Foster and Whitney, eminent scientists, and whose joint work on the Lake Superior mineral districts remains to this day a standard authority. In 1842 the Chippewa Indians ceded some 30,000 square miles of their lands to the United States, the cession comprising the entire southern shore of Lake Superior. The cession was made under the usual pressure and for the usual consideration—reservations further west, belonging to other tribes, who had also traded their lands for a few gallons of rum and a few plausible promises which Uncle Sam has never carried out, and probably never will make good. With the acquisition of title and the surveying of the ground fair opportunity was given for the exploitation of the mineral resources of the new country. In 1842 John Tyler was president, and his secretary of war, under the management of which department the Chippewa treaty and cession was secured, was David Henshaw of Boston. The occupancy of the war department by Mr. Henshaw was one of the apparently trivial matters upon which the future history of the district hinged, for Mr. Henshaw was an enthusiastic believer in the future of the Lake district, and it was through his personal solicitation and assurances that the first capital was invested in copper mining; since which date Boston money has almost invariably opened every new copper mine, and many millions of dollars have been added to the wealth of that city by the red metal dug from the hills of Lake Superior.



## Mining Permits and Land Titles.

Early in 1843 the war department appointed Walter Cunningham a special agent for the purpose of granting mining permits in the Lake Superior district; as at first no mineral lands were sold outright. As early in the late spring of that year as the opening of lake navigation would allow, Capt. Cunningham opened an office at Copper Harbor, the first mining settlement on the shores of Lake Superior. James Paull and Nick Miniclear, who came overland from the lead mines of Platteville, Wisconsin, in midwinter, arriving at the shore of the lake in March, 1843, were the first miners to reach the district subsequently to the ill-fated Henry expedition of 1770. With the opening of navigation in 1843, there was a rush for the copper fields, and a score or more of prospective miners reached Copper Harbor on the same boat as the government land agent, and, securing permits, began searching for copper at once. There was copper everywhere, and embryo millionaires were as many in number as the numerical force of prospectors; but it was soon found that float copper did not mean the existence of a mine, and that all copper lodes and veins were not sufficiently productive to pay for opening.

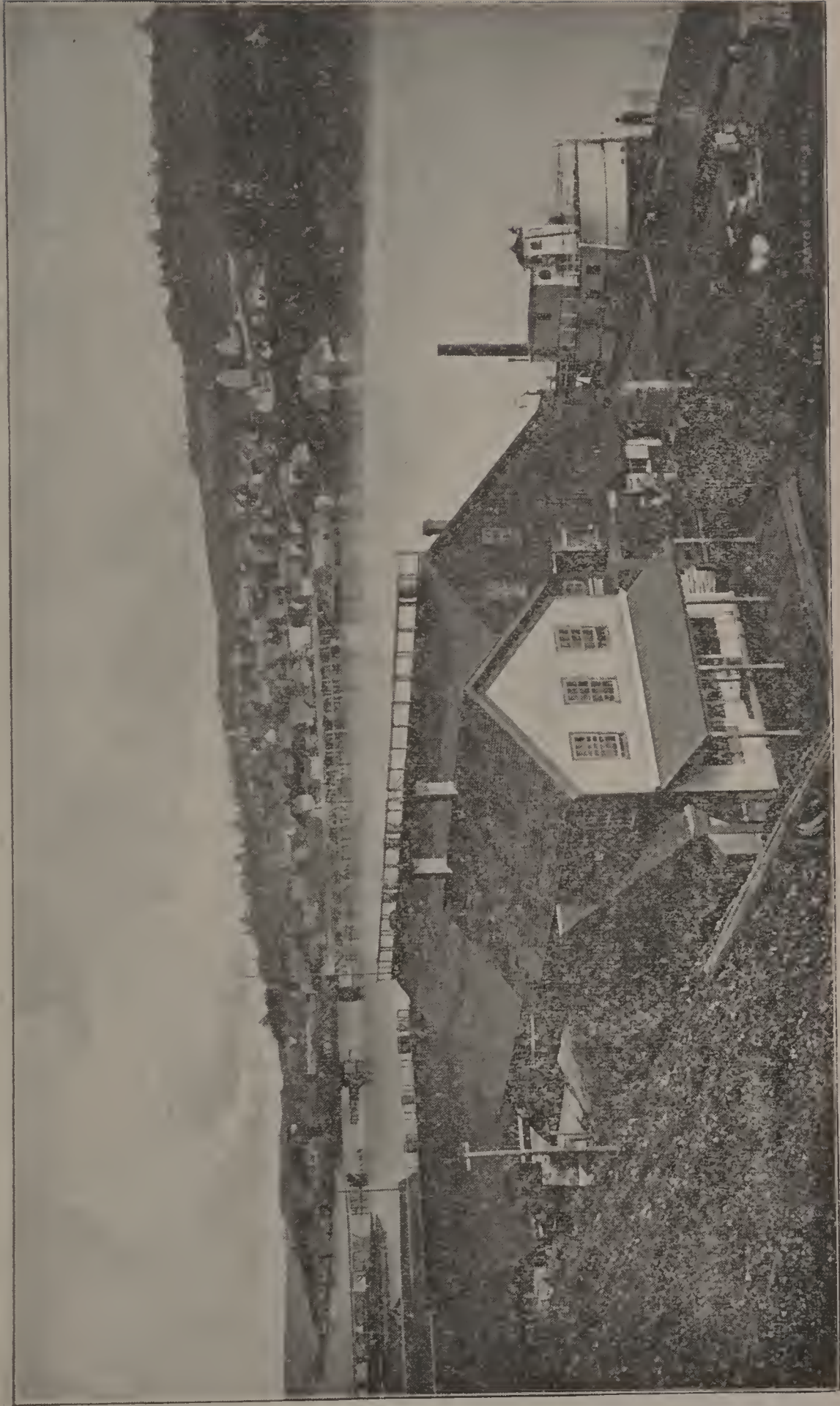
The mining permits issued by the government at first allowed nine square miles to each prospector; but a few months later were reduced to cover but one square mile each. One year was allowed for prospecting and nine additional years for mining, on a royalty of 20 per cent. The only people who really secured substantial profits from these mining concessions were those who sold them at fancy figures. Copper was found everywhere, from the beach along the lake shore for as many miles back into the forest as the prospectors went. Many valuable copper deposits were thus located of which succeeding generations of miners and geologists have been unable to discover the slightest trace. The existence of a central belt of trap rock, carrying copper-bearing amygdaloid and conglomerate lodes, and traversed by cupriferous fissure veins, had been shown by the labors of Dr. Houghton and his assistants, but the geological experts were calmly ignored by the "miners", grown wise through a few months' or even a few weeks' residence in the district; and as many copper mines were located on the sandstone formation, which abuts unconformably upon either side of the trap belt, as were located within the limits later ascertained to mark the boundaries of the district within which native copper could be found in place. It was a wild and happy time, when every new-comer found a mine without difficulty, with graceful deer thronging the forest, awaiting the coming of the hunter who was to convert them into venison, while every brook held schools of

speckled trout which struggled for the privilege of swallowing the bit of red flannel which concealed the treacherous hook of the angler. The early forties in the copper district were days of heavy drinking, of mingled feasting and fasting, of hard labor and of carousing. A small post of federal troops was stationed at Fort Wilkins, on Keweenaw point, but the troops were never called on to suppress rioting, subdue violence or maintain order. The pioneers were a wild and hardy lot, but honest and neighborly, ready to strip off the coat for a fist fight on slight provocation, yet ever-ready to divide the last biscuit with a new-comer or hungry wayfarer. Of fighting, feasting and fasting there was much, but of murders and robberies almost none. No vigilance committees were ever required in the early days of the lake copper district, which was perhaps the only great mining district of the world so suddenly populated without disorder and violence, and which did not finally require the services of Judge Lynch in the promotion of order and to bring the wicked to a realizing sense of the sanctity of life and property. The copper country was never a wicked or turbulent district, even when officers of the law were fewest and litigation was commonly settled by a stand-up-and-knock-down fight between the plaintiff and defendant. It has never been a lawless district, and there is perhaps less disorder at present in Houghton county, with its 75,000 souls, than in any other county in the United States of equal population. On the last pay-day at Calumet, before the writing of this sketch, eight thousand men received their monthly wages and not a single arrest was made for drunkenness, disorder or crime on that or the following day, by the six policemen who form the entire constabulary of a mining camp of over 40,000 souls.

The system of permits adopted by the government was not a success, and after two years' trial was abandoned. Impinging claims were common, and in some cases overlying permits were piled up three or four deep. The Federal authorities decided that the lands should be sold, as surveyed, for \$5 an acre. Later this price was modified, and a uniform figure of \$1.25 per acre affixed on all government lands. The Calumet & Hecla is at present taking nearly 100,000,000 pounds of refined copper annually from the conglomerate lode underlying twenty acres of surface—a product valued at \$18,000,000, taken from under land which cost \$25.

### **Inauguration of Practical Mining.**

From the explorations of the first three years but few mines resulted. That such proved the case is not at all surprising, for the men who inaugurated the modern era of copper mining were in most



HOUGHTON, MICH., FROM THE HANCOCK SIDE.

PHOTOGRAPHED BY A. F. ISLER,  
LAKE LINDEN.



cases neither practical miners nor geologists. They were in search of mines of native copper, and located claims on the sandstones with as much confidence as on the trap formation. Native copper exists at a number of points on the globe, but nowhere except in the Lake Superior district is native copper mined in quantities to be considered of importance. The copper supply of the world, previous to the fourth decade of the nineteenth century, had been obtained almost exclusively from copper ores, mainly sulphurets and carbonates, and nearly all raised from the mines of Cornwall, Spain and Germany, where there are copper ore mines of great antiquity. Julius Cæsar found the natives of West Britain mining tin and copper when he invaded the island, in the century preceding the Christian era, and there are ample grounds for thinking that the ancient Phœnicians traded in Britain nearly ten centuries before the birth of Christ, and that tin and copper were then being mined and smelted in Cornwall. The native copper of Lake Superior was an anomaly, and it is not to be wondered at that many mistakes which now appear ludicrous, but were then perfectly natural, should have been made by the pioneer miners of the Michigan copper district. With 1846, when it became possible to obtain title to mineral lands from the government, there came an era of saner development, and the first real mines of the district were opened. Men of scientific attainments were sent to the district to develop mines, and the vanguard of the great host of Cornish miners, which has reached our shores in a never-ending procession for more than fifty years, arrived to supplement with their shrewd, practical knowledge the theories of the men who were skilled in book-lore but deficient in the practice of mining. In the year 1846 the Cliff mine was first opened, and this property, now idle, is unquestionably the oldest in the district as a mine, although cursory scratching of the ground was done at several other points where real mines were opened in later years. The masses of native copper found on the shores of the lake and rivers proved too infrequent to be remunerative, and the attention of miners was turned to the finding of copper ores, powerfully impelled thereto by the first Cornishmen who reached the district. They regarded the masses of native metal as *lusus naturæ*, but the copper ores were familiar to them. Fissure veins, crossing the formation at approximately right angles, were located at a number of points, and from them were taken considerable quantities of copper ore in the form of sulphurets, carbonates and oxides. One feature, both of the lodes running parallel with the formation, and the fissure veins crossing them transversely, which disquieted the practical miners from Cornwall, was the changing of the mineral deposits from ore to native copper at slight depth. The copper lying near surface, originally native, had been oxydized by countless ages of exposure to

the elements; but at a little depth the black oxides and green carbonates were replaced with the virgin metal. The Cliff mine was opened on a fissure vein, and the first product of the Cliff company was something under fifty tons of black oxide, taken from a fissure vein near Copper Harbor. At a little depth the ore disappeared, but was replaced with native copper in such profusion that the vein was followed steadily until it was worked out, some twenty years ago—for all fissure veins have their ending, though the conglomerate and amygdaloid lodes are known to pass entirely under Lake Superior and reappear on the earth's crust on Isle Royale, forty miles to the northwest of the Keweenaw peninsula. The Pittsburg & Boston Mining company, which was the official title of the corporation operating the Cliff mine, was organized in 1844, began actual mining in 1846, and paid its first dividend, of \$10 per share on 6,000 shares, in 1849, thus being the first mining corporation in date of organization, the first mine opened, and the first dividend-paying property in the district. Until just previous to the payment of the first dividend the stock sold at far below subscription price, and in 1847 nearly half of the shareholders forfeited their stock in preference to paying a small assessment. Fortunately, both for the district and for themselves, the other shareholders raised the required sum, and after assessing the comparatively small sum of \$111,000 between 1844 and 1848, the mine paid its first dividend of \$60,000 in 1849, and continued paying large profits until it was finally abandoned, returning in all the magnificent total of \$2,518,620, or more than \$22 profit for every dollar invested. The Pittsburg & Boston company paid regular semi-annual dividends from 1850 to 1857 inclusive; the smallest being \$30,000, while the largest was \$120,000.

### **Copper in Ontonagon County.**

Although the first real mine was opened well toward the northern end of the Keweenaw peninsula, the desultory work of the early prospectors soon after bore fruit in the Ontonagon district, where the Minnesota was the first and largest of the mines ever opened there. The middle stretch of the copper range, wherein are now located all of the largest and most profitable mines of the Lake Superior copper district, was the last of the three fields of the Michigan copper country to be opened. The early explorers spent considerable time and labor in the central district, but with small results, and abandoned it in disgust. They were looking for fissure veins and mass mines, whereas the Houghton county or Portage Lake district is exceptionally rich in strong stamp lodes, and remarkably deficient in the fissure veins, which are both numerous and productive in Ontonagon and Keweenaw

counties, on either side. The Minnesota mine was opened on a contact vein, and was regarded with suspicion by the "experienced" men of that day for that very reason, it being then held that only the true fissure veins would pay to work. Fortunately, the Minnesota disappointed the prophets of evil—then, as now, too numerous for the welfare of the district—and on January 1, 1854, five years after its first opening, rewarded its shareholders with a dividend of \$90,000; thus becoming the second profit-paying mine of the Lake copper region. The Minnesota paid regular dividends for more than twenty years, its last payment of \$10,000, in March, 1875, being a fractional dividend of 50 cents per share, paid preparatory to abandoning the mine, and completing the handsome total of \$1,820,000 returned to the shareholders in a trifle over twenty-two years, on an original investment of \$380,000. To the Minnesota belongs the distinction of having yielded the largest mass of native copper ever taken from the earth. It was found at a depth of about 220 feet, in 1855, and weighed a trifle over 563 tons, requiring the services of forty men for six months to cut it into pieces small enough to permit of hoisting to surface and transportation to the east. As copper was then worth about 50 cents per pound, it requires but small mathematical talent to demonstrate that the value of this little nugget was upwards of a half million dollars. The second-largest mass ever secured in the district, or for that matter in the world, was raised from the Central mine a few years later, and was of approximately 500 tons weight. Although the Minnesota mine was abandoned in 1876, it is held by many of the oldest and wisest miners of the district that further exploration would be more than apt to reveal the continuation of the contact vein from which nearly two million dollars in profits was secured. The Michigan Mining company now owns the Minnesota property, and although mining work is at present being confined to the "Calico" stamp lode, a promising amygdaloid, it is the intention of the management to eventually cross-cut to a point under the old workings, at considerable depth, which will effectually demonstrate the truth or falsity of the theory before noted.

No further dividend-paying properties were developed until 1861, when the National, an Ontonagon county property adjoining the Minnesota, paid its first dividend. In 1862 the Pewabic, now a portion of the Quincy, made its first division of profits, thus being the first Houghton county mine to enter the ranks of the dividend payers. It was followed a few months later, in 1863, by the Franklin and Quincy mines, its immediate neighbors on either side, and both have made handsome records of profits since that date, the Quincy standing next to the Calumet & Hecla in dividend payments among the Lake copper properties, and ranking among the twenty most profitable

mines of the world; in which list the gigantic Calumet & Hecla stands second only to the Consolidated California & Virginia, the greatest property of the Comstock lode, of Nevada—and in which list the Calumet & Hecla will take first place early in the coming century. In 1864 the Central mine, in Keweenaw county, began dividing profits, and has already paid nearly \$2,000,000 to shareholders, with a valuable property remaining, although the fissure vein on which the mine was opened has been worked out. In 1869 came the Hecla, and in the following year the Calumet, the two being consolidated, to form the peerless Calumet & Hecla, in 1871. Later accessions to the list of dividend-paying lake copper properties have been as follows, in the order of their advent: Ridge mine in 1873, Phoenix in 1877, Atlantic and Osceola in 1878, Tamarack in 1888, Kearsarge in 1890 and Wolverine in 1898. Out of the great number of new properties now being opened it is as certain as any future event can well be that a number of dividend payers will come under the wire, probably closely bunched, very early in the twentieth century. Of the mines named among the latter dividend paying properties, the Ridge is in Ontonagon county and is now a portion of the newly organized Mass Consolidated Mining company, all the others being in Houghton county. The Kearsarge is now a portion of the Osceola Consolidated, having been merged in that corporation, together with the Tamarack Junior and Iroquois, in 1897.

### **Production and Capitalization.**

The records regarding the production of copper by the Lake mines are far from complete, but nearly one hundred corporations are credited with having actually produced and marketed refined copper. In this list there are many duplications—as for instance the Centennial and Schoolcraft, the property having been opened as the Schoolcraft on the Calumet conglomerate lode in 1869, and reorganized as the Centennial. The old Albany & Boston mine later became the Peninsula, and in 1895 passed under control of the Franklin company, and is now known as the Franklin Junior. The Belt property was also known as the International and Bohemian, and credited with copper production under all three names. The task of untangling and verifying the figures of production is comparable only to the labors of Sisyphus, ever approaching completion and anon requiring to be done over from the beginning. One fruitful source of confusion is the copper credited to tributors. In former days it was the fashion for mining companies, when they became embarrassed for funds—which was very frequently with the great majority—to let miners get out what copper they could on shares.



In the early days of Lake Superior mining the capitalization was very small, one company having been organized at Boston in the early forties with only 1,200 shares, par value \$100 per share, while another company had but 3,000 shares, par value \$10 each. The largest stock issue of any of the early mines was 6,000 shares. It was not until the civil war period that the state of Michigan finally took cognizance of the importance of the copper and iron mining interests of the Lake district, and passed a comprehensive mining law, one which, with slight modifications, still stands on the statute books, and is justly regarded as the best state mining code in the union, as it calls for full annual reports and limits the issue of stock, while providing that all mining shares shall be issued at the par value of \$25. The mining laws, as originally passed by the Michigan legislature and approved by the governor nearly forty years ago, provided for a maximum capitalization of 20,000 shares. This law was later amended, largely for the convenience of the Calumet and Hecla mines, which desired to consolidate, permitting the issue of a maximum of 100,000 shares, thus allowing a capitalization of \$2,500,000. It was at that time thought that the sum named was as large as any of the mines could reasonably hope to grow to, but in the light of the developments of the early months of 1899, when Calumet & Hecla sold at \$895 per share, or at the rate of \$89,500,000 for the entire property, the maximum fixed by the state seems a trifling sum. A bill is now before the legislature, with apparently good prospects of passage, allowing the increase of capitalization by 50 per cent. above the present maximum.

In this connection, while the subject is perhaps not strictly germane to an historical article, a few words may be said regarding capitalization and par values. The facts stated should be carefully considered by investors residing outside of the mining district, who, as a rule, pay scant attention to the number of shares and inquire closely into the par value of the stock issue. This process should be reversed. The par value of Michigan copper stocks—at least when organized under Michigan laws, as is the case with the great majority of Lake copper mines—is perfunctorily placed at \$25, whether the actual cost of the company's realty, personal estate and cash working fund be \$1 per share or \$20 per share. The really important point is the number of shares into which the property is divided. For purposes of speculation it seems to matter but little, so far as the price per share is concerned, whether the company has 20,000 shares or 100,000 shares, but when the time comes to divide profits, if they be earned, the profits from copper which will pay a \$5 per share dividend on an issue of only 20,000 shares will pay but \$1 per share on the maximum capitalization. At present the Central mine has the smallest capitalization of any copper company whose shares are traded in on the Boston ex-

change, the property being divided into only 20,000 shares. Several of the inactive Keweenaw county mines, such as the Washington and others of its class, whose shares are active at times, have stock issues of 40,000 shares, while among the dividend-paying properties the Wolverine and Tamarack have 60,000 shares each. Judging from the course of the market for copper shares during the past six months, the average investor never stops to consider whether he is buying one part in twenty thousand or one part in a hundred thousand, with each share, and it is probable that both the Tamarack and Wolverine could easily have issued new stock to the maximum limit without seriously depressing the selling price of their shares. The pinch would be felt later on, when these properties, both of which are dividend payers, would be forced to reduce their dividend rates, even when distributing the same sums in profits, semi-annually.

Another point regarding mining shares, which is also scarcely germane to the history of the copper district, but which should be carefully digested by the investors who know little or nothing of actual mining and mining procedure, is the matter of assessable stock. There is a general impression prevalent in such circles that a non-assessable stock possesses certain advantages. This theory will not stand investigation. A mine is apt to be an expensive property to develop, and there is no other mineral district in the world where as much money is required to open a property and set it on a profit-paying basis as in the lake copper district. This is due partially to natural conditions and largely to the exceptionally broad and far-seeing policy which has ruled for many years, with some exceptions, in the development of Lake Superior copper mines. The successful copper mines of this district, without exception during the past third of a century, have been opened on a large scale, equipped in the most substantial manner, and fortified in every way by the best machinery, men and methods possible to secure. These things cost money, but the richest copper deposit in the district could not be worked profitably at present under the crude methods of the pioneer days, when copper sold at fifty cents a pound and even higher. The first miners looked for fissure veins carrying big masses. The big mines of the present day are without exception opened on the sedimentary and eruptive lodes, which yield stamp-rock mainly, though occasional masses are met with. The development of a stamp-lode means the expenditure of hundreds of thousands of dollars before the mine can be made to pay, no matter how rich in copper it may prove. The Calumet & Hecla, unquestionably the richest, deepest and most profitable mine in the entire world, would have proven a flat failure had it been opened ten years earlier than was the case. Larger initial investments are required with every year that passes; yet the

investments in copper mining grow safer as they grow larger. Given a lode of merit, it is but a matter of money, brains and labor to develop a paying mine, for the bottoms of the Houghton county copper mines are grass roots on Isle Royale, forty miles to the northwest in the blue waters of Lake Superior; and the internal heat of the earth will in all likelihood put a stop to copper mining many miles above the deepest point of the copper bearing lodes. Even now, the temperature of the rock at the bottom of the Red Jacket vertical shaft of the Calumet & Hecla is 87 6-10 degrees. Fortunately, this temperature is reduced somewhat by the use of compressed air in the power drills, so that the miners are enabled to work in fair comfort at the depth of 4,900 feet below the earth's surface.

In view of the necessity for heavy investments, the desirability of an assessable stock is apparent. If the management of the mine has no means of raising funds to prosecute necessary development work and complete equipment, no matter how promising the mine may appear, a reorganization is necessary, and such action inevitably means the temporary abandonment of all work and lengthy legal proceedings which depress the selling price of the stock nearly to the zero point. Fortunately for the best interests of the investors and of the copper district, the organizers of the many new copper companies floated during the past eighteen months have, without a single exception, recognized the cost of adequate development work, and have started their corporate existence with cash working funds of anywhere from \$250,000 to an even million dollars in the treasury of each.

The traveler who today visits the thriving cities of Houghton, Hancock, Lake Linden or Calumet, and views on every hand evidences of wealth, culture and refinement, can have but the haziest comprehension of the struggles of the pioneers who laid both broad and deep the foundations on which are built the abundant prosperity prevailing in these towns at the close of the nineteenth century. How is it possible for the traveler who is whirled in a palace car up the mountainous hillside from Hancock and thence over the rolling plains of the Keweenaw peninsula's backbone toward Calumet, to comprehend that thirty years ago there was dense forest where there are now busy mining camps, interspersed with peaceful farms and pasture lands; and how much harder for him to understand that a third of a century past there was an unbroken forest of tall pine trees, undisturbed save by the hooting of the owl and the snarling of the lynx, upon the site now occupied by Calumet, the greatest and most populous mining camp of America? Such visions of the past may be conjured in his brain, through the smoke of a cigar, as he gazes through the car window upon the fleeting panorama of mines and

fields; but the pioneers of the forties and fifties who still live must sometimes rub their eyes to comprehend the reality of the present.

### **Transportation Facilities in the Early Days.**

When copper mining was first begun in the early forties, Lake Superior was a terra incognita—using the words “Lake Superior” in the sense the pioneers still use them, to distinguish the southern shore of the lake, and not the waters of Gitchee Gumee itself. There were a few sailing vessels of small burden upon the lake, and at Sault Ste. Marie, which was as far as steamers could ascend, owing to the rapids of St. Mary’s river which drains the inland sea, the pioneers bade farewell to civilization. The small sailing craft usually hugged the southern shore rather closely, for the lake was but poorly charted, and a storm upon its bosom was like a storm upon the salt seas. The frowning ramparts of the Pictured Rocks were encountered before a third of the distance was traversed, and at that point the sailing masters hugged the shore only on calm days or with a favoring wind, for a sterner lee shore is not presented to the harassed mariner upon the seven seas—sheer walls of red sandstone, sculptured by the billows of untold ages into castles, pillars, spires and minarets of most awful sublimity, and holding forth to the unfortunates thrown upon them no hope save of a speedy death. As the early settlements were all made upon the western shore of the Keweenaw peninsula, between Copper Harbor and the mouth of the Ontonagon river, it was necessary for the early navigators to sail boldly to the northwestward after leaving Marquette, braving the perils of the hideous reef at Stannard rock and the violent winds of the open lake. That accidents were so few, and safe voyages the rule, speaks well for the seamanship of the early navigators of the big lake.

Arrived at the scene of their future labors, whether at Copper Harbor, Eagle River, Ontonagon or some later settlement, the pioneers were under the necessity of building their own homes. Fortunately, material was ready at hand, and it required but strong and willing arms to speedily erect log cabins, rude in design and construction but rich in their housings of brawn and brain and hope. The summers were not bad—to be exact, the seasons were highly enjoyable from late May until early November. The explorers brought with them flour, coffee, tea, bacon, salt and pepper. Baking powder, that friend-in-need of the modern explorer, was then unknown, but flour and water in the shape of pancakes cooked upon the embers of a camp-fire were eaten with a relish by the pioneer, tired by a day’s tramping or digging, and with an appetite whetted to an acute point by the ozone of the waters and the piney breath of the solemn forest,

which stretched its unbroken length for hundreds of miles to the east, the south and the west, while to the north the meeting line of the lake and the sky loomed apparently in mid air. For the hardy pioneer there was always a fresh cut of venison, if he would but take his gun to some near-by runway of the red deer; while the little streams that brawled over sandstone bottoms toward the lake were rich in speckled trout, ever hungry and then unwary of the angler's lure. The catch that is now made with infinite cunning and the aid of many rods and flies was then secured with a bit of red flannel or a few earth-worms.

There were neighbors too, close at hand in the little villages on the lake shore; while in the forest the pioneer might find them at many miles distance. There were calls from occasional trappers, and from the Chippewas. The Indians all professed the Catholic faith, thanks to the zeal of the early Jesuit fathers and the unremitting labors of their successors. Perhaps the Christianity of the children of the forest was but skin-deep in some cases, and the brave who smoked his pipe of kinnikinnic, made from the tender inner bark of the sumac, before the hospitable camp-fire of the pioneer, may have harbored strange fears of heathen gods, the evil Manitous, the Missibizzi, and have reflected upon the disappearance of the half-mythical Hiawatha, who had sailed into the depths of the blue sea lying before the stolid dreamer's gaze, never to return; but the religion of the Indian was deep enough in spots. He never stole from his white neighbor, and never did he raise the hatchet in enmity against him. Even had no statues of marble and bronze been reared to him at Washington and in the city that bears his name upon the waters of the lake he sailed so many years ago, Father Marquette would have an enduring monument in the truth and honor and humanity of the dusky-skinned Algonquins, whom he called his children, and to whom his life was devoted.

Then there was the voyageur, the *courrier du bois*, who knew the forests as a scholar knows his books, and was ever a merry companion and a staunch friend. Of French-Canadian parentage, the voyageur oftener than not had Indian blood in his veins, and the forests held no secrets from him. Wherefore should he carry a compass in the trackless wilderness, for had not nature placed her sign posts even in the deepest tangle of the dark woods? Were there not the sun by day and the myriads of twinkling stars by night? And if these failed and the sky was overcast, did not the pointed trees ever incline toward the rising sun and the moss grow upon the northern sides of the trees? Why a compass, indeed, to him who roamed the forests as much at home as is the dweller in crowded cities who threads the maze of familiar streets?

The voyageur and the courier du bois are now things of the past, at least in the country lying south of Lake Superior; though they are still to be found a thousand and even two thousand miles farther north, where the mink and otter, the beaver and the lynx are yet found, and where the musk ox roams the desolate tracts along Hudson Bay. The French voyageur has left the shores of the great lakes, but he still exists in the remote corners of the continent, and it is well that the genius of a Gilbert Parker has arisen to tell us the truth in fiction about this picturesque character, who must ever recede before the advancing waves of civilization.

In the winter the pioneers were cut off from the outer world by a barrier of ice and snow. Navigation upon the lake became dangerous in November, and the supplies for the long season of snow were all laid in before the ice in the harbors rendered it impossible for vessels to land their cargoes. The first steamboat plying the waters of Lake Superior was the propeller Independence, which was portaged from the lower lakes at the Sault, and made her first trip in 1845.

This little propeller Independence, the first steam vessel on Lake Superior, must have been a remarkable craft in some things, as the greatest speed ever claimed for her was five miles per hour, when not beset by head winds. She ended her honorable if not glorious career by bursting her single boiler while lying at the wharf at Sault Ste. Marie in 1847. In the spring of 1846 the side-wheel steamer Julia Palmer was safely portaged past the Sault, a prodigious labor, as the vessel was of 240 tons burden. For some years she plied the lake, being considered a floating palace, as she was not only much larger than the Independence, but actually made two miles an hour greater speed, with favoring winds. Several other steamers were portaged at the Sault and sailed Lake Superior, previous to the opening of the first ship canal in 1857. As the copper mines began shipping considerable quantities of their product, and as rich iron mines were opened in Marquette county shortly after the beginning of copper mining, the question of getting freight from and to the mines became a serious one. Early in the fifties a strap-rail tramway was built at Sault Ste. Marie, by means of which cargoes between upper and lower lake ports were trans-shipped with a fair degree of expedition and economy, but the operation of the tram line was discontinued with the opening of the ship canal in 1857, when free access to Lake Superior became possible to every sailing and steaming vessel plying the lower lake.

When the last vessel had cleared and sailed for Sault Ste. Marie, or had perchance been caught by early ice and forced to winter at Copper Harbor or Ontonagon, the pioneers settled down to a life of toil and monotony, relieved by occasional dances, where a calico dress was good enough for any woman, and every woman was an undisputed

belle. The male residents occasionally broke the irksomeness of their existence by a Saturday night spree, frequently walking twenty or more miles for the opportunity of again mingling with mankind and exchanging their hard-earned money for whisky which, from all accounts, was as vile as the worst. These drinking bouts usually wound up in a fight, wherein every man felt at liberty to select an antagonist and have it out with him to his heart's content. The fighting was with fists; knives and guns being barred by universal consent. Fortunately fighting and drunkenness usually moderated toward spring, the reason therefor being that the dispensers of "forty-rod" almost invariably underestimated the consumptive capacity of their clientele, and as the winter waned found their supplies running short. When the last barrel was tapped, it was customary to pour in enough water though the bung at the close of each night's business to refill it. There being a limit to the virulence of even "forty-rod", there necessarily came a time when none but the veriest tyro could absorb enough of the diluted beverage to acquire a "fighting load", and compulsory sobriety ruled until the first vessel began unloading more of the article which killed the tenderfoot at forty rods and crazed the most hardened at short range.

All ordinary means of communication with the outer world were cut off with the departure of the last vessel in the fall from the rocky haven of Copper Harbor. The government officials usually left on the last boat, at such times as they had not left on a previous one, returning in the spring. Unhappy were the junior officers who were left to uphold the dignity of the government and defend the sanctity of the flag at Fort Wilkins; and during the long and apparently interminable winter many a young gallant sighed with envy as he thought of the balls and sprees at which his superior officers were assisting. The federal government determined, at an early date, that some means of winter communication must be opened with the Lake Superior settlements, and the only practicable arrangement was found to be the running of an overland mail from Green Bay to Copper Harbor, via Marquette. In the early forties Green Bay was relatively a much more important town than at present, being the oldest established settlement in Wisconsin, and at that time nearly as populous as Milwaukee, and having been, until a few years previous, a larger town than Chicago. There were no railroads west of New York state, though a beginning was being made by the state of Michigan, in the lower peninsula, on what has since become the great Michigan Central system. As there were no roads north of Green Bay, and the trails were unsuited for horses except in summer, owing to the deep snows, the mails were carried on sleds drawn by dogs. The drivers were almost invariably recruited from the ranks of the voyageurs and

courriers du bois, who were of French-Canadian extraction, with oftener than not an admixture of Chippewa or Ottawa blood. For these men the forests had no terrors. Clad in furs and blankets they calmly faced the terrible temperatures of the far northern winters, ranging as low as fifty or more degrees below zero. In this connection it may be stated that the coldest recorded temperature accurately taken in the United States, outside of the arctic appanage of Alaska, was noted three winters ago at Deer River, less than one hundred miles west of the head of Lake Superior, where a registering spirit thermometer noted a temperature of sixty-seven degrees below zero, Fahrenheit.

The dogs driven by the mail-carriers were but little less wild than the grey timber wolves which ranged the forest, murdering sleep for such of the settlers as had not become used to their dismal howlings. A dog is perhaps the most intelligent animal of the four-footed tribes, but he lacks the tractability and devotion to labor of the horse or ox. A good dog will fight for his master and will give up his own life in defense of those he loves; but as a day laborer or beast of burden he is not always a success. There is an irksome something about steady work which is as little liked by the dog as by the Gypsy. For this reason, driving a dog team is not as pleasurable a calling as might be inferred by those unacquainted with canine nature when under harness. Dogs that are the best of friends if free will fight on small provocation when harnessed together and pulling a heavy load. Dog teams were the only available means of communication, so they were used; but it happened all too frequently that the dogs sulked at bad roads or over-heavy burdens and the postman-driver lightened their loads. In the days of the overland mail between St. Joe and Sacramento, the drivers unloaded their superfluous mail sacks on the plains for the benefit of the untutored savage, but the Michigan driver of the dog train was more conscientious. The burdensome sacks were hung in the crotches of convenient trees, whence they were removed and forwarded on some following trip when roads were better. This was easy on the dogs but hard on the people who awaited letters from friends or loved ones, and at times annoying to those who were expecting important business letters. There was usually a grand clean-up of delayed mail in the spring, after the snow was gone; and the "spring mail" was a heavy one, just previous to the arrival of the first vessel.

The forest couriers who carried the mails in winter traveled on snowshoes, for the dogs were usually overburdened with the weight of sledge and mail sacks. The round trip from Green Bay to Copper Harbor by way of Marquette was a full six hundred miles, and to make it on snowshoes in charge of a dog-team carrying government mails was not a sinecure. Peter White, of Marquette, who came to the Lake Superior district as a boy in his teens, fifty years ago, is perhaps



the only survivor of the old-time mail carriers. He made the trip several times when still a stripling, and his reminiscences are full of the most delightful mingling of fact and fancy. To listen to Peter White's recollections of the days of long ago, during which recitals he assumes the name of Pierre Le Blanc and with it the French-Canadian patois, is a pleasure only to be appreciated by those who have once enjoyed his inimitable mingling of fact, fun and philosophy, delivered in the quaintest jargon of French-English.

### **Pioneers of the Copper District.**

Occasionally there were others than the mail carriers who made these winter trips on snowshoes, for pressing reasons. Among the number of those who repeatedly traversed the unbroken forests in days of long ago is John Senter, a pioneer of the Keweenaw district, and now residing, in honored age and well-earned affluence, in the village of Houghton. Five times did Mr. Senter make the journey on snow shoes between Copper Harbor and Green Bay, or points beyond that northern Wisconsin town. One of these mid-winter jaunts, made in the middle fifties, contained all the requisites for a thrilling romance. A certain important strike of copper in a Keweenaw mine greatly enhanced the value of the property, but the discovery was made in mid-winter and there was apparently no means of getting the news to the east except by the slow mails of that time. Mr. Senter and a few friends decided that there would be money in the purchase of shares of the mine, which were at that time selling for a low price, owing to the poor prospects of the property previous to the rich discovery. The mail advice would reach Boston within a few weeks, but there would then be no opportunity of buying the stock cheaply, as the news would speedily become known to all. At that time, more than forty years ago, Mr. Senter was in the prime of a young and vigorous manhood, and what that meant in his case can be inferred by those who still see his rapid, swinging walk, or witness him alert and speedy upon his bicycle at upwards of seventy years of age. A trip to the nearest telegraph station, then at Appleton, Wisconsin, was hastily decided on. Clad in mackinaws and furs, and with a stout pair of Chippewa snowshoes strapped to his moccasins, with compass, gun, matches and a slender store of provisions, the intrepid pioneer set forth upon his three hundred and fifty mile jaunt, in the dead of winter, over four feet of snow, with the thermometer hovering about the freezing point of the mercury, which is at forty degrees below zero. The trip was made in safety in less than two weeks, the first three hundred miles through an unbroken forest, where the flight of the startled deer, the scream of the lynx and the howling of

the timber wolves were of daily, and even almost hourly, occurrence. The pioneers had hearts of oak and sinews of iron, but in this case they were richly rewarded. The fateful messages with orders to buy were flashed over the wires from Appleton within two weeks after the discovery had been made on the distant shores of the big blue lake, and that dangerous mid-winter journey laid the foundations of several large fortunes. The latter day speculator, who sits in an easy chair in a warm office at Houghton or Marquette, near a telegraph wire at the other end of which is an operator within two hundred feet of the stock exchange in Boston, may know a trifle about the uncertainties of copper stock speculation; but of the hardships and dangers of the past he can have only feeble comprehension.

Of the Lake Superior pioneers of the forties there are now but a few remaining with us. Among the number is D. D. Brockway, better known to all old residents of the copper district as "Dad" Brockway. Accompanied by his wife, he came to Lake Superior in 1839, from the state of New York, three years after their marriage, and settled at L'Anse in the year named, Mr. Brockway acting as government mechanic at the little post established there. Five years later came the opening of the first copper mines, on the near by Keweenaw peninsula, and in 1846 Mr. and Mrs. Brockway removed to Copper Harbor, building the first permanent residence and hotel in that place. In this building Mr. and Mrs. Brockway lived for just half a century, removing from it in 1896 to spend their last years with their children in Lake Linden, where Mrs. Brockway breathed her last on March 3, 1899, sincerely lamented not only by her immediate family but by thousands who had at various times come to know and love the good old couple. Mr. Brockway, in addition to being the first hotel keeper of the copper district, was engaged for many years in the general merchandise trade at Copper Harbor and the Cliff mine, and was agent of the Northwest mine for some years. Since the death of Peter Crebassa there is no question that "Dad" Brockway is the oldest living settler of the entire Lake Superior district.

Among the pioneers of the copper country whose labors were crowned with the greatest success were Columbus C. Douglass and Ransom Shelden. Mr. Douglass was a cousin of Dr. Douglass Houghton, and Mr. Shelden was married to the sister of Mr. Douglass. C. C. Douglass was early engaged by Dr. Houghton as an assistant on the geological survey, and, through his years of association with Dr. Houghton in the practical exploratory work carried on under the auspices of the state, became an expert geologist and a recognized authority on the copper formation. In 1846, at the solicitation of his brother-in-law, Mr. Shelden left his home at Bigfoot Prairie, Walworth county, Wisconsin, and with his wife and two eldest children,

Carlos D. and George C., then mere youths, sailed from Southport, now Kenosha, on a steamer, for Mackinac island, thence by another steamer for Sault Ste. Marie. From the Sault to Portage Entry passage was taken in the schooner Napoleon, commanded by Capt. McKay, father of George P. and John McKay, well known to early settlers of Lake Superior as steamboat captains of more than ordinary ability. John McKay was lost some years ago by the foundering of the ill-fated steamer Manistee. Ransom Shelden reached Copper Harbor with his wife and two small children, no cash, and a pair of strong arms directed by a clear head, in which sterling honesty and strong common sense were ever the controlling factors. At Copper Harbor he found a potato famine. Without a dollar in the world he chartered a small coasting schooner immediately after his arrival and set out for L'Anse, where he secured a cargo of potatoes on credit, and returning with them disposed of the entire lot at a handsome profit. After paying all expenses there remained \$300 in cash, and from this capital was built up one of the largest and wealthiest landed estates in the country. Shelden removed with his family to L'Anse in the fall of 1846 and remained there till the following spring, when he went to Portage Entry and there built a dwelling, store and warehouse, and engaged in trade with the Indians. The house was of logs, but the store and warehouse were of framed and sawed lumber, their superior finish attracting the admiration of every Indian within trading distance. Here the family lived for four years, and here a daughter, Christine M., now dead, was born. The nearest white neighbor was at L'Anse, twelve miles distant across the waters of Keweenaw bay and twice as far by land. The Shelden boys roamed the forest and lake shore with copper-colored playmates of their own age, and it is through this companionship that the eldest son, Carlos, now representative in congress from the Twelfth Michigan district, acquired a perfect mastery of the Chippewa tongue and an insight into woodcraft which has stood him in such valuable stead in the intervening years. Even today Mr. Shelden speaks the Chippewa language as fluently as any Indian brave, and many a dark-skinned forest companion of his boyhood days has found in him a staunch friend in later years.

In the summers of 1849, 1850 and 1851, the elder Shelden did much exploring. C. C. Douglas, was at that time in charge of a copper mine at Rock Harbor, Isle Royale, and later at Ontonagon, as superintendent of the Flint and Fire Steel mines. While in the latter place he endeavored to get Shelden to join him, holding out flattering inducements, but the Wisconsin farmer flatly refused, giving as his reason the opinion that there was more copper in the Portage Lake district than in Ontonagon and Keweenaw counties combined. At that time he was alone in holding this opinion, but his remarkable judgment

has been verified in later years, for a single one of the mines of Portage Lake, the great Quincy, has paid larger dividends than all of the mines of Keweenaw and Ontonagon counties combined, and every dividend-paying mine of the Lake copper district is now located in Houghton county. In 1851 Mr. Shelden removed to the Quincy mine, on the high hill north of Portage Lake, to which Mr. Douglass had come from Ontonagon county as agent. Shelden continued his summer explorations and gradually gathered together most copious field-notes of the Houghton county copper range, covering the timber and agricultural possibilities, as well as the mineral prospects. Promising tracts were bought from time to time as money was obtained. In these ventures he was joined by Douglass, and the available funds of both were locked up in lands as rapidly as the money was raised. Until the day of his death, more than twenty years ago, the elder Shelden was always a poor man, so far as cash resources were concerned, for every dollar above taxes and necessary living expenses was invested in lands. How well these were selected is best shown by the sales made during the past three years by the Shelden-Douglass estate, which has disposed of hundreds of thousands of dollars worth of choice mineral lands, and in so doing has sold but a small fraction of its original holdings. There never was but one settlement between these partners, and that was merely a rough division of a portion of the lands, shortly before the death of Douglass. The sons of the original partners carry on the real estate business as the fathers began it, and the partnership begun more than fifty years ago by the pioneers is still intact, long after their death.

In 1854 Mr. Shelden removed to the site of the present village of Houghton and constructed a log dwelling and a log store. The dwelling, which was the first house erected in Houghton, occupied the site of the livery stable on Shelden street, at present conducted by Coulombe & Roi. The log house was torn down later, and Mr. Shelden built two houses on the southern side of Shelden street, one of which was later removed to make room for the quaint, roomy, rambling building now known as the Shelden homestead, while the other house still stands, in the same block and on the original site, being occupied by Mrs. John Rice.

The first mine—if it be worthy the appellation—opened in the Portage Lake district was the “Wheal Kate”. Its existence has been forgotten by all but the oldest residents of the copper country, and it would be a difficult matter to locate it exactly by the musty old records in the county court house vaults, but its site is marked by the massive hill arising back of the Atlantic mine and visible for many miles in all directions. This little mount, also known as Wheal Kate, is the highest ground in the state of Michigan. All Portage Lake

explorations and mines were abandoned in 1847, the lack of fissure veins and large masses of native copper discouraging the early explorers. A few years later work was resumed at several of the more promising explorations, including the Quincy. After the return of Douglass to the district, as agent of the Quincy, Shelden succeeded in inoculating his partner with some of his own enthusiasm regarding the district, and the scientific training of the latter soon led him to appreciate the importance of the discoveries made by Shelden; who, from a farmer and fur-trader, had within a few years developed into one of the shrewdest judges of mineral values in the district. Messrs. Shelden and Douglass jointly opened the Isle Royale mine, the first copper producing property of permanence developed on the Houghton side of Portage Lake. Among the many mines later opened by these partners were the Portage, Albion, Shelden, Douglass, Concord, Arcadian, Columbian, Huron, Dodge and Jefferson. During his latter years Ransom Shelden became interested in a number of local industries, prominent among which was the foundry and machine shop later sold to S. E. Cleaves, and now known as the Portage Lake Foundry and Iron Works. It was a proof of the ability of the man that even in this line of effort he was among the number who helped achieve the remarkable results in foundry practice that have made Lake Superior hard iron the world's standard. Even today there is no foundry outside of Portage Lake which even pretends to duplicate the work regularly turned out of the three iron-working establishments of Houghton and Hancock. It is considered a remarkable feat in the best foundries of the world, outside of this district, to make a casting having a half-inch chill—yet the foundries there are turning out stamp-shoes every working day in the year which are chilled to a depth of two and even three inches—that is, the shoes have an inner core of cast iron and an outer jacket two to three inches deep of the finest-quality steel. It is for this reason that the foundries and machine shops of Portage Lake send their products to every mining state in the union, to Australia, Mexico, South America and South Africa. They simply have no competitors in this particular branch of metallurgy.

Wm. B. Frue, long a resident of Houghton, was a pioneer mining man of far more than ordinary ability. Perhaps his most sensational achievements were made at Silver Islet, just off the Canadian mainland on the north shore of Lake Superior. Here he developed the richest silver mine ever opened, on a mere reef, which was overswept by the waves in every gale. To recount his work on Silver Islet would require many pages, which cannot well be spared for use upon a Canadian silver mine in a brief historical article upon the Michigan copper district. Capt. Frue was prominent in the copper district, and at his

death left a comfortable estate in copper shares, which have since appreciated to many times their value at the time of his demise.

Quincy A. Shaw, now a resident of Boston, was for years prominent in Portage Lake mining matters. Nearly all of his fortune was swept away in 1865 by the failure of the Huron mine, of which he had charge; but in the following year he became interested in the Calumet & Hecla, which has since not only fully recouped his previous losses, but has made him a multi-millionaire.

Captain Daniel Dunn, prominent forty years ago in Portage Lake mining matters, left Houghton in the winter of 1873 because his house was burned and there was not a dwelling for rent in the town. He drifted eastward and is now a resident of Boston, where judicious mining investments have rendered him independent.

Among the veterans of early days who are still in harness are Captain Samuel B. Harris of the Quincy and Captain W. E. Parnall of the Tamarack, Osceola and Isle Royale mines. Both are self-made men, starting life with little more than strong arms, willing hearts and right purposes. Both have risen by dint of energy, incessant labor and equally incessant study of mines, minerals and methods. They have not arrived at their present positions by any accident, as is best proven by the constantly decreasing cost of production, without decrease in wages, which is shown at their mines.

Among the pioneers who have prospered is Graham Pope, of Houghton, proprietor of a large general merchandise business and until lately agent of the Franklin mine, which he took charge of a few years ago as an exhausted property, and retired from on April 1, 1899, with the old mine more promising than when he took it, and a new mine, the Franklin, Jr., developed to the point of large and profitable production. Mr. Pope resigned in order to take a rest, but owners of other mines are bothering him so with petitions to take charge of their properties that it would be an even wager that he succumbs to their blandishments, and takes up some new mine or some decrepit property and puts it on its feet.

Captain Johnson Vivian, of Houghton, is a fine type of the Cornish miner of the pioneer days. His connection with the Lake copper mines dates nearly fifty years back, and he has been in charge of some of the largest properties of Houghton and Keweenaw counties. Some years ago he was forced to retire from mining, because his various real estate, merchandise, mining and banking investments required his entire attention.

Although not a mining man in the usual sense of the term, Judge Jay A. Hubbell has been so prominently connected with the mines of the district that his name naturally comes forward in considering its notable pioneers. Honored by his fellow citizens with every office,

from supervisor to five successive terms in congress, where he became one of the Republican leaders in the lower house, Judge Hubbell has been one of the strong men of the district and a leader among men for four decades. The achievement which will be longest remembered, and of which he perhaps is proudest, is the founding of the Michigan College of Mines, at Houghton. It is for good reason that Judge Hubbell is called the "Father of the College of Mines". It was his idea; it was on the site donated by him that the college buildings were erected; and it was by his efforts in the state senate fifteen years ago that a grudging legislature was alternately coaxed, cajoled and bullied into appropriating money for an object to which the majority were frankly opposed. Whether the appropriation for the school could have been secured by any other man is doubtful. The wisdom of the school's establishment is apparent now, even to those who opposed the project at its inception, for the Michigan College of Mines, despite its youth, already ranks, not merely well at the top, but actually at the head, of all the mining schools of the world, and its graduates are filling the most responsible positions in the great mines of almost every mining camp of the world. Such a monument as this great school is better than one of marble or of bronze, for it lives forever and its good works are felt in all succeeding generations.

Easily one of the greatest mining men of the early days, or of any day, for that matter, was E. J. Hulbert, now living in Rome. Even his bitterest opponents—and he had many, for he was and still remains a man of marked individuality and strong likes and dislikes—must now admit that in scope and foresight he was a wonderful man. His predictions have nearly all been verified, even those which seemed the wildest three decades ago. His examination of the copper district was of the most minute and yet of the most comprehensive character. Even had he performed no other work—which is not the case—his development of the Calumet & Hecla would have stamped him as a genius. This mine, easily the greatest in the world in every essential, was opened in 1866. There are many conflicting stories afloat regarding its discovery but the one which is best authenticated divides the credit for finding it between Billy Royal's hogs and Billy Royal himself. William Royal was one of that band of eccentric characters so frequently developed in pioneer life. He was a bit of everything, could turn his hand to any sort of labor, and loved best to labor not at all. In 1865 he was keeping a road house midway between Houghton and Eagle River, his log shanty standing not far from where the Calumet hotel is now located. Royal's establishment furnished "fodder" for man and beast, and stronger refreshments for man. The beast knew better than to drink the rot-gut dealt out over Royal's little bar. Among his other possessions was a small drove of

pigs. Being of an improvident nature, Royal allowed his pigs to forage for themselves during the winter, and digging a living from under the snow in the Lake Superior country is no slight task for even so acute a forager as a pig. Not having seen his pigs for several weeks Royal started out to locate them one day in early spring, and found them burrowed in a quantity of fallen leaves under the shelter of a peculiar mass of reddish rock, mottled with green and shot with red. The rock was of nearly the size of a log cabin, and its peculiar appearance attracted Royal's attention, after he had satisfied himself that the hogs were safe. Closer examination showed that the red rock was a conglomerate, considered worthless before that time. The green blotches were copper carbonate, formed by the action of air and water upon the native copper, and the dull red spots were bits of the virgin metal.

Upon making this great discovery Royal proceeded forthwith to celebrate the joyous occasion by filing up on his own whisky. The find was shown to at least one man, still living, before Hulbert appeared on the ground and secured possession of the land on which the outcrop was located. It is but just to Mr. Hulbert to state that he denies the Royal story with some heat, but it is supported by such excellent evidence that the tale must be accepted as true. It is not at all improbable that the conglomerate outcrop was discovered by Hulbert previous to the nesting of Royal's hogs under its protecting shelter, and that the find was kept quiet by him, but it is certain that information regarding the existence of the rock was given by Royal, immediately after his discovery and before Hulbert had confided the news to any of his associates or friends. The discovery of the conglomerate outcrop was speedily followed by the organization of three mining companies to work the lode, these being the Calumet, Hecla and Red Jacket. The two first-named companies controlled the outcrop for more than two miles' distance, while the Red Jacket was located some distance to the westward. The owners of the Calumet and Hecla properties felt satisfied that the Red Jacket must eventually come to them on their own terms, but Hulbert decided to open a mine there in his own way. His proposal to sink a vertical shaft to the conglomerate and then deflect the shaft to the angle of the lode was laughed at as ridiculous, but after the shaft was fairly started the feasibility of the plan began worrying the owners of the outcrop, who hastily bought the Red Jacket mineral rights. The original Red Jacket vertical shaft, long since filled in, was located not far from the present armory of the Calumet Light Guard. To Hulbert also belongs the credit of sinking the first successful vertical shaft in the Lake copper district, at the Cliff mine. The project was begun in



fear and trembling by the owners of the mine but proved a success in every particular.

In the untimely death of Capt. John Daniell, who departed this life two years ago as the result of an affection of the brain brought about by overwork and incessant study, the copper district was deprived of one of the greatest mining geniuses ever given the world. Like so many other successful mining men of the district, Capt. Daniell was a self-made man. Born in Cornwall and early put in the mines to earn a trifle toward the support of his family, Capt. Daniell bent all his energies toward mastering every detail of mining work. He came to the Lake district a young man and steadily rose in position, until at a comparatively youthful age he was at the top—agent of the Osceola mine. Not content with resting upon his laurels and enjoying life, as too many young men would have been, he redoubled his labors and his studies. Denied all but the most meagre scholastic training in his early days, Capt. Daniell by reading, observation, thought and contact with men of affairs, became a highly educated man; and, furthermore, what not all self-made men are, a credit to his maker. His greatest achievement was in the development of the Tamarack mine, a property now valued at more than twelve millions of dollars. The lands on which this mine was opened were well to the westward of the Calumet & Hecla; and while it was generally believed that the Calumet conglomerate lode underlay the entire tract, the depth of overburden was so great that the men of means to whom the project was broached laughed at the idea as visionary. Nothing daunted, Capt. Daniell continued to figure on the scheme and kept bombarding the officials of the Osceola company, by whom he was employed as agent, with plans and information regarding the great mine which he could open on the coveted Calumet conglomerate lode. Eventually he succeeded in interesting Mr. A. S. Bigelow, of Boston, and the quarter of a million dollars needed for the work was raised. There were times when Mr. Bigelow and his associates most heartily wished the plan had never been unfolded to them, but Capt. Daniell never wavered. He assured the men who furnished the money—and his own small savings were also invested in the enterprise—that the conglomerate lode would be found at a depth not exceeding 2,250 feet. For nearly four years this work was prosecuted, and in 1885 the long-looked-for lode was tapped, at a depth of 2,240 feet—within ten feet of where the projector had promised it would be found! The Tamarack made many millionaires and it rendered Capt. Daniell a wealthy man, but the strain of his labors and studies was too great, and his faculties began failing in 1893, followed by his death four years later. He was a victim to his sense of duty and his desire to master all knowledge pertaining to the chosen calling of his life.

## Fluctuations in the Price of Copper.

Like all other industries, especially those of a mining sort, the Lake copper trade has been subjected to many vicissitudes during the more than fifty years of its existence. The price of the product has fluctuated greatly from time to time, and there have been periods when the future of the industry looked black indeed. In 1860 the production of Lake Superior ingot copper reached the unprecedented amount of 6,034 tons, and at that time the pessimists raised the cry, so often heard in succeeding years, that the production was too great and that the market would be flooded. The average price of copper that year was about 22 cents per pound. With the opening of the civil war in the spring of 1861 there came a period of depression, which, though short-lived, was profound. The copper country furnished more than its full quota of troops for the repression of the rebellion, just as it furnished quadruple its quota of troops for the late Spanish war. The future of the copper industry looked as dark as it well could and several of the mines suspended operations entirely, their managers and owners believing that the industry was completely ruined. The price of copper fell to  $17\frac{1}{2}$  cents per pound in July, 1861, a low-price record which was not duplicated until December, 1877, in the period of greatest depression following the panic of 1873. At  $17\frac{1}{2}$  cents per pound there was scarcely a mine in the district which could pay the expenses of operation. Fortunately there came a speedy turn for the better. The government needed copper for cartridges and for munitions of war. The metal began rising in price and in December, 1861, sold at 27 cents. From that time forward until very nearly the close of the war the price advanced steadily, until in July, 1864, Lake copper sold at 55 cents per pound, the highest price ever obtained. With the closing of the war there came a gradual sagging in values until 1870. This five-year term was the crucial period in the development of the Lake copper district. The smaller and weaker mines were forced to the wall, one after the other. It was not necessarily the mines least rich in copper which succumbed, but those which by reason of lack of capital, courage or skill in management were unable to withstand the constantly increasing pressure of falling prices. It was during this five-year period that the Calumet & Hecla was opened, and the wonderful richness and marvelous production of this great mine were no small factors in reducing the price of the metal. In 1865 the production of Lake copper was 7,179 net tons; while in 1870 it had risen to 12,311 tons. Despite the decreased number of producing mines, the production grew nearly 75 per cent in the face of falling prices for copper. It was during this

period that the foundations of modern mining and milling methods were laid. The necessity for the utmost economy led to the introduction of heavier machinery and labor-saving methods. Thus it happened that in the time of greatest adversity the way was paved for a period of far greater prosperity than was ever dreamed of by the pioneer mining men of the district.

It was during the dark days following the war that Judge Jay A. Hubbell was sent to Washington as a representative of the Lake copper producers to pray for a protective tariff that would save the industry from utter extinction. The tariff was secured and was of much benefit to the mines for some years: but for the past decade or more the Lake mines have set the price of metal the world over, and at present 60 per cent of the American production is sold abroad.

From 1870 until the panic of 1873 prostrated values the copper district flourished amazingly. New mines were developed and abandoned properties reopened. In the last-named year copper sold at 35 cents per pound in January, and dropped to 20 cents per pound in November. From 1874 until 1878, inclusive, the average annual price of copper showed a steady shrinkage, declining from 23½ cents per pound in 1874 to less than 16½ cents in 1878. With the general business revival coming in the following year, copper again advanced, going from 15½ cents in January, the record low price, to 21½ cents in November. Meanwhile the production had materially increased, advancing from 17,167 tons in 1874 to 21,426 tons in 1879. From 1880 to 1886, a seven-year period, there was a steady decrease in price, accompanied by a large increase in production, the average annual price of Lake ingot dropping from 20 1-5 cents in 1880 to a fraction under 11 cents in 1886, while production increased from 24,869 tons in 1880 to 40,130 tons in 1886. This period was not, strictly speaking, one of adversity. It was rather one of enforced economy, wherein increased production and improvement in processes enabled the mines to realize larger net profits than ever before. There was nothing approaching a boom, but the district increased steadily in population, wealth and culture. The earlier months of 1887 were a continuation of this preceding seven-year period, and in May, 1887, Lake copper touched the lowest price on record until the panic of 1893, selling at 9¾ cents.

In December, 1887, the Société des Metaux, of France, better known as the French copper syndicate, showed its hand. This gigantic pool, or trust as it would now be termed, was planned and organized by one M. Secretan, who for eighteen months was the copper king, and who then dropped into utter obscurity, from which he was recently raised for a day, by his death during the month of March, 1899. The plan of M. Secretan was delightfully simple. Backed by a

syndicate having a nominal cash capital of nearly one hundred million francs, he contracted with all the leading copper mines of the world to take their product at a considerable advance over the market prices which had ruled for several years previously. Having thus secured control of practically the entire world's product of copper, M. Secretan and his associates calmly marked up the price of the metal 50 per cent, and proceeded to rake in the large profits thus assured. Under the stimulus afforded by the copper corner the metal advanced from 11 4-10 cents per pound in November, to 17 9-10 cents in December, 1887. During the following years copper fluctuated in but narrow limits, with an average annual price a trifle better than 16½ cents. In April, 1889, the crash came, and copper dropped in the twinkling of an eye three cents per pound. The copper syndicate had overestimated its own strength, and had contravened the laws of commerce, which are as immutable as the laws of the Medes and Persians, or as those of nature itself. M. Secretan and his associates had forgotten to take into calculation the stimulus to production brought about by higher prices, and had also omitted to consider the decrease in consumption certain to follow an arbitrary advance of fifty per cent in the cost of the metal. During the eighteen months that the French pool controlled the price of copper every established mine increased its production greatly, old mines were reopened, new mines developed, and old stores of copper brought forth from every corner of the world. Every consumer knew that the advance in price was brought about by a combination and not by natural laws, and in consequence used the minimum amount of the metal in his business. Electrical construction, then in its infancy, received a check which almost brought new work in that line to a standstill. At that time electric lighting and the trolley car were luxuries, not necessities as now, and they could be foregone for a year or two, until copper became cheaper. The syndicate made enormous profits, on paper; but these profits from almost the first month went into raw copper, which the mines kept shipping much more rapidly than the consumers would buy. In a few months the syndicate was pressed for cash. Would the banks lend a little money, say ten cents per pound, on a few thousand tons of copper, worth say sixteen cents per pound? Certainly, the banks had idle millions and would be pleased to loan on such excellent collateral. A month later, would the banks again negotiate a small loan on copper, on the same terms as before? Certainly. Once again, and twice, and three and four and five times, would the banks lend? At first gladly, then gingerly, then in consternation, because they must lend or see their borrower go the wall, the banks loaned millions on copper. The leading bankers of Paris, London and Berlin loaned to the Société des Metaux until they had advanced some \$35,000,000 on copper worth at

the market rates fully \$50,000,000. Too late the bankers awoke to the gravity of the situation. Copper was piling up twice as fast as it was being consumed, and while the market price was upheld it was kept up solely by the money of the banks—the funds of the syndicate had long since gone into the same vortex. As well try to fill a sieve with water.

After hurried cablegrams the representatives of the great money powers of Europe conferred at Paris. The Rothschilds, the Bleichroeders of Berlin, the Credit Lyonnais, and others who are a power in the world of finance, canvassed the situation in all its bearings, found it hopeless, and so informed M. Secretan. The following day saw the collapse of the Société des Metaux. It was as complete as that of a soap bubble, which one moment is large and shining in all the colors of the rainbow—the next is so completely gone that not the slightest trace can ever again be found. Foreseeing the crash, M. Secretan and a few of his associates hurriedly secured sufficient funds to enable them to live in comfort for the balance of their days. All that remained in the way of assets was 170,000 tons of copper, pledged to the banks—and the creditors promptly took their security. Their first movement, a perfectly natural one under the circumstances, was to realize on their collateral as rapidly as possible. It was at this juncture that a new factor appeared in the copper world. The sale of the enormous reserve of copper, nearly equivalent to the world's demands for an entire year, would perhaps enable the bankers to get back nearly all they had loaned on it, but such action would mean ruin to all but the strongest mines, and would cause suffering and beggary to thousands of families in all the leading copper producing districts of the world, through loss of employment for an indefinite time. The bankers merely wished to get back the cash they had lent, or as great a proportion of their loans as possible. They had had enough of copper and were anxious to get out of it on the best terms possible. This they had begun doing, and the copper market broke severely and repeatedly, when the combined action of the Calumet & Hecla and Anaconda mining companies forced the bankers to desist. The corporations named owned and operated the two largest copper mines in the world, one in Michigan, the other in Montana. Their representatives waited upon the bankers, under cable orders from their principals, and coolly informed the princes of finance that the selling of copper must cease instantly. The bankers laughed this order to scorn and asked what their callers proposed to do about it. The answer was ready and was to the effect that the Calumet & Hecla and Anaconda also had copper to sell and that the price would be five cents per pound on the following morning. A thunderbolt from Jove in a Grecian temple filled with devotees could scarcely have excited more consternation than this cool announcement, for the bankers knew it was made in earnest.

The value of their collateral, already less than the amounts loaned, would be cut in half again within a few hours, and instead of losing a few millions they would lose a score. There was but one thing to do and that was to capitulate, as gracefully as possible but instantly, and the bankers with unnumbered millions surrendered as meekly as lambs led to the slaughter. For almost the first time in their lives they had reached a position where their millions were naught before the superior power that dictated terms to them.

The Yankee miners were not unreasonable, and even the bankers who were forced to yield to them soon came to see that the step was for the best interests of all concerned. The bankers promised to hold the copper and to dole it out from time to time as the market warranted. On their part, the American mining companies pledged themselves to not materially increase their production until the larger part of the surplus metal had been absorbed. The pact thus made under duress was scrupulously observed by both parties, and by their courageous action in defying the allied monied power of Europe the two American mining companies not only saved themselves great loss, but averted untold disaster from the smaller mines and the tens of thousands of industrious workmen and their families who were dependent upon the Michigan and Montana copper mines for their daily bread.

Following the collapse of the Société des Metaux in the spring of 1889, there followed a nine-year period of low prices, with the exception of 1890, and a few months in 1891. The bankers unloaded a portion of their stock copper at prices nearly as high as ruled under the regime of Secretan, but the Baring failure of October, 1890, shook the foundations of credit the world over, and the wisdom of allowing copper to find its natural level was so apparent that after June, 1891, Lake ingot did not again sell as high as 13 cents per pound until brought to that, and even higher, figures by purely natural causes, within the past few months. The average selling price of Lake copper has been as follows since 1891: in 1892, 11½; 1893, 10¾; 1894, 9½; 1895, 10¾; 1896, 11; 1897, 11½; 1898, 12 cents. During the period from 1890, to 1894, inclusive, the Lake Superior copper production increased but 15 per cent, but beginning with 1895 the production has grown greatly, the 1898 output being very nearly 50 per cent larger than that of 1890. Much of this recent increase is due to the Calumet & Hecla, which, in keeping faith with the European banking syndicate, maintained its production at 25,000 to 30,000 tons per annum from 1890 until the close of 1895. The surplus copper then having been reduced to a point where it was no longer burdensome to the owners, who had gradually become accustomed to carrying it, and found their apparently bad bargain a profitable one, the Calumet & Hecla and Anaconda were released from their moral obligation, and both began increasing production very material-

ly. In 1896 the Calumet & Hecla increased its output more than one-third over the production of the previous year: and in 1897 made and marketed over 46,000 tons of copper, or over 50 per cent more than its average annual output during the years from 1889 to 1895.

### **Improvement in Mining Methods.**

Any historical sketch treating of the Lake Superior copper district would be incomplete if without reference to the wonderful progress made in mining, stamping and smelting. In other chapters of this work will be found descriptions of the titanic mechanical plants at the Houghton county mines and mills, undisputably the largest, costliest and most efficient machinery now in use on the globe. The contrast between the mechanical equipments, mining methods and reduction plants of today, and the primitive operations of fifty years ago, is almost as great as that between daylight at noon and the darkness of midnight. The pioneers depended on their own muscle for results. Much of the copper secured during the forties was taken from the rock with drills and gads. Black powder came into general use a little later, and by its aid it was possible, in the middle sixties, to drift from twelve to eighteen feet per month. Within the past two years a drift has been driven 106 feet in a month of twenty-six working days of two ten-hour shifts each, in the Osceola mine—a total working time of 496 hours, deducting six hours for each of the four short Saturday night shifts, when the miners work but four hours, instead of ten. High explosives came into gingerly use about 1874, nitro-glycerine being introduced to the copper district by Captain W. A. Dunn in that year. This explosive did great execution, but it was highly dangerous. It has since been succeeded by dynamite, in which form the nitro-glycerine is taken up by kieselguhr, wood-pulp, diatom earth, or some similar material of high absorbent power, and rendered so safe for use that accidents rarely occur except through gross carelessness on the part of those handling it. The rending power of ordinary black powder and of dynamite are as far apart as the propulsive power of the pleasure launch and the ocean-going passenger steamer. The power-drill came into general use only twenty years ago, and was bitterly opposed by the miners, who thought they saw an enemy in the machine, but later found it their best friend. No attempt is now made to mine on any extensive scale without power rock drills. The diamond drill for exploratory purposes has also come into use within the past two decades. This marvelous little machine does its work with a hollow tube of soft steel, into the outer and inner edges of which black diamonds from Brazil are carefully set by experienced diamond-setters. Rotated by pipes from the drilling machine, this

diamond-studded bit bores its way through the hardest granite at remarkable speed. The three great advantages possessed by the diamond drill are its reach, for it will bore a hole a mile in depth; the ability of the operator to bore a hole vertically, horizontally or at any angle desired; and the core obtained from its use, for the bit being hollow, it is possible to obtain cylindrical sections from the hole for its entire depth, and a thorough record of every inch of the strata is thus obtained. More than any other factor, the diamond drill has helped to change mining, in every part of the world, from a game of hazard more or less skillfully played to a legitimate industry in which there is scarcely a greater element of chance than in a well conducted manufacturing or commercial establishment.

The first miners used hand power whims for hoisting rock from their diminutive shafts. Naturally the early miners preferred adits to shafts, for it is easier to push a tram car through a tunnel than to hoist a bucket of rock with a windlass from a deep hole. Oxen were also drafted into service a little later and a few horses were used for motive power. The first steam engines were mere toys of a few horse power each, so puny that the one-ton skips and buckets were frequently stalled in the shafts until more steam could be gotten up in the boilers. At the present day the Calumet & Hecla has an eight-thousand horse-power hoisting engine at the Red Jacket shaft, fed with steam from ten boilers of one thousand horse-power each, while half a mile to the northward the Tamarack has a hoist at No. 3 shaft which has raised a ten-ton car of rock, from a depth of 4,450 feet, at the rate of fifty-five miles an hour—a vertical speed far greater than is attained by the average express train running on a horizontal plane.

The early stamp mills were as rude as the mining appliances. Chilean arastras, identical with those used for centuries in the silver mines of Potosi, were tried, but found too cumbersome and inefficient. Gravity stamps were next used, similar to those still employed in gold fields the world over. A gravity stamp which crushes one and one-half tons of rock working twenty-four hours daily is doing fair service. To crush the conglomerate rock now treated by the Calumet & Hecla would require a row of gravity stamps one mile in length, pounding without cessation for twenty-four hours daily every working day in the year. The old style stamp being so manifestly inefficient, a steam stamp was devised and is now in universal use in the district. The Calumet & Hecla uses twenty-two of these titans, each striking blows of thousands of foot-tons and grinding the refractory conglomerate, as hard as granite, into sand which is soluble in water, at the rate of 300 tons daily. The inventive genius of the district proved adequate to every demand made upon it, and the Ball steam stamp, the Evans slime table, the Frue vanner, and the Hodge jig, each bearing the name



of its inventor, are in use around the globe. Lake Superior mechanics and engineers are in positions of the highest responsibility the world over, and the mere fact that a miner or mechanic has served with the Calumet & Hecla, the Tamarack, the Quincy, or one of the other great copper mines of the Lake district, is more potent with mine managers from Mexico to South Africa than the handsomest diplomas or the most fulsome letters of recommendation. For two thousand years Cornwall was the nursery and training school of the world's best miners and engineers; but that proud distinction is now enjoyed by Houghton county, though Cornish-born miners and mechanics have helped to bring the proud distinction to this side of the Atlantic.

### **Silver Taken From Copper Mines.**

Copper is but one of the mineral products of the southern shore of Lake Superior. The five ranges of the Lake Superior iron district lying to the east, the south and the west of copperdom are the sources of the largest and purest supply of iron ore in the world. The precious metals are found in considerable quantities, and there is one gold mine near Ishpeming, eighty miles east of Houghton, which has produced more than three-quarters of a million dollars' worth of gold. Placer gold is found in small quantities in a number of streams in the copper district. Silver is found in every copper mine of the district in greater or less quantities, always native, as is the copper itself. Few of the Houghton county mines have been notably rich in silver, but at all of them more or less is secured. At the old Franklin stamp mill silver was picked from the copper for forty years. The Osceola produces a considerable amount of silver in small grains, and the Quincy reduces its No. 3 and No. 4 grades of mineral by electrolysis in order to save the silver, which averages twenty-eight ounces to the ton of copper. The Isle Royale, Huron, Portage and Shelden & Columbian mines, on the Houghton side of Portage lake, were richer in silver than any other Houghton county mines, the two latter carrying especially large quantities, and the No. 1 shaft of the Shelden & Columbian was known as the Silver shaft; while a washboss of the old Portage mill put himself on record one day in the seventies by saying that while the company paid him only \$60 per month he would cheerfully pay the company that amount rather than lose his job and the rich pickings in silver. None of these mines, however, could compare with the Cliff mine in Keweenaw county, opened on a fissure vein, or the Minnesota mine of Ontonagon county, opened on a contact vein, for richness in silver. It is a matter of record that the Minnesota company once mislaid a barrel of silver, weighing nearly a ton, and did not find it until several months later. A nugget of solid

silver weighing over eighty pounds avoirdupois was taken from the Cliff, being the largest found in this district, if not in the world.

Michigan stands credited on the books of the director of the mint with a silver production of upwards of \$4,000,000; and there is no question that this amount is much too small. The larger part of the silver never reached the coffers of the companies owning the mines. The miners, no matter how honest in every other respect, were a unit in the theory and practice that while the copper belonged to the company the silver went to the man who found it. Some thirty years ago a party of miners in one of the lower levels of the Cliff mine broke into a "vug", or cave, of the size of a small room, and literally studded from floor to roof with nuggets of pure silver. The masses of white metal were quickly pried from the walls and nearly a dozen empty powder kegs were filled with the nuggets and secreted under stulls, over lagging and in abandoned drifts, awaiting removal from the mine, a few pounds at a time. Unfortunately for the discoverers, the mining captain saw the vug on the following day, noted little masses of silver overlooked by the despoilers, and, making a systematic search of the mine, captured all the treasure kegs but one, leaving the crestfallen miners but a scant two hundred-weight of silver, then worth \$1.30 per troy ounce, for their share of the spoil. All estimates of the amount of silver secured by miners must necessarily be mere guess-work, but it is certain that millions were taken which never paid toll to the owners of the mines. An outlying spur of the Keweenaw formation, known as Silver Mountain, lies in the valley of the Sturgeon river, and weird tales are told of the rich silver mine repeatedly found and lost there by successive explorers. The mountain is still believed by the Chippewas to be haunted, and it is certain that the explorers who have ventured there have uniformly met with disaster and even death. Promising finds of silver have also been made from time to time in the Iron River district, west of Ontonagon but within the limits of the trap formation of the Keweenaw peninsula.

### **Characteristics of the Copper Lodes.**

The early miners searched for fissure veins and had but hazy ideas regarding the conglomerate and amygdaloid lodes, which they called floors. Various attempts to develop mines on conglomerate reefs came to grief and it was for this reason that the possibility of opening a paying mine on the Calumet conglomerate was generally scouted by experienced mining men during the early days of the Calumet & Hecla. After that property had demonstrated its wonderful value, and thus effectually upset all previous theories regarding the conglomerates, public opinion veered to an exactly opposite quarter and many

prospective bonanzas were opened on the conglomerates. None of them have ever paid, and at present a conglomerate proposition would receive but scant attention from any experienced mining man, unless the showing were of a truly phenomenal nature. With the single exception of the Calumet & Hecla, all of the big and lasting mines have been opened on amygdaloid lodes, and it is on these that every one of the new mines of the district, from Keeweenaw Point to the Ontonagon river, are now being exploited. That there are fissure veins which will yet prove as rich as the Cliff, and contact veins which may duplicate the record of the Minnesota, seems more than probable. It is even possible, though improbable, that conglomerates may yet be found which will give the world another Calumet & Hecla.

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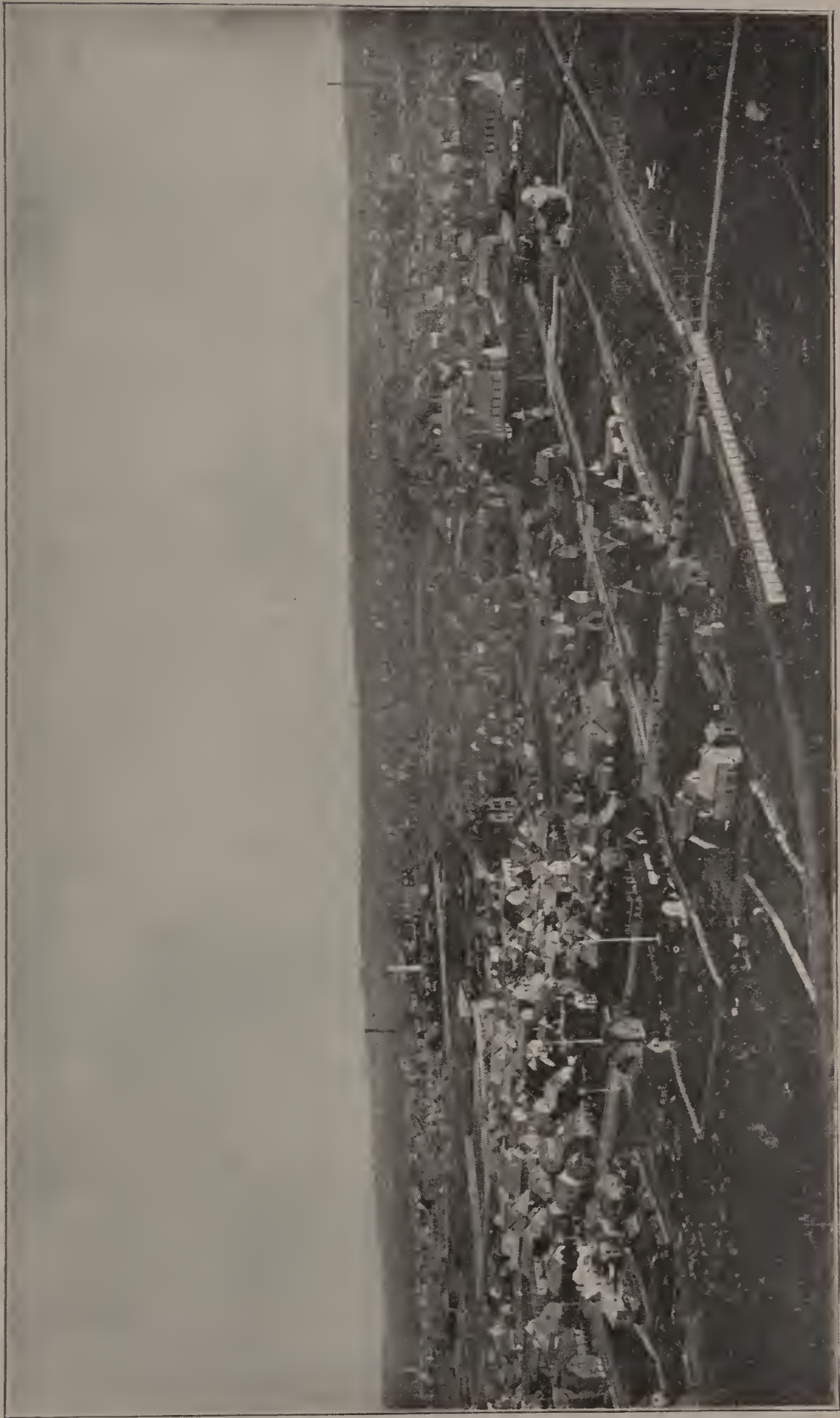
The opening of the Portage Lake ship canal has proven a great benefit to the copper mines as well as to lake navigation. Originally constructed by the state, as was the Sault Ste. Marie canal, it also passed into the hands of the federal government. The canal is two miles in length, and connects the cul de sac of Portage Lake with Lake Superior. Millions have been expended on this work and in the task of straightening and deepening the Portage Entry channel. It is now possible for the very largest vessels plying the lakes to pass through Portage Lake from end to end, and the joint harbor of Houghton and Hancock is one of the busiest and most important on the chain of lakes. In 1875 the Calumet & Hecla completed a private canal connecting Portage lake with Torch lake, at a cost of \$100,000. This canal is still a private enterprise, but will eventually pass under control of the federal government. Such a consummation is desirable, as all vessels landing freight at or taking cargoes from Lake Linden, South Lake Linden, Gregoryville, or the stamp mills of the Tamarack, Osceola or Quincy mines, must pay tolls of ten to fifty cents per ton.

In the early days stamp mills were built on Portage lake by the Franklin, Pewabic, Quincy, Osceola, Atlantic, Isle Royale, Portage and Shelden & Columbian mines. The three mills last named were dismantled during the eighties and their sites sold for business purposes. The Pewabic mill was razed when the Quincy secured possession of that mine, and the magnificent new smelters of the Quincy company occupy the former site of the Pewabic mill. The Quincy and Osceola mills were torn down and new mills built on Torch lake some ten years ago. The Atlantic mill was abandoned two years ago, on the

completion of the big new mill at the mouth of the Salmon Trout river, Lake Superior; and the Franklin mill was burned late last year; thus removing the last stamp mill from Portage lake. The mills so filled the channel, naturally about 1,000 feet in width, with their sands that the federal government compelled their removal, one after the other. The Franklin is building a new mill, as is also the Arcadian, on Grosse Pointe, Grand Portage; and the Isle Royale will build a mill at the junction of Portage and Grand Portage lakes, behind the natural barrier offered by Snowshoe island.

Naturally much has been left unsaid in this brief and hastily written sketch of the history of the Lake Superior copper district. It is to be hoped that in the near future an association of the pioneers and of the studious minded later comers may be formed, by which valuable historical matter can be obtained and preserved, access to which will enable the historian of the future to present his labors to the public without the lively sense of his shortcomings which afflicts the present writer.





PHOTOGRAPHED BY A. F. ISLER,  
LAKE LINDEN.

CALUMET, MICHIGAN.



## Geology of the Mineral Range.

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Since a review of the copper mining industry of the Lake Superior region would be incomplete without a description of the geological structure and of the character of the rocks with which the metal is associated, a brief generalized outline of the geology is here given:

**DISTRIBUTION.**—The so-called Mineral Range is a portion of a great series of rocks which border the south shore of Lake Superior, from Keweenaw point southwesterly through Michigan and Wisconsin into Minnesota. Their southern limit crosses the St. Croix river below the falls, where the formation bends sharply to the north, and north-east to Duluth. They also form the greater portion of the Minnesota coast line, and extend at least thirty miles into the interior. The beds reappear on Isle Royale, and also compose the numerous small islands off Black and Nipigon bays, and extend northward into the interior, covering quite extensive areas in the valleys of the Black, Sturgeon and Nipigon rivers. East of Nipigon Bay no rocks of this series are found on the north shore of Lake Superior. They reappear, however, on Michipicoten island and occur in several isolated patches along the eastern shore of the lake as far south as Gros Cap, a few miles northwest of Sault Ste. Marie. Off the extreme end of Keweenaw point they form Manitou island, and still farther southeast they form Stannard rock, beyond which point they are lost below the waters of the lake.

The dip or inclination of these rocks is usually lakeward. Those on the north shore, as well as those on Michipicoten Island and Isle Royale, dip in a southerly direction; while those on the south shore dip toward the north and northwest. Thus a broad, synclinal rock basin is formed which underlies nearly all of the waters of Lake Superior. These rocks cover at least 40,000 square miles in area.

**KINDS OF ROCK.**—This series is typically a sandstone formation, the materials of which were accumulated upon a subsiding sea bottom. Contemporaneous with the deposition of detrital material,

great floods of lava welled forth from fissures and flowed over the bottom of the sea.

The lava was generally basic, like our modern basalts, but acid and intermediate types were present. Owing to slight differences in the original composition of the basic lavas and their rate and conditions of cooling, various rocks have resulted. Among the typical kinds may be mentioned *gabbro*, *diabase* and *melaphyr*, including the amygdaloidal types of the latter two.

Typically, *gabbro* is a coarse-grained, thoroughly crystalline rock, containing plagioclase feldspar, the diallage variety of pyroxene, and iron oxide, usually magnetite. Often, however, the diallage may be replaced by some other variety of pyroxene, or even by hornblende, or the pyroxene may be absent—when different varietal names are given to the rock.

Diabase is composed of plagioclase, augite, and iron oxide as the chief ingredients. A peculiar structure, due to the long, narrow, lath-shaped, divergent feldspars, holding the darker colored minerals in their interstices, is also characteristic. The rock is usually thoroughly crystalline, and may be either coarse or fine-grained.

Melaphyr is a term somewhat loosely applied, but is generally used to designate altered rocks closely related to diabase in which some portion of the residual glass remained uncrystallized. All of these rocks may contain olivene and other minerals.

Amygdaloid, from the Greek word for almond, is “technically” not a rock, but refers to a rock texture, and may be explained as follows:—

When a lava is cooling, the escaping steam and gas, owing to their expansive force, have a tendency to form almond-shaped or elliptical cavities, or cells, in the upper portions of the flow. These cavities are often drawn out into elongated and irregular shapes by the flowing motion of the lava. Not only this occurs, but the cellular, scoriaceous upper portion is often broken up into a mass of cinder-like fragments. The porous, open character of the rock renders it liable to alteration under the influence of infiltrating mineralized waters.

In the course of time, the cavities are partially, or entirely, filled, forming the rock texture known as amygdaloidal.

The rocks most likely to show the amygdaloidal character are the diabases and melaphyrs, to which reference will be made later. The basic crystalline rocks mentioned above are the dark-colored rocks of the series, and are locally called greenstones, traps and amygdaloids, by the Lake Superior miners.

Other types of rock, quite distinct from the above, are the acid eruptives, including the felsites and quartz porphyries. These rocks are of interest because they have furnished the detritus for much of



the sandstone, and the pebbles and boulders for many of the conglomerates.

The felsites are usually reddish to purplish brown in color, with a fine-grained or aphanitic ground-mass, with or without porphyritic crystals of feldspar.

The quartz porphyry may be considered as essentially like the above, with the addition of porphyritic quartz. It is true, however, that all gradations exist between the more acid quartz porphyry containing nearly 80 per cent of silica, and the diabases, which typically should not exceed 55 per cent in silica.

The acid lavas were more viscous than the basic kinds, and consequently did not flow as far and are thus confined to less longitudinal extent in the series. They were often intruded across the trend of the other rocks in the form of dikes and bosses.

Owing to their pasty condition, they often formed dome shaped masses upon reaching the surface, and were thus more readily attacked by the waves, and redistributed in the form of sand and shingle, to form sandstone and conglomerate.

The acid eruptives are well exposed along the north side of Bete Grise bay in the Bare hills, and at Mt. Houghton; they also occur near the base of the series east of Calumet, where they have a surface-width approximating a thousand feet. They are still more extensive in the Porcupine mountain region and beyond.

While the eruptive rocks are only incidents in the history of the series to which they belong, the great copper mines wrought within their limits make them pre-eminent from an economic standpoint.

The eruptive rocks are confined to the lower part of the series, and have been the basis for making two divisions; an upper and a lower one.

The lower division covers the time from when the first sediments of the series were deposited to the time that the eruptive activity of the region ceased.

The upper division marks the time of more quiet deposition, during which from twelve thousand to fifteen thousand feet of conglomerate, sandstones and shales were formed. This upper detrital member of the series has produced but little copper, only one mine—the Nonesuch—having ever been opened within its limits.

The sandstones of the upper division are often coarse-grained, passing into conglomerate or fine-grained, grading into shale. The detritus from which these rocks were formed was derived largely from the lower division of the series, especially from the eruptives.

The shale belt and accompanying gray sandstone, which is well exposed in Swedetown Creek, west of Hancock, contains much melaphyr debris.

It is in a rather coarse-grained, gray sandstone, containing much basic material, that the copper at the old Nonesuch mine occurs.

Some silver has been found in this gray sandstone in the Porcupine Mountain region, but not in sufficient quantity to be profitably mined. Very little exploratory work has ever been done in the upper division, and it is doubtful if copper exists there in paying quantities; although at the present price of copper there are probably some capitalists who would be willing to invest in much less promising properties than the Nonesuch.

It was not the lack of copper, so much as the inability to save what there was, owing to its being so finely disseminated through the rock, that discouraged operations there.

### **The Mineral Range.**

The copper bearing belt, or Mineral Range proper—so far as it has been exploited—is practically confined to the lower division of the series; and, so far as present mining is concerned, lies entirely within the limits of the state of Michigan. This belt of rocks covers a narrow strip of country from the end of Keweenaw Point southwest to the Montreal River at the state boundary line, a distance of 150 miles.

Future developments will probably disclose rich mines farther southwest along the continuation of the range into Wisconsin.

The surface width of the belt in Michigan varies from four to eleven miles. The varying width is due largely to the dip of the rocks, the flat dipping beds covering a broader area than the steeply inclined ones.

Other causes which have affected the thickness are the thinning out or the thickening of the individual beds.

The conglomerates thin out away from the chief source of supply of the pebbles and boulders of which they are largely composed. The eruptive crystallines also thin out, or end, at greater or less distances from their source.

Basic lavas, being more easily fusible than the acid ones, were more liquid, and consequently flowed farther under the same conditions. Subordinate folding may also increase the width, as is the case in the Porcupine Mountains. Faulting may, and has, caused variations in the apparent thickness of the series.

**TOPOGRAPHY.**—The Mineral Range is a more or less distinctly defined ridge, or series of ridges, with a summit elevation of from five hundred to more than a thousand feet above the level of Lake Superior.

The southern limit is, for the greater length of its course, formed by a fault-escarpment, from which the usually highly inclined beds face the low lying lands to the south. The north limit is the base of the sandstone which overlies the latest lava flow.

Toward the eastern end of the range, where the dip is not steep, the harder, more crystalline, diabases stand out in bold relief above the more deeply eroded, softer rocks, and form steep, mural-like, south-facing cliffs, with more gently sloping surfaces to the north. The so-called "greenstone" ridge that overhangs the workings at the old Cliff, Phoenix and Central mines, is a good example. This structure is well developed in the Porcupine Mountains, especially at Carp Lake, where the rocks, sloping gradually up from Lake Superior, attain an elevation of 1,000 feet, and then drop off precipitously 300 or 400 feet into the valley of Carp Lake.

When the dip is steeper, the harder rocks form ridges with more rounded contours. The intervening valleys, that have been formed by the deeper erosion of the less enduring rocks, are often covered with swamps and bogs.

In other places along the range scarcely an outcrop will be encountered for several miles, owing to the deep accumulation of glacial drift.

In such places the hills are generally more irregular in outline, and the surface is often dotted with sink-holes and small ponds and lakes, or traversed by irregular swales and marshy areas; thus giving a highly diversified topography to the surface.

Several large, superimposed streams have eroded transverse channels across the range, dividing it into numerous segments, and it has thus been aptly termed the backbone of Keweenaw point.

There are other topographical features that deserve mention. These are the numerous shelving lake terraces, which flank the range and may also be seen in the transverse valleys. The higher of these terraces reach an elevation of between 500 and 600 feet. And in fact the whole range was at one time entirely base-leveled by an ancient sea. The various terraces mark, as it were, the chapters in the history of Lake Superior. The main streets of the villages of Houghton and Hancock are laid out along one of these lower terraces.

It is only when looking at the varied sculpture of mountain and valley, crag and ravine from a geological standpoint that the great revolutions in the past geological history of the globe are revealed.

From the character and position of the rocks, the geologist reads their past history, and is likewise enabled to foretell their inevitable future.

In studying the rocks along the mineral range, the mind is carried back through the dim vistas of the past to Cambrian times, when a

vast sea covered the greater portion of that part of the globe which now is the continent of North America.

The angry waves, lashed to fury by the southern gales, beat against the embattled cliffs of its northern limits, and wrested from them, through right of conquest, much of the material that was to form the future continent. During this early struggle for supremacy between land and sea, Vulcan, aroused from his slumbers by the strife above, arose and in his anger poured out upon the fierce combatants the molten products from his furnaces below. The strife, however, continued until the conquering land arose, regained its lost possessions, and forced the vanquished sea from the field of action.

The rocks formed were folded and faulted, and thousands of feet of their upturned edges were worn away, before the sea receded from the region: and as we contemplate these changes there comes to our mind these words of Tennyson :

There rolls the deep where grew the tree.  
O, earth, what changes thou hast seen!  
There where the long street roars, hath been  
The stillness of the central sea.

The hills are shadows, and they flow  
From form to form, and nothing stands;  
They melt like mist, the solid lands,  
Like clouds they shape themselves and go.

CROSS-SECTION.—Only a very generalized idea of the rocks, as exhibited in cross-section, will be attempted.

Neither at Portage Lake, nor, in fact, at any place on Keweenaw Point, are the lowest beds of the series exposed, the lower portion having been cut off by the great Keweenaw fault.

The first bed encountered, north and west of the fault line, may be a coarse-grained, dark, greenish colored diabase, showing a distinctly spotted or mottled surface, as at Lac La Belle; or, it may be a quartz porphyry, as occurs east of the Kearsarge mine. Then, again, it may be one of the amygdaloidal melaphyrs: as at the Douglass Houghton and Hungarian ravines. At other times, a conglomerate will be the lowest bed exposed.

It will thus be seen that the fault plane cuts diagonally across the trend of the beds of the range, and is at one time in contact with a higher, and again with a lower, bed of the series. Eastward from the fault line, the further extension of the cupriferous beds is buried beneath thick accumulations of sandstone, and only reappears along its southern limit, fifteen to twenty miles further south.

This eastern sandstone is usually in a nearly horizontal position,

away from the fault escarpment: but near the latter it is often inclined even to a vertical position, and is sometimes overturned.

Owing to the nature of the origin of the series, the cross-section will vary at different points along the range.

Lava flows that measure a great thickness at one locality may thin out and disappear altogether at some other place in the series.

The conglomerates will be built up to much greater thicknesses in the vicinity of the more yielding rocks that furnished the debris from which they were formed.

The acid rocks, owing to their viscosity, will be confined to local areas. These latter rocks, where they flowed into the sea, had portions of their mass immediately broken up and distributed by the action of the waves. If an island was formed in the sea by one of these acid lavas, its wave-worn material would be deposited in all directions at sea. Where a cross-section through the island would show a felsite, one at either side would expose a bed of conglomerate at the same horizon. Minor mistakes may be made in the subordinate stratigraphy, by mapping felsites where none occur. Further, while a conglomerate was being laid down over the floor of the sea, a flow or series of flows, may have been poured over a portion of the sea bottom. Over and around these the conglomerates, without a break in the deposition, would continue to be accumulated, until the lavas may have been entirely covered. Thus, a section in one locality would show a conglomerate, followed by a lava flow, or series of flows, and then by conglomerate again: while, perhaps at no great distance, but beyond the limit of the flows, the section would show only a thick bed of conglomerate, for the same horizon.

It is, therefore, possible for a conglomerate to split up into two or more parts and to unite again. It is also evident that the two portions of the conglomerate would not be parallel, but would at first diverge from each other, and then converge to the point of junction.

Phenomena like the above have led to confusion regarding the number of conglomerates in certain cross-sections. From the preceding remarks it will be understood why a detailed cross-section in one region will fail to denote the true succession in another region far remote from the first. To give a few examples, let us compare a cross-section, first, through the Porcupine Mountains, with one at Portage Lake. In the former place several thousand feet of felsites occur near the top of the section. None are found in the Portage Lake section. At the base of the Porcupine Mountain section occur several hundred feet of sandstone and many diabase flows that are not represented in the Portage Lake section. A section through Mount Houghton will show several hundred feet of felsite in the lower half, and exceedingly thick beds of lustre-mottled diabase in the upper half

of the section. The felsites are missing, and the diabases, if they occur, have lost their prominence in the Portage Lake section. Another example may be taken from Mt. Bohemia, where more than 1,000 feet of a coarse-grained gabbro-like rock occurs near the base of the series; this rock is a local intrusion, and has a vertical thickness about equal to its longitudinal extent, and would not show in another section even one-half mile away. Again, a section at the Allouez mine would show about 800 feet of quartz porphyry at the base of the series, while none occurs at Portage Lake.

Notwithstanding the apparent discrepancies in the various cross-sections, there is after all considerable uniformity in the succession: As a rule, the base of the series is made up of coarser-grained, thicker flows than occur at the top. The conglomerates are less numerous and thinner near the base than toward the top of the series.

In the Portage Lake section, where the rocks attain a thickness of nearly three miles, at least twenty conglomerates may be recognized. These, following the general rule, are thicker as we go up in the series. Those near the base may vary from mere seams to thirty feet in thickness, rarely exceeding fifty feet. Toward the top of the series they may attain a thickness of one hundred, or several hundred, feet, the uppermost being more than 2,000 feet thick. The reverse of this is generally true regarding the basic eruptives; the lower part of the series being composed of thicker flows than the upper portion.

There are, however, exceptions to both rules. While the basic rocks have several distinct types, the same type occurring at different horizons may lead to much confusion in the correlative stratigraphy. The same is true of the conglomerates, many of which received their materials from the same source, and are scarcely distinguishable.

There are others, again, which from the character of their pebbles, or matrix, are usually easily recognized.

Regarding the stratigraphical position of the Portage Lake group of mines:

The Baltic is working near the base, being lower in the series than any other mine of the district. The Isle Royale Consolidated and Arcadian are about one-third of the way up, the Quincy and Franklin about two-thirds, and the Atlantic somewhat nearer the top.

At the extreme top of this lower division the dip does not exceed 40 degrees, but increases toward the bottom of the series, where it reaches at least 60 degrees. From Portage lake the dip decreases in going northeast and increases as we go southwest along the range.

**COPPER DEPOSITS.**—These may, for all practical purposes, be divided into two classes, "bed deposits" and "fissure veins".

The bed deposits include the cupriferous conglomerates, like the one worked by the two chief producers, the Calumet & Hecla and

Tamarack mines; and the cupriferous melaphyrs and diabases, "amygdaloids", that are wrought by all of the other producing mines of the region.

The fissure veins, or transverse vein deposits, are not being worked at present; but examples may be cited in the old Cliff, Phoenix and Central mines, all of which were worked under the Greenstone Range previously referred to as marking one of the chief topographical features of the eastern part of the Mineral Range.

ALTERATIONS.—It is probably among the diabases and melaphyrs, referred to on a previous page, that the new mines of the range are to be sought. As stated, many of these rocks are porous, especially in their upper portions, and are thus subject to speedy alteration as they are penetrated by chemical waters. The pyroxene is changed to uralite, and chlorite, and the ferrous iron is changed to the ferric condition by taking up more oxygen; or it unites with other elements, to form new minerals.

The magnetite undergoes oxydation to hematite; the olivene when present is changed to serpentine and hematite, or by hydration to limonite, giving the altered rocks a brownish or reddish appearance. The feldspars alter to quartz, and with the addition of calcium and iron, which may have been furnished by the pyroxene, form epidote. This requires a loss of alkalis. The alkalis, however, have united with other dissociated elements and formed such minerals as analcite, apophyllite, natrolite, etc., which are often abundant in the more altered portions of the flows. Other products of alteration are calcite, prehnite, laumontite and datolite, the orthosilicate of boron, and calcium.

There are many others which we need not mention. The constant association of copper with one or more of these alteration products is very noticeable at any of the mines. This is particularly true with chlorite, epidote and prehnite.

The pyroxene and olivene, when present, were the first to undergo alteration, and to the alteration of these is probably due the formation of the non-alkaline silicates, or a large portion of them. The feldspars next went, giving the materials for many of the alkaline silicates. These appear to be much more plentiful in the upper levels of the mines, where the alteration has generally been carried to the extreme.

From the above it will be seen that, besides the simple filling up of the pre-existing cavities, a large amount of replacement has occurred. This has affected not only the originally porous portions of the rock, but has in some cases extended throughout their mass, forming a pseudo-amygdaloidal texture.

Where the alteration extends throughout the mass, the whole

flow may be impregnated with copper. Usually each flow will have a central portion that is more massive, with a more altered amygdaloidal upper portion to which the copper is confined.

The copper will be most abundant along the old channels formed by the underground waters, and will consequently be bunchy in distribution.

The copper may occur in shot-like forms, forming the amygdules, or in sheet-like forms, lining the joint crevices; and also occurs in pronged or branching stringers and masses.

As the copper is found in the altered portions of the flows, which are more easily eroded than the massive crystalline ones, it is obvious that it must be sought in the low, in preference to the high, lands. An exception to the above would be when the more crystalline rocks might protect the softer ones from erosion.

PRECIPITATION.—That the copper was carried in solution, and arrested in its present position by some precipitating agent, is generally conceded; and that it is intimately associated with the melaphyrs that have had their ferrous iron changed to a ferric state has given rise to the widely accepted theory that in the peroxydation of the ferrous iron is to be found the agent of precipitation.

The origin, or original source, of the copper is not so easily explained. Two views have been advanced. One view is that the copper was brought to the surface in the lavas themselves; the other that it was deposited in a sulphuretted form, along with the detrital rocks of the series.

If this latter view were the correct one, we might expect to find copper ores in the detrital members of the upper division of the series; such, however, is not the case, the only place where copper has been found in that division being, as previously stated, at the Nonesuch mine. At that place the copper may as well have leached from the melaphyrs which, by faulting, are brought into a position above the Nonesuch beds. These latter beds are basic in character, and the fine copper is, in fact, precipitated around grains of magnetite, so that the theory for precipitation holds here, as well as in the lower division of the series.

The view that the basic eruptives was the home of the copper is somewhat strengthened by the fact that in many of the coarse-grained, slightly altered diabases considerable chalcocite, chalcopyrite and bornite, sulphides of copper or of iron and copper, are found scattered through their mass.

This is particularly noticeable on the South Trap Range. We may here state that the South Trap Range is a term applied to the broken ridge of hills that skirts the southern limit of the eastern sandstone area, of which mention was made on a previous page.

The South Range branches off from the Mineral Range about ten



miles west of Lake Gogebic. It forms a prominent ridge of hills nearly to the south end of the lake, where the distance between the two ranges is about six miles.

The base of the series is composed of a coarse sandstone, resting unconformably upon the rocks of the iron-bearing series. Above the sandstone is a succession of melaphyr and diabase flows, often porphyritic, which make up the greater part of the range. The valley between the two ranges has the Eastern sandstone for its surface rock. The dip of the rocks of the South Range is steep, west of the lake—being usually from 60 degrees to 80 degrees to the north.

East of the lake, the trap hills are not so well defined, but occur in isolated low ridges, with a gently sloping surface to the north, and often with steep cliffs to the south. About six miles east of the lake quite a prominent ridge of the diabase and melaphyr, with the underlying sandstone, is exposed.

The sandstone can be seen in direct contact with the underlying green schists that form the surface rock to the south, and contains many fragments of them. This sandstone can be traced for about one mile east, to the west branch of the Ontonagon River, where it forms high cliffs along the north bank of the stream.

The melaphyrs that form the top of the ridge west of the river rest upon the top of this sandstone and dip to the north at an angle that does not exceed 12 degrees. The melaphyr continues to be the surface rock for at least two miles to the north, before it disappears below the Eastern Sandstone.

The rocks show at several points further east, near the old Military Road, and are well exposed on the south branch of the Ontonagon River, and beyond, where the average dip is about 15 degrees. They form quite a prominent ridge southeast of Trout Creek, near the Duluth, South Shore & Atlantic Railway. The steepest dip is nearly 20 degrees. At this place, the two ranges are about twenty miles apart.

The most northern outcrop of these rocks that is known at present is at Silver Mountain, about fifteen miles southwest of Baraga. The Silver Mountain rocks dip northwest at about 14 degrees, and form a bold, precipitous bluff to the southeast. Twelve to fifteen miles northeasterly from Silver Mountain are two quite high hills or ridges of Ordovician limestone, with abundant fossils.

This limestone lies conformably above the eastern sandstone. These rocks at the most easterly exposure are seen to dip northwest at about 28 degrees as a maximum. This is the steepest northwest dip recorded for the Eastern Sandstone along its southern margin. The dip does not generally exceed five degrees, and is more commonly only two or three degrees, and often less.

This would seem to indicate that the sandstone must be at least 3,000 feet thick, which is probably a very conservative estimate.

The eastern sandstone, like that on the west side of the Mineral Range, contains much material that was derived from the erosion of the eruptives of the range. Pebbles of felsite are found, and the melaphyr pebbles are extremely abundant.

It is probable that at the time the folding began, and the great longitudinal fault was produced, much of the area to the south of the range was elevated with it; that it was for a long time exposed to subærial denudation, during which the sandstone and shales were accumulating along the western side of the range, to which the shore line had been transferred.

During the time in which the Mineral Range was being worn away, there was a transgression of the sea which hastened the base leveling of the region. This was after the eruptive activity had ceased and the normal conditions of deposition had been restored. In the time of the transgression, the sea over-rode the Mineral Range, and the eastern sandstone was deposited in continuity with that on the west. The sea still deepened, and marine life became abundant in a region which for a long period had been the theatre of action for the fire gods.

The sea finally withdrew from the land, and the rocks were further folded; and, yielding along the lines of least resistance, were further faulted, folding the overlying sandstone into the positions in which we now find it.

Subsequent erosion has made great inroads, and carried away nearly all of the limestone which gave evidence of the former life of the sea. The sandstone has also suffered extensively from the continual wear of the agents of denudation, and now occupies only the low lying land, and a few patches on the upturned edges of the rocks of the range.

Such appears to be the past geological history of the Range, as we decipher it from the torn pages of the book of nature.



## Statistics of Copper Production.

Compiled by Horace J. Stevens.

Outputs of refined copper, in pounds, by operating Lake Superior copper mines, for four years: (Estimated products are marked by \*.)

MINE.	1895.	1896.	1897.	1898.
Calumet & Hecla...	79,137,399	89,260,621	83,248,054	*90,000,000
Tamarack.....	14,900,286	16,044,860	20,222,529	*21,500,000
Quincy.....	16,304,721	16,863,477	16,924,618	16,354,061
Osceola.....	10,755,029	9,526,415	11,201,103	*12,679,143
Atlantic.....	4,832,497	4,894,228	5,109,663	4,377,399
Franklin.....	3,086,933	2,746,076	2,908,384	*2,750,000
Wolverine.....	1,815,391	2,196,791	2,316,296	*4,500,000
Centennial.....				*750,000
Miscellaneous.....	531,679	586,762	*600,000	*750,000
Total.....	131,363,945	142,119,230	142,530,646	*153,660,603

Michigan's production of refined copper, in tons, has been as follows since the first mines were opened:

YEAR.	PRODUCT.		YEAR.	PRODUCT.	
	Tons.	Lbs.		Tons.	Lbs.
1843-54.....	7,002	1,727	1878.....	20,843	1,266
1855.....	2,904	1,334	9.....	21,335	1,529
1856.....	4,108	1,392	1880.....	24,859	337
7.. .. .	4,765	830	1.....	27,274	909
8.....	4,579	1,916	2.....	28,577	1,980
9.....	4,463	1,995	3.. .. .	29,851	404
1860.....	6,034	375	4.....	34,676	1,202
1.....	7,591	837	5.....	36,074	172
2.....	6,793	318	6.....	39,845	1,600
3... .. .	6,492	1,344	7.....	38,015	-----
4.....	6,245	1,965	8.. .. .	43,250	-----
5.....	7,179	592	9.....	44,090	-----
6.....	6,875	63	1890.....	50,750	-----
7.....	8,757	1,607	1.....	57,112	1,000
8.....	10,467	124	2.....	61,600	-----
9. . . .	13,312	1,301	3.....	56,300	-----
1870 .....	12,311	759	4.....	57,155	-----
1.... ..	12,873	448	5.....	65,681	1,945
2.....	12,276	1,523	6.....	71,054	1,230
3.....	15,145	1,505	7.....	71,265	646
4.....	17,167	389	1898.....	*76,830	603
5.....	18,019	1,497	Total....	1,190,361	332
6.....	19,135	997			
7.....	19,513	671			

The estimated copper production of the world for a ten year period, 1889 to 1898, inclusive, is as follows, in short tons:

YEAR.	TONS REFINED COPPER.
1889.....	313,446
1890.....	323,346
1891.....	335,269
1892.....	372,566
1893.....	364,236
1894.....	359,406
1895.....	401,142
1896.....	426,459
1897.....	452,256
1898.....	481,369

The world's copper production, as obtained from English sources, for the past four years has been as follows, figures being given in long tons of 2,240 pounds each, the gross ton being invariably used in all English metal transactions, whereas in the United States long tons are commonly used in the iron and steel trades and short tons of 2,000 pounds in the copper trade:

COUNTRY.	1895.	1896.	1897.	1898.
United States.....	172,300	203,893	216,060	234,271
Spain and Portugal.....	54,950	53,325	54,060	53,225
Chile.....	22,075	23,500	21,900	24,850
Japan.....	18,430	21,000	23,000	25,175
Germany.....	16,555	20,065	20,145	20,085
Australia.....	10,000	11,000	17,000	18,000
Mexico.....	11,620	11,150	11,370	10,435
South Africa.....	7,080	7,450	7,440	7,060
British America.....	4,000	4,000	5,905	8,040
Totals.....	316,710	355,383	386,880	401,141

The percentage of the world's supply of copper furnished by the United States has been as follows during the past four years:

In 1895 .....	54%
" 1896.....	57 "
" 1897.....	56 "
" 1898.....	58 "

## Dividends and Assessments.

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The following table shows all assessments levied and dividends paid to January 1, 1899, by all dividend-paying Lake Superior copper mines. Since the beginning of 1899 the Calumet & Hecla has paid one dividend of \$4,000,000 :

MINES.	ASSESSMENTS.	DIVIDENDS.
Calumet & Hecla.....	\$1,200,000	\$54,850,000
Quincy.....	200,000	10,120,000
Tamarack.....	520,000	5,430,000
Osceola Consolidated.....	1,700,000	2,354,000
Cliff....	111,000	2,518,620
Central.....	100,000	1,990,000
Minnesota.....	456,000	1,820,000
Franklin.....	320,000	1,280,000
Atlantic .....	280,000	780,000
National.....	320,000	359,255
Copper Falls.....	1,000,000	100,000
Pewabic.....	585,200	460,000
Ridge ...	470,000	100,000
Phoenix....	937,500	20,000
Wolverine ...	180,000	60,000
Total .....	\$8,379,700	\$82,241,875

In addition to the foregoing assessments on dividend paying properties, about \$12,000,000 has been levied on assessments of mining stock on which no dividends have been paid. Of the foregoing mines, the Cliff has long since passed from the possession of the corporation which developed the property and operated it until mined out. The Central is at present inactive, but has a large mineral area on which something of promise is reasonably certain to be found by diligent exploratory work. The Minnesota is now known as the Michigan mine. The National has been idle some years, but is to resume work during 1899. The Copper Falls is now a portion of the Arnold mine and the Pewabic a portion of the Quincy, while the Ridge is now a part of the Mass Consolidated property. The Phoenix is also again to be operated under a consolidation of that and adjoining properties.

## Percentages of Refined Copper.

The copper in the Lake Superior copper mines is found in native form, but necessarily contains more or less of the rock-matrix when barreled from the stamps. The crude copper coming in barrels from the stamp mills is known as "mineral", and requires smelting to free it from the rock mechanically connected with it. The reporting mines give the figures of production of mineral at the stamp mills each month, and several of the mining companies, such as the Osceola and Tamarack, report production to the shareholders in "mineral" and not in refined copper. The percentage of copper contained in the mineral coming from the various stamp mills varies greatly, owing to the difference in the nature of the rock matrices, (amygdaloids returning much higher percentages than conglomerates), and also by reason of the coarseness or fineness with which the mineral is dressed at the mills. The percentages carried by the "mineral" of the several mines varies from year to year, for obvious reasons, but the following table is a fair average:

MINE.	% REFINED COPPER IN MINERAL.
Wolverine .....	86.5
Osceola Consolidated.....	81.5
Franklin.....	81.4
Quincy.....	80.2
Atlantic.....	75.3
Tamarack .....	70.3
Calumet & Hecla.....	67.5

## Copper Percentages in Stamp Rock.

The appended table gives, approximately, the percentage of refined copper obtained from the rock stamped at the various producing mines of the district. As the percentages vary from year to year, and from month to month, the figures can be considered as approximate only.

MINES.	% COPPER IN ROCK STAMPED.
Calumet & Hecla.....	3.05
Tamarack.....	1.61
Quincy.....	1.50
Osceola.....	1.25
Tamarack Junior.....	2.00
Kearsarge .....	1.50
Wolverine.....	1.35
Franklin.....	1.00
Atlantic.....	.61



LAKE LINDEN, MICHIGAN.

PHOTOGRAPHED BY A. F. ISLER,  
LAKE LINDEN.





The Osceola, Tamarack Junior and Kearsarge mines are all owned and operated by the Osceola Consolidated Company, but as the three mines are unconnected, and are opened on three separate amygdaloid belts of markedly divergent characteristics, it follows that any average of Osceola Consolidated percentage for a single year would represent merely the average of the yield of the three mines, and the figures would vary greatly from time to time, as more or less rock was stamped from one mine or the other.

The percentages obtained from the same lodes by adjoining mines varies remarkably. The Quincy and Franklin work the same lode on either side of an imaginary line, yet the Quincy obtains 50 per cent more copper. The Calumet & Hecla gets an average of 70 pounds of copper to the ton of rock— $3\frac{1}{2}$  per cent—while the Tamarack, working on the same lode, obtains but 1.61 per cent. The Tamarack Junior has mined no small quantity of rock from this lode which has given as high as 20 per cent refined copper, 400 pounds of ingot copper for every ton of rock stamped.

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## Mineral Bodies of the District.

The working and developing mines of the counties of Houghton, Ontonagon and Keweenaw are without exception opened on mineral lodes or veins which carry native copper. There are, however, fissure veins of copper ore in Keweenaw county, carrying gray sulphurets, which assay as high as 25 per cent refined copper. The mines are opened on contact and fissure veins (none of these properties are working at present), and on conglomerate and amygdaloid beds. The country rock of the copper range is a blue trap, resting nonconformably between a sandstone formation on either side. The trap rock is of igneous origin, being merely ancient lava flows. The amygdaloids are the frothy portions of these lava flows, similar to the slag which gathers on molten metal in a blast furnace. Being more or less porous, its interstices were filled with copper deposited from superincumbent seas by electro-chemical action. The conglomerates are ancient seabeds, formed of boulders, gravel and sand, broken from the surrounding shores by ancient seas. These also having interstices, copper was deposited therein by electro-chemical action from the sea. There are many belts of both conglomerate and amygdaloids in any given cross-section of the Keweenawan copper-bearing trap formation, but some of them do not carry copper, while others, such as the Allouez conglom-

erate, carry copper in considerable quantity, but not enough of the metal to allow its profitable extraction.

The principal cupriferous lodes of the district are the Calumet Conglomerate, on which are opened the Calumet & Hecla, Tamarack and Tamarack Junior mines. The Osceola once worked this lode, but speedily exhausted the profitable portion. The Centennial has also spent fully \$1,500,000 in an attempt to develop a mine on the Calumet Conglomerate, but with negative results. The Pewabic amygdaloid lode ranks next to the Calumet Conglomerate in dividend returns, and on it are opened the Quincy, Pewabic, (now a part of its neighbor and known as the North Quincy), the Franklin and Franklin Junior. The Rhode Island, a new property, is being opened on the same lode. The Osceola lode is worked by the Osceola mine, and is also being developed by the Centennial and Calumet & Hecla mines, with an excellent showing in each. It is also being opened on the Tecumseh property, with indifferent results as yet. The Kearsarge and Wolverine, both highly profitable small mines, are opened on the Kearsarge lode, and to the northward the Mohawk, an exceptionally promising mine, is being opened on the same lode.

The Winona and Wyandot mines are being opened 26 miles south of Houghton on an amygdaloid which bears every resemblance to the Pewabic lode. As it also occupies the same horizon on the copper formation, its identity with the Pewabic is reasonably assured, despite the 25 mile tract intervening on which the Pewabic lode has not yet been discovered.

The Isle Royale lode has the Huron, Isle Royale and Portage properties south of Portage Lake and the Arcadian to the northward opened upon it. The lode now being developed at the Old Colony mine is probably the same. This will be opened soon by the Mayflower, immediately north of the Old Colony.

The Portage lode, lying parallel with and near the Isle Royale, is opened on the Portage and Shelden & Columbian properties in Houghton.

The Atlantic Ashbed, an amygdaloid, is worked by the Atlantic alone. It is quite possible later researches and development work will prove the identity of the Atlantic with the Ashbed lode, on which the Arnold, Humboldt, Ashbed and Meadow properties are now being worked in Keweenaw county.

The Baltic is perhaps the only new lode opened in the district for thirty years or more. It is exceptionally wide and most promising. The success of the Baltic mine will unquestionably lead to the opening of new mines on the same lode, both north and south of the Baltic mine.

## Strike and Dip of Copper-Bearing Lodes.

The strike of the copper-bearing lodes of the district is uniformly to the northward, although well toward the end of Keweenaw Point the copper formation lies at an angle but a few degrees north of east; and again in Ontonagon county there is another deflection by which the strike of the lodes is but a few degrees north of west. In Houghton County, from the Baltic to the Centennial mines, where nearly all of the regular producers are located, and where is found the greatest activity in the opening of new mines, the strike of the lodes is almost exactly north 30 degrees east for the entire distance.

The dip of the lodes varies from point to point along the formation and also across the formation; while no exact rule can be laid down for determining dips, it can be said in a general way that the angles of dip are invariably steepest where the trap formation is narrowest, and any given cross-section of the copper belt will show the dip at the sharpest angle nearest the Eastern Sandstone. The compressive force of the nonconformable sandstone was evidently applied from the eastern side. This is nicely shown by the Calumet Conglomerate, which dips at  $37\frac{1}{2}$  degrees in the Calumet & Hecla, while the Osceola lode, lying 730 feet to the eastward on the surface of the same company's lands, dips at an angle of 41 degrees. The Baltic lode dips at an angle of 71 degrees 73 minutes, the sharpest pitch of any mine yet opened; the reason being that the Baltic lies at a point where the copper formation is narrowest and that the mine itself is very near the Eastern Sandstone, the Baltic amygdaloid overlying the No. 3 conglomerate at a distance of but 115 feet. The Isle Royale lode dips at an angle of 59 degrees, while the Pewabic lode, in a direct line to the northwestward across the formation, dips at 51 degrees in the Quincy and 52 degrees in the Franklin. The appended table gives the average dip of the mines named:

MINE.	LODE.	ANGLE OF DIP.
Calumet & Hecla.....	Calumet.....	$37\frac{1}{2}$ deg.
Tamarack.....	" .....	$37\frac{1}{2}$
Tamarack Junior.....	" .....	$37\frac{1}{2}$
Quincy .....	Pewabic... ..	51
Franklin .....	" .....	51
Franklin Junior.....	" .....	47
Osceola .....	Osceola.....	41
Isle Royale.....	Isle Royale.....	59
Arcadian.....	" .....	53
Atlantic.....	Atlantic.....	54
Wolverine .....	Kearsarge.....	42
Kearsarge.....	" .....	42
Baltic. ....	Baltic.....	72

## Depth of Shafts.

The mining shafts of the copper district are the deepest in the world. The Red Jacket vertical shaft is 4,900 feet in depth. Nos. 3 and 4 shafts of the Tamarack are each approximately 4,650 feet in depth. These, the three deepest shafts on the globe, are within one-half mile of each other and on the same lode. The Tamarack is sinking a new shaft, No. 5, begun in August, 1895, and to be completed in the spring of 1901, which will be a full mile, or over, in depth. The Calumet & Hecla has one shaft 5,370 feet in depth—ninety feet over a mile—but as this is sunk on the angle of the lode, at an incline of  $37\frac{1}{2}$  degrees, it does not begin to reach the same vertical distance below earth's surface as the shafts previously named. The Quincy has shafts exceeding 4,000 feet in depth, and the Osceola has one shaft down to nearly that depth. The Franklin has one shaft 3,200 feet deep. None of the other mines of the district have shafts over 3,000 feet in depth.

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## Dividend Payments.

The appended table gives dates of first and last dividends paid by all dividend paying Lake copper mines up to January 1, 1899:

MINE.	FIRST DIVIDEND.	LAST DIVIDEND.
1 Cliff .....	1849.....	1867 (a)
2 Minnesota.....	1854.....	1876 (b)
3 National.....	1861.....	1872 (c)
4 Pewabic.....	1862.....	1873 (d)
5 Franklin.....	1863.....	1894 (e)
6 Quincy.....	1863.....	1898
7 Central.....	1864.....	1891 (f)
8 Copper Falls.....	1864.....	1871
9 Hecla .....	1869.....	1871 (g)
10 Calumet.....	1870.....	1871 (g)
11 Calumet & Hecla.....	1871.....	1898 (g)
12 Ridge.....	1873.....	1880 (h)
13 Phoenix.....	1877.....	1877 (i)
14 Atlantic.....	1878.....	1898
15 Osceola .....	1878.....	1898
16 Tamarack.....	1888.....	1898
17 Kearsarge.....	1890.....	1897 (j)
18 Wolverine.....	1898.....	1898

(a) Although the Cliff (Pittsburg & Boston Co.) paid its last regular dividend in February, 1867, there were three subsequent dividends, in 1871, 1872 and 1879, respectively, in liquidation, amounting to a total sum of \$238,620, in addition to the dividends of \$2,280,000 earned from mining profits. Title to the Cliff mine passed from the hands of

the Pittsburg & Boston Co. in 1879, and the affairs of the company were wound up and the corporation dissolved in that year.

(b) Title to the Minnesota mine passed to Wm. B. Jeffs in the early eighties, thence from his heirs to the Michigan Copper Company, the present owner.

(c) The National mine has been idle since August, 1893, being the last of the Ontonagon county mines to succumb to the depression and low prices which began in 1889 and culminated in the so-called "panic years" beginning in 1893. Arrangements are now being made for resumption of mining work during the present season.

(d) The Pewabic mine is now a part of the Quincy property. The Pewabic company paid dividends of \$460,000 from mining profits between September, 1862, and July, 1873. The charter expired, was not renewed and, a majority of the stock passing into hands adverse to the management, the mine was sold in 1890 by a special master in chancery for \$710,000. Since that date two dividends in liquidation, amounting to \$540,000, have been paid. There remains a considerable cash balance in the hands of the master and a judgment for upwards of \$100,000 against the Franklin company.

(e) The Franklin paid its last dividend on January 1, 1894. Since that date it has bought and opened the Franklin Junior mine, formerly the Peninsula and originally the Boston & Albany, a property of great promise. The Franklin has had its engine house burned three times, and its stamp mill once, within the past decade. A new stamp mill is nearing completion. The capital stock was doubled in 1898 and the proceeds, \$400,000, have been devoted to development and equipment upon a large and thoroughly modern scale.

(f) The Central is at present idle, but exploratory work to be conducted this year promises to reveal workable amygdaloid lodes of greater permanency than the fissure vein on which the mine was opened originally.

(g) The Calumet and Hecla were originally opened as separate mines. The Hecla paid dividends of \$650,000 and the Calumet paid \$300,000 previous to the consolidation of these properties on May 1, 1871.

(h) Title to the Ridge mine was lost in 1896 by failure of the owners to pay taxes. The property is now a part of the lands of the Mass Consolidated company.

(i) The first and last dividend of the Phoenix was paid on Jan. 20, 1877, when one dollar per share, a total of \$20,000, was returned to shareholders. Under a reorganization recently effected the Phoenix will soon be reopened.

(j) The Kearsarge paid three dividends, amounting to \$160,000, before it was merged in the Osceola Consolidated company in 1897.

### Number of Dividends.

The number of dividends paid by the various copper mining companies to January 1, 1899, is shown by the following table:

MINE.	TOTAL NO. DIVIDENDS PAID.
1 Cliff.....	37
2 Minnesota .....	19
3 National.....	9
4 Pewabic.....	11
5 Franklin.....	21
6 Quincy.....	65
7 Central.....	30
8 Copper Falls.....	3
9 Hecla.....	7
10 Calumet.....	3
11 Calumet & Hecla.....	109
12 Ridge.....	4
13 Phoenix .....	1
14 Atlantic.....	16
15 Osceola .....	46
16 Tamarack.....	31
17 Kearsarge.....	3
18 Wolverine.....	1

### American Copper Production.

The production of refined copper by American mines, in net tons of 2,000 pounds each, has been as follows since the Lake Superior mines began producing in 1845:

YEAR.	PRODUCT. TONS.	YEAR.	PRODUCT. TONS.	YEAR.	PRODUCT. TONS.
1845.....	112	1863.....	—	1881.....	35,840
6.....	168	4.....	8,960	2.....	45,323
7.....	336	5.....	9,520	3.....	57,712
8.....	560	6.....	9,968	4.....	72,472
9.....	784	7.....	11,200	5.....	82,938
1850.....	728	8.....	12,992	6.....	80,617
1.....	1,008	9.....	14,000	7.....	92,613
2.....	1,232	1870.....	14,112	8.....	115,635
3.....	2,240	1.....	14,560	9.....	115,623
4.....	2,520	2.....	14,000	1890.....	132,557
5.....	3,360	3.....	17,360	1.....	147,906
6.....	4,480	4.....	19,600	2.....	176,485
7.....	5,376	5.....	20,160	3.....	169,892
8.....	6,160	6.....	21,280	4.....	182,433
9.....	7,056	7.....	23,520	5.....	196,319
1860.....	8,064	8.....	24,080	6.....	230,030
1.....	—	9.....	25,760	7.....	259,272
1862.....	—	1880.....	30,240	1898.....	281,125

### Prices of Lake Copper.

Lake Superior copper commands a higher price in the markets of the world than copper from any other district, this premium varying from  $\frac{15}{100}$  of one cent to one-quarter of one cent, according to demand. This enhanced price is due, not to the superior conductivity, as is generally thought, but to the greater ductility and tensile strength of lake copper, when compared with the metal produced in Montana, Chile, Spain or elsewhere. The electrical conductivity of Montana electrolytic copper is, if anything, a trifle superior to that of Lake copper, but the greater tensile strength of the latter makes it pre-eminently desirable for all forms of copper wire.

The Lake copper leaves the smelters in the form of cakes, bars and ingots, mainly in the latter form. Cakes weighing as much as 7,000 pounds have been turned out of the Lake Linden smelters of the Calumet & Hecla on a special Russian order. The highest and lowest prices obtained for Lake ingot copper, at New York, for the past thirty-five years, have been as follows :

YEAR.	PRICE IN CENTS PER POUND.		YEAR.	PRICE IN CENTS PER POUND.	
	HIGHEST.	LOWEST.		HIGHEST.	LOWEST.
1864.....	55.00	39.00	1882.....	20.50	17.87
5.....	50.50	28.00	3.....	18.00	14.75
6.....	42.00	26.50	4.....	15.00	10.50
7.....	29.25	21.50	5.....	11.75	10.50
8.....	24.50	21.25	6.....	12.12	10.00
9.....	27.00	21.50	7.....	17.87	9.87
1870.....	22.50	19.00	8.....	17.62	15.87
1.....	27.25	21.12	9.....	17.50	11.00
2.....	45.00	27.25	1890.....	17.25	14.00
3.....	35.00	20.00	1.....	14.50	10.25
4.....	25.00	19.00	2.....	12.37	10.50
5.....	23.50	21.50	3.....	12.50	9.50
6.....	23.00	18.75	4.....	10.25	9.00
7.....	20.37	17.50	5.....	12.25	9.37
8.....	17.62	15.50	6.....	12.00	9.75
9.....	21.75	15.37	1897.....	12.00	10.75
1880.....	24.87	18.00	8.....	13.25	11.00
1.....	20.25	16.00			

## High Prices of Copper Stocks.

The following tables give the highest prices at which copper shares have sold since January 1, 1899, up to March 24, 1899:

### LISTED COPPER STOCKS.

MINE.	PRICE PER SHARE.	TOTAL VALUATION OF MINES.
Arcadian.....	\$ 95.25 .....	\$ 9,525,000
Arnold.....	15.00.....	900,000
Allouez.....	13.00....	1,040,000
Atlantic.....	44.50.....	1,780,000
Adventure.....	18.12½.....	1,812,500
Baltic .....	36.50.....	3,650,000
Calumet & Hecla....	895.00.....	89,500,000
Centennial.....	61.00.....	6,100,000
Franklin.....	30.00.....	2,400,000
Isle Royale.....	73.50.....	7,350,000
Mohawk.....	36.00.....	3,600,000
Old Colony.....	21.50.....	2,150,000
Osceola .....	105.00.....	10,500,000
Quincy.....	190.00.....	19,000,000
Rhode Island.....	15.00.....	1,500,000
Tamarack.....	265.00.....	15,900,000
Winona.....	22.50.....	2,250,000
Wolverine .....	50.00.....	3,000,000
Total for eighteen mines.....		<b>\$181,957,500</b>

Among the unlisted stocks dealt in on the curb, the following quotations can be given as only approximating the truth, as no official record of transactions in these shares is ever kept:

MINE.	PRICE PER SHARE.	TOTAL VALUATION OF MINES.
Wyandot.....	\$11.50.....	\$1,150,000
Mayflower .....	8.50....	850,000
Miner's.....	45.00.....	4,500,000
Mass Consolidated.....	18.00.....	1,800,000
Michigan .....	19.50.....	1,950,000
Tri-Mountain. . . . .	16.00 .....	1,600,000
Victoria.....	11.50.....	1,150,000
Total, seven mines.....		<b>\$13,000,000</b>

In addition to the two previous classes, there is a third, composed of inactive stocks, such as Washington, Central, Ashbed, Ahmeek, Seneca, Florida, Laurium, Meadow, Humboldt and some others; quotations on which are rare, but the aggregate value of which, at the present time, may be set down as at least \$3,000,000, and perhaps \$5,000,000.



## Mine Stock Capitalizations.

The capitalizations of the leading copper mining companies are as follows, the par value of each share of stock, under the Michigan law, being \$25. All of the corporations operating or arranging to operate mines in the Lake Copper district are chartered under the laws of Michigan, though the Arcadian, Isle Royale, and perhaps others identified with the so-called "Standard Oil" properties, are to be re-incorporated under the laws of New Jersey, which are much less stringent than those of Michigan :

MINING COMPANY.	NO. SHARES.	PAR VALUE.
Arcadian .....	100,000.....	\$2,500,000
Arnold .....	60,000.....	1,500,000
Allouez.....	100,000.....	2,500,000
Atlantic.....	40,000.....	1,000,000
Adventure.....	100,000.....	2,500,000
Ahmeek. ....	20,000.....	500,000
Ashbed.....	40,000.....	1,000,000
Baltic .....	100,000.....	2,500,000
Calumet & Hecla.....	100,000.....	2,500,000
Centennial.....	100,000.....	2,500,000
Central.....	20,000.....	500,000
Franklin.....	80,000.....	2,000,000
Florida.....	20,000.....	500,000
Humboldt.....	40,000.....	1,000,000
Isle Royale.....	100,000.....	2,500,000
Mohawk .....	100,000.....	2,500,000
Miner's.....	100,000.....	2,500,000
Mayflower .....	100,000.....	2,500,000
Mass Consolidated.....	100,000.....	2,500,000
Michigan.....	100,000.....	2,500,000
Meadow .....	60,000.....	1,500,000
Old Colony.....	100,000.....	2,500,000
Osceola.....	100,000.....	2,500,000
Quincy.....	100,000.....	2,500,000
Rhode Island.....	100,000.....	2,500,000
Seneca.....	40,000.....	1,000,000
Tamarack.....	60,000.....	1,500,000
Union Land & Copper...	100,000.....	2,500,000
Victoria.....	100,000.....	2,500,000
Winona.....	100,000.....	2,500,000
Wolverine .....	60,000 .....	1,500,000
Wyandot. ....	100,000.....	2,500,000
Washington.....	40,000.....	1,000,000
TOTAL.....		<u>\$64,500,000</u>



## Producing and Prospective Copper Mines.

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### Results of the Application of Modern Mining Methods to Their Development in the Lake Copper Region.

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The main purpose of this Review is to familiarize the outside public—particularly that portion of it which is investing in “coppers”—with the present condition of the copper mining industry in the Lake district, the prospect for it in the future and the promise it holds for those who invest in the shares of copper mining companies, old and new.

The need for such a work has been created by the deep and widespread interest in coppers which has developed within the past two years, this having during that interval caused millions of dollars to flow into the Lake region from all parts of the world for investment in producing mines, or the exploitation of undeveloped properties that are believed to have value. This influx of capital has brought about a wonderful advance in the value of developed mines of the district, and the flotation of a large number of new properties, and the intending investor has need to learn something of the propositions that invite him to risk his money in ventures regarding which he may be but slightly informed.

The historical portion of the Review, also that devoted to a description of the geological characteristics of the copper belt running through the counties of Keweenaw, Houghton and Ontonagon, no less than the statistics of the copper industry, given in preceding pages, possess an interest and value of their own, but it may be safely assumed that the bulk of the readers of this little work will be more concerned in what it acquaints him with regarding the Lake copper industry as it exists today, the present and prospective values of the properties which invite investment, and the causes which underlie and have produced the present remarkable activity in the copper market, than in a recital of what has been accomplished in the past, marvelous though that may be,

In no other part of the country has the increase in property values during the past two years been as great as in the three counties named, in which are located the great copper properties whose richness has made the state noted among her sisters of the Union. The cause of this advance puzzles many, and there are those who regard it as having no adequate producing, or sustaining, cause, and believe it to be only a promoted result of a purely speculative movement set on foot by manipulators of the stock market for a selfish purpose, which will subside as suddenly as it grew, when it has run its appointed course.

If this view were correct, the wise thing for the public to do would be to let copper shares severely alone. But it is not correct, even approximately, and the best proof of its incorrectness is to be found in the significant fact that millions of dollars have been placed aside by the new companies for expenditure in the development of properties that are believed to have value; and that it is conceded to be certain that some of these are sure to soon take rank among the dividend-earners, bringing large returns to those who put money in them at the present value of their shares on the market. Some of the propositions presented to investors will not bear close and intelligent scrutiny, unquestionably, but only the stupid or recklessly careless investor will put money into these with the means for informing himself as to the properties that have merit, and those which lack it, so easily and readily obtainable.

The readiness with which money is now enlisted in the development of copper properties which are presumed to have value comes from the remarkable strength of the market for the metal itself, which has advanced in price about 50 per cent within twelve months in the face of an increased production, and in spite of an effort put forth by some of the larger producers to hold the price down to what they, for reasons of their own, consider to be as high as it should go. But the market value of copper has climbed to the figure it now brings in response to a steadily growing consumption of the metal, which has latterly outrun production, and this sufficiently explains why capital now shows such readiness to engage in the development of copper properties that have long been permitted to remain untouched, though it was known that only proper handling was required to make them large and profitable producers.

It may be well to here call attention to the significant fact that when the great French copper syndicate artificially advanced the price of copper in 1887, from less than twelve cents a pound to over seventeen, holding it at an average advanced price of sixteen and three-fourths cents until the syndicate collapsed in 1889, the increase in the selling price of the metal utterly failed to promote the develop-

ment of new producers in the Lake district. The profit in the production of copper at the price the syndicate made for the metal in the markets of the world was sufficient to have created an interest in the development of new properties such as now exists; nevertheless it failed to materialize. Capitalists well knew that the advance in price was the result of manipulation, and could not continue, and warily let propositions having in view investment in the development of new producers alone. But now capital is aware that the advance has come through natural causes, in response to a steadily growing consumption of the metal in a variety of new uses to which it is being applied, and is eager to lend its aid to propositions for the flotation of meritorious properties which heretofore it was wont to scrutinize with a coldly critical eye.

The publishers of this Review have aimed to place the producing and prospective mines treated of in the succeeding pages fully and fairly before the public, as nearly as this may be done within the limits of so modest a work. Their representative in the copper district, Mr. S. J. Beahan, who has capably conducted the Copper Department of The Mining Journal for the past two years, has written up each of these properties after careful examination, and they feel that they are safe in vouching for the conscientiousness and value of his work.

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## **Houghton County Properties.**

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### **Calumet & Hecla Mining Company.**

The Calumet & Hecla stands pre-eminently at the head of the world's mining industries; an exalted position from which it will not be dethroned for long years to come, during which period the property will continue to enrich its fortunate shareholders, probably at a rate even greater than that of recent years, as the outlook for this wonderful mine was never so bright as it is at present.

During the general business depression of recent years the copper

district of Michigan suffered, to a trifling extent only, this happy circumstance being very largely due to the fact that within its borders was a mine yielding enormous profits and paying a high rate of wages, even with the price of the metal not much more than half of what it has been of late. The earnings of this company find no equal in the history of mining or commercial ventures, while its recent dividend of \$4,000,000 is without a parallel. In securing a stretch of mineral land which is underlaid by the greatest wealth of copper ever opened, the foundation for the company's property was luckily, as well as securely, laid, as mining on the same lode, both north and south of its boundary, has failed to yield profitable results after the expenditure of enormous sums. To the west of the company's lands lies the Tamarack, which carries the Calumet conglomerate lode, and it is only on these properties that this vein has yielded profits, though millions have been expended in vain efforts to secure hoped-for results on a number of other mineral tracts by which the lode is traversed. And yet this was not all loss in the fullest sense. The Osceola company was organized in 1873 to work the Calumet conglomerate lode south, but the company, finding it barren at that point, turned its attention to the other mineral belts traversing its property, which resulted in the discovery of the Osceola amygdaloid lode, since proved to be of great value. The Centennial, north, furnishes a similar case, where developments on the Osceola lode give promise of a good future, though the conglomerate has been found unprofitable. The Allouez might be cited as another instance, the effect being the development of the Osceola lode on the properties above referred to much earlier at least than would have been the case were it not for the effort originally made to develop the conglomerate.

The Calumet conglomerate lode was discovered by Edward J. Hurlbut, a civil engineer in the employ of the Cliff Mining company, in 1865, and before the year rolled by the Calumet Mining company was organized and had commenced operations on the most valuable mineral discovery of the present age. The early development work produced rather indifferent results, and before the close of the year 1865 the stock was selling for one dollar per share. In the early summer of 1866, the Hecla company was organized, as an offshoot from the Calumet Mining company. The stock was apportioned to holders of Calumet stock at five dollars per share, and the funds thus realized were devoted to the development of the property on a broader scale. The great value of the conglomerate began to be demonstrated and the stock of both companies rose during the winter of 1896 to \$75 per share. The future of both companies was well assured, and stockholders willingly paid the assessments necessary to place the properties on a profitable working basis. Three years later Hecla stock was quoted at \$85, and in Decem-

ber, 1869, the company paid its first dividend, amounting to three dollars per share. The Calumet followed with its first dividend in August, 1870.

The Calumet and Hecla companies were consolidated May 1, 1871, up to which time the Calumet stock had been assessed \$15 per share and had paid \$15 in dividends; and the Hecla had been assessed \$25 per share and paid \$32.50 in dividends.

With the consolidation of the two companies the capital was made \$1,000,000, divided into 40,000 shares of a par value of \$25 each. Shortly after the number of shares was increased to 50,000, and again in 1873 to 80,000. In 1879 the capital was increased to \$2,500,000, divided into 100,000 shares of a par value of \$25 each.

The company's mineral lands comprise about 2,600 acres, situate in Calumet township. Adjoining on the north are the Centennial and Tamarack Junior, on the south the Osceola, and on the west the Tamarack. The Calumet conglomerate, which is the most westerly lode, traverses the entire length of the property, a distance of more than two miles. East of the conglomerate 750 feet is the Osceola amygdaloid lode, upon which three shafts are being sunk, and some distance still further east is the Kearsarge amygdaloid vein.

The immense profits secured by the company have been from the Calumet conglomerate vein. The average bearing of this lode is north 33 degrees and 31 minutes east, and its general dip with the horizon about 38 degrees northwesterly. Its elevation above Lake Superior is 655 feet. The lode averages about 13 feet in width, and the rock yields a trifle more than 4 per cent mineral. Beginning at the north end, known as the Calumet branch, the approximate depths of the shafts on the plane of the lode are as follows: No. 5, 5,500 feet; No. 4, 5,800 feet; No. 2, 4,600 feet. Hecla branch—No. 2, 3,900 feet; No. 3, 3,900 feet; No. 6, 4,700 feet; No. 7, 4,800 feet; No. 8, 4,100 feet; Nos. 9 and 10, 3,500 feet; No. 11, 1,500 feet; No. 12, 4,600 feet. Calumet shafts Nos. 1 and 3 and Hecla shaft No. 1 have been abandoned since the underground fire of 1887 and 1888, and the territory is now reached from Calumet No. 2 and Hecla No. 2 shafts, respectively. The underground openings are always kept well advanced, and the company's reserves are regarded as ample, at the present rate of production, for nearly, if not fully, twelve years' operation.

The equipment of this mine is unequalled by any in the world, and installed in its engine houses are some of the most powerful hoisting engines ever built. The machinery that attracts, probably, the most attention from sight-seers is locally known as the "Jumbo", which is installed in the Calumet engine house, a building of brick and stone, 146 x 62 feet. In this structure are the engine "Superior", with cylinders of 40" and 70" x 72" stroke, of 4,700 horse-power; the Cor-

liss engine "Rockland", 30"x48", of 600 horse-power, used as a spare; the Leavitt engine "Baraga", 40"x60", of 2,000 horse-power, also a spare; one pair of 32"x48" Rand compressors with a capacity of 26 air drills, and one pair of 36"x60" Rand compressors, with a capacity of 41 air drills. There are four drums, 20 feet 6½ inches in diameter by 8 feet 4 inches face, to hoist from a depth of 4,000 feet from shafts Nos. 2, 4 and 5 Calumet and from No. 3 Hecla. The "Macinac", which is used for the compressors, is a four-cylinder triple-expansion engine of 7,000 horse-power, and undoubtedly the largest in Michigan. The old boiler house is 77 x 60 feet, and contains a battery of five boilers, two of 84 inches in diameter by 35 feet long, and three of 90 inches diameter by 34 feet 6½ inches long, the battery giving 2,780 horse-power. The new boiler house contains six boilers. The smoke-stack is 12 feet 6 inches in diameter and 250 feet in height.

The Hecla engine house is a brick building, 80 x 47 feet, with an ell 44 x 17½ feet, and contains the compound engine "Frontenac", 27½" and 48"x72", of 2,000 horse-power; the Corliss engine "La Salle," 30"x72", of 900 horse-power, used as a spare; and the Corliss engine "Perrot", 30"x48", of 600 horse-power, also a spare engine; in addition, the two pair of compressors, water-plunge type, 42"x60", with a capacity of 144 air drills, 72 drills for each set; one pair of Rand compressors, 28"x48", of a capacity of 31 air drills. The boiler house is of brick, 80'x58', and contains five boilers having a total capacity of 1,690 horse-power. The brick stack is 4½ feet in diameter and 120 feet high.

At the Hecla another hoisting plant consists of the triple-expansion engines "Gratiot", "Houghton" and "Seneca", of 2,000 horse-power each, having cylinders 18" and 27½" and 48"x90", fitted with conical hoisting drums to reach to a depth of 5,500 feet. The engine house is of stone, 112'x78'. The boiler house, of the same material, is 76'x68'. There are five boilers of 505 horse-power each, 90 inches in diameter by 34½ feet long. The brick stack is 9½ feet in diameter and 200 feet high. These engines operate Hecla shafts Nos. 3, 6 and 7. The engine house for Hecla shafts Nos. 7 and 8, contains the triple-expansion engines "Hancock" and "Pewabic", each of 2,000 horse-power and each operating by spur gearing its own drum, which is 25 feet in diameter by 8 feet 2⅞ inches face, having a rope capacity of 5,500 feet of 1½ inch diameter. The cylinders are 20½" and 31½" and 50"x48". The maximum speed is 92 revolutions per minute, which is 3¼ revolutions to one of the drums. The house is of stone, 122 x 50 feet. The boiler house, 150 x 65 feet, affords room for 10 boilers. The stack is 12½ feet inside diameter and 250 feet high. Shafts Nos. 9 and 10, are operated from an engine house built of stone, 75x46 feet. It contains two compound hoisting engines, the "Detroit" and "Onota", of 1,000 horse-power combined, having cylin-





PHOTOGRAPHED BY A. F. ISLER,  
LAKE LINDEN.

CALUMET & HECLA SMELTING WORKS, LAKE LINDEN, MICH.



ders 18" and 32" with 48" stroke. These engines drive by spur gearing two hoisting drums, each 20 feet in diameter by 8 feet 4 inch face, and will wind 4,000 feet of  $1\frac{1}{2}$  inch rope. Shafts Nos. 11 and 12, are operated by a pair of Woodruff and Beach engines of 20 inches diameter by 48 inch stroke, with two drums 8 feet in diameter and 6 foot face. The shaft houses each contain a Westinghouse driving engine of 60 horse-power and two Blake crushers; also a bin with a capacity of 1,500 tons. Located at No. 5 Calumet and at No. 4 Hecla are fans 30 feet in diameter with a capacity of about 100,000 cubic feet of air a minute, which are used for underground ventilation. By all odds the largest and deepest shaft in the world is that of this company, known as the "Red Jacket", which is sunk vertically to a depth of 4,900 feet. This wonderful undertaking was planned after the two mine fires of 1887, in order to insure the company against the loss of the northern extremity of the mine, in case of a similar future disaster. The Red Jacket shaft is located 2,000 feet east of the west boundary. The site was laid out by the company's civil engineers, August 4, 1888, and two days later ground was broken and the work under way. Toward the close of 1893, the lode was cut at a depth of 3,287 feet. The greatest amount of sinking accomplished in any one month was 127 feet. The dimensions of this shaft are  $15\frac{1}{2}$  x 25 feet. It contains six hoisting compartments in which there will be in operation four 10-ton and two 2-ton cages. The bottom of this shaft was reached February 15, 1896, when the extension of cross-cuts was at once begun. Connections have been established with No.4 shaft at the thirty-sixth, thirty-ninth, forty-second, fifty-seventh and sixtieth levels. The plan is to extend every third level. The lode has been reached at the thirty-sixth, thirty-ninth, forty-second, fifty-seventh, sixtieth, sixty-third and sixty-sixth levels, while at the four latter levels drifting on the lode is under way.

The forty-fifth, forty-eighth, fifty-first, sixty-ninth and seventy-second levels are under way. Cross-cuts have been started from the seventy-eighth and eighty-first levels. The working depth of the shaft is 4,800 feet, the distance below this point being used as a sump. The main hoisting engine house, built of stone, 220 x 70 feet, contains two pairs of triple-expansion engines of 3,000 horse-power per pair, having cylinders  $20\frac{1}{2}$ ",  $31\frac{1}{4}$ " and 50" in diameter with six foot stroke, to run 60 revolutions per minute, and fitted with the Whiting drum system arranged to hoist ten tons per load, at a speed of sixty feet a second.

The tail house for the fleet gear, 412 x 32 feet, is at the north end of the engine house. These engines are calculated to hoist from a maximum vertical depth of 5,000 feet.

The boiler house, of stone, 150 x 68 feet, will contain ten boilers, each 90 inches in diameter by  $34\frac{1}{2}$  feet long, and adapted to a working

pressure of 185 pounds, at which each will furnish steam for 1,000 horse-power. The stack is of brick,  $12\frac{1}{2}$  feet inside diameter and 250 feet high. For this shaft also, the sinking-engine house, of stone, 69 x 36 feet, contains a pair of horizontal-tandem Corliss engines, with cylinders 16" x 32" in diameter having a four-foot stroke, with tail-rope house and the Whiting drum system.

The shaft house, of steel, is 104 x 84 feet and contains four 24" x 36" and eight 13" x 30" rock crushers of the Blake pattern, made of gun metal, also two high speed triple-expansion engines, each 275 horse-power.

In the territory tributary to the Red Jacket shaft is found the richest conglomerate, and the increased production from this source will be large.

The combined capacity of the six cages is 44 tons, and should they make a round trip every ten minutes, working 20 hours a day, the rock hoisted would amount to 5,280 tons, or more than any mine in the district, except the Calumet & Hecla, is mining.

The development of the Osceola amygdaloid lode by the Calumet & Hecla company commenced in December, 1897, prior to which drifts had been driven to it from the underground workings of the conglomerate at three places. The shafts on this belt are Nos. 13, 14 and 15, each of which has attained an approximate depth of 900 feet. The best results have been obtained at shaft No. 13. The older workings are protected from the ravages of fire by a carefully planned system of fire-alarms, fire-doors and pipe-lines carrying water for fire protection. The companies of firemen are organized from among the employees, all of whom are thoroughly drilled in the methods of fighting fire. The property is equipped with electric bells and a private telephone system. The company has, in addition to this, three steam fire-engines at the mine and a full complement of carts, hose, etc. Six duplex fire-pumps are located at various of the engine houses at the mine, all of which can be brought into service in case of fire.

Four and one-half miles distant on the shore of Lake Superior is located the company's pumping station. The equipment consists of a Worthington high-pressure compound condensing pump with cylinders  $19\frac{1}{4}$ " and  $33\frac{3}{8}$ " x 24", and plungers 9" x 24"; two spare Worthington pumps with cylinders 10" x 8"; two boilers 64 inches in diameter by 17 feet in length, of 300 horse-power, and one boiler 54 inches in diameter of 100 horse-power. The capacity is 2,000,000 gallons a day. The water is taken from a pipe 18 inches in diameter, extending 1,200 feet into Lake Superior, and is pumped through a 12-inch wrought-iron pipe-line  $4\frac{1}{2}$  miles in length to an altitude of more than 700 feet to the mine, where it is distributed over the whole location. The water works building at the mine contains a Leavitt pumping engine of a capacity of 5,000,000 gallons a day, steam cylinders  $11\frac{1}{4}$ "

and plungers 17"x24". In addition there are two Worthington pumping engines, of a capacity of 14,000,000 gallons; one pump with steam cylinders 14" and 24"x36", and 20"x36" plungers, of a capacity of 4,000,000 gallons; and two others with cylinders of steam 21" and 42"x36", and 29"x36" plungers, of a capacity of 10,000,000 gallons. A pipe line 16 and 24 inches in diameter runs to the Superior engine house, and from there north and south along the lode. The mine is connected with the company's milling plant at Lake Linden by the Hecla & Torch Lake railroad, which is owned and operated by the Calumet & Hecla Mining Company. The road is about ten miles in length and is fully equipped.

On the shore of Torch Lake are located the company's stamp mills, which are treating in the neighborhood of two million tons of rock per year.

Each of the two mills contains eleven Leavitt heads with steam cylinders of 14" and 21½", with 24" stroke, and a complete equipment of washers, grinding mills and slime tables. The pumping plant which supplies the mills with water consists of the triple-expansion pumping engine "Michigan", having a capacity of 60,000,000 gallons daily, and the following spare pumps: The compound pumping engine "Erie", with a daily capacity of 10,000,000 gallons; the compound pumping engine "Ontario", with a capacity of 20,000,000 gallons daily, and the geared pumping engine "Huron", with a capacity of 20,000,000 gallons daily. By means of wire rope transmission, the compound engine "Wabeek", 22¾" and 38"x60" stroke, of 780 horsepower, operates the washing machinery, steam-valve gear, and sand wheels. Four wheels distribute the stamped sand, two for each mill. The forty-foot sand wheels have a capacity of 18,000,000 gallons of water and 1,600 tons of sand, and the fifty-foot wheel a capacity of 30,000,000 gallons and 3,000 tons of sand.

Some thirteen years ago the company decided to do all of its own smelting, and accordingly erected a plant at South Lake Linden, on a tract of land comprising about thirty acres facing the shore of Torch Lake. There are four furnace buildings 80 x 130 feet; a blister furnace building, 50 x 70 feet; a cupola building, shops, offices, etc. The two mineral buildings have bin capacities of 11,000 tons.

The buildings, including the laboratory and drafting rooms, are properly equipped and the entire plant is capable of and renders most excellent service. James B. Cooper is superintendent and Charles Smith clerk.

It is the policy of this company as far as practicable to guard against all possible contingencies. The coal famine of '93, following the railroad employees' strike, was a severe experience to a great many large consumers of bituminous coal. It was felt to some extent by

the local mines, and to guard against its recurrence the Calumet & Hecla at once proceeded to erect a mammoth coal shed at South Lake Linden, in addition to the old one of 80,000 tons capacity, and henceforth a supply of coal sufficient for something like two years will be kept on hand. The coal storage capacity next year will be 200,000 tons.

The real estate of the company consists of 2,599 $\frac{1}{4}$  acres of mineral lands in Houghton county and 20,352 acres of timber lands in Keweenaw, Houghton and Ontonagon counties. At the stamp mill there are 988 acres. There are more than 800 dwellings on the various properties owned by the company, and a much larger number of houses erected by employees on lots leased from the company. There are twenty-six churches on the property of the company, and in the work of building them the various religious societies can testify to the liberal donations made by this corporation in the interest of furthering the cause of Christianity. It can truthfully be said that a mining corporation more generous, liberal and considerate toward its employees exists nowhere. The employees of all the mines on the copper range are well treated, as is evidenced by the absence of labor troubles: but unfortunately all are not working Calumet conglomerates, and the smaller producers could scarcely attempt to follow the exceptionally liberal policy of the Calumet & Hecla tending to the spiritual, mental and physical welfare of its employees, numbering during the summer season about 5,000. The school houses on the company's property were built at its expense. In addition to the churches and schools mentioned, there is at the mine a manual training school well equipped and a handsome public library containing some 7,000 volumes, which number will be increased to 25,000. The library is constantly being added to and will soon contain many fine works published in foreign languages, some of which have already arrived. In the basement of the library are located some thirty bath rooms, the privileges of which are also free to all employees. The company's hospital is excelled by few in the larger cities, and the same might be said of its corps of physicians, at the head of which is Dr. E. H. Pomeroy. During the past two years the hospital and medical service has been rendered the employees free of any charge.

The company's smelting plant at Buffalo is located on the Niagara river. The mineral house has a capacity of nearly 14,000 tons. The two refining furnace buildings are of brick, 140 x 88 feet, and the blister furnace is 50 x 55 feet. Added to this are the various shops, offices, docks, storage houses, slag shed, cupola building, etc. Wonderful as is the company's surface equipment it is almost constantly undergoing improvement at some point or other, as well as being added to. After this long and most successful period the Calumet & Hecla Mining Company has yet, it is believed, to reach the zenith of its career. Up to the present time the mine has produced about 1,269,000,000 pounds

of refined copper, and has paid to its shareholders in dividends the sum of \$59,850,000. The last report issued by the company is dated April 30, 1898, and shows cash assets amounting to \$6,558,456.46.

The main office of the company is in Boston. Alexander Agassiz is president; T. L. Livermore, vice president, and George A. Flagg, secretary and treasurer. The local officers are S. B. Whiting, general manager; S. D. Warriner, superintendent; John Duncan, assistant superintendent; J. H. Lathrop, clerk; J. N. Cox, cashier; P. F. C. West, civil and mining engineer; James W. Milligan, chief mining captain; Thomas Wills, Thomas Hoatson, Jr., James Wilson and William Wear, mining captains. At the stamp mill F. G. Coggin is superintendent and H. W. Cake assistant superintendent. W. A. Childs is superintendent of the Hecla & Torch Lake railroad.

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### **Tamarack Mining Company.**

The mineral lands of the Tamarack comprise 1,280 acres, situated directly west of the Calumet & Hecla, in sections 10, 11, 14 and 15. The company is an offshoot of the Canal company, and the commencement of mining operations by it marked the inception of the most interesting project in the history of the mining industry in the Lake copper region. Much has been said and written regarding the organization of this company and its decision to go ahead and develop the property. The true condition of affairs was that in the early eighties the Calumet & Hecla company fully appreciated the immense value of the Tamarack lands and submitted a proposition to J. D. Clark, since deceased, of the Clark-Bigelow syndicate, for their purchase. Mr. Clark gave the proposition some consideration, as he at once consulted the late John Daniell, then superintendent of the Osceola, regarding it. The matter was held under advisement for some little time, during which the question of working the property through vertical shafts received attention.

Captain Daniell held that the project was feasible, and in this was strongly supported by the present general manager, Willam E. Parnall, and others. The result was that Mr. Clark declined the offer and the Tamarack mining company was organized in January, 1882, for the purpose of developing a property adjoining the world's greatest copper mine. The mine has now been an active property seventeen years and, like most mining ventures, passed through periods of gloom. But it has paid to its stockholders an aggregate of \$5,670,000 in divi-

dends, and with the completion, about two years hence, of the developments now under way the Tamarack should, at the very least, double its present value.

Shaft No. 1 was commenced in February, 1882, and in June, 1885, more than three years later, the company was rewarded for its outlay by reaching the Calumet & Hecla conglomerate belt at a depth of 2,270 feet. Success crowned a wonderful feat of mining and the future of the Tamarack was thereby securely established. This shaft has a present depth of 3,240 feet, which is the maximum, as it would be impossible to sink further at this point without encroaching upon the territory of the Calumet & Hecla adjoining. The sinking of this shaft revealed a lode with a dip of  $37\frac{1}{2}$  degrees and varying in width from 10 to 24 feet. When the formation was encountered at No. 1 shaft, preparations for the sinking of No. 2 were in order, and in March, 1886, it was started at a point 600 feet north. The lode was cut at a depth of 2,575 feet. This shaft had a depth, January 1, 1899, of 3,866 feet, and is equipped with a direct-acting double hoist, 24" x 48" cylinders, the drum having a 10-foot face and being 36 feet in diameter. Each shaft has two hoists, the auxiliary being used for lowering employees, timber, tools, etc.

No. 3 shaft is north of No. 2 about 4,200 feet. It reached the lode August 5, 1894, at a depth of 4,185 feet. The ground encountered was not rich, but since then it has been the mine's most valuable source of production, and in addition to this gives promise of a most encouraging future. No. 4 shaft is located 700 feet north of No. 3, and at a depth of 4,550 feet reached the conglomerate lode January 9, 1895. The lode has not been found rich at this point, yet the hope is entertained that it will be found better to the north.

What gives every promise of becoming one of the greatest copper producing shafts in the world is the mammoth No. 5 shaft, being sunk at a point 3,300 feet south of No. 4, and which was started in September, 1895. That this shaft will become a great producer is conceded by every one familiar with its location. In the extreme north and south of the Calumet & Hecla and Tamarack the conglomerate is rather barren of copper, while No. 5 shaft is in the center of what is known as the highest mineralized formation, as evidenced by all the ground opened up by the Calumet & Hecla. Since reaching a depth below the water line this shaft has been extended at a rate of about 1,000 feet a year. The location of the shaft is in a cedar swamp, and in the early sinking much inconvenience was met with from the inflow of surface water. A rather singular fact in this connection is that since passing a depth of 1,000 feet the surface water has ceased to be a source of annoyance. It is expected that this shaft will encounter the lode at a depth of 4,580 feet. Its depth January first of this



year was 3,000 feet, and sinking is being pushed at the rate of 1,000 feet per year. At the five levels above the bottom plats will be cut and preparations made to extend the drifts, but the wealth of mineral tributary to this shaft will scarcely be reached earlier than September, 1900, by which time the shaft will be fully equipped. It is unlikely, however, that No. 5 shaft will be furnishing rock commensurate with its wonderful resources until well along in the year 1901. This shaft contains five compartments, each five feet four inches by seven feet two inches within timbers, of which four are skip ways, and one a pipe and ladder way. This shaft is directed to the same copper course as that being wrought at No. 4 shaft of the Calumet & Hecla, and which is a continuation of the lode cut by the wonderful Red Jacket shaft of the Calumet & Hecla at a depth of about 4,500 feet. The equipment at No. 5 shaft will include the biggest drum winding hoist in the world. There will be four engines with cylinders 44"x 84", one of which will be located at each end of the massive frame. The face of the drum is 25 feet and it will hold 6,500 feet of 1½-inch rope. The machinery is being installed in a fine building of sandstone, on the most substantial foundations that can be devised. Nos. 1, 2 and 3 shafts are permanently equipped. At No. 3 shaft a compressor building of red sandstone contains a compressor capable of supplying power to 80 drills.

The Tamarack has a vast territory on both the dip and strike of the lode and in depth it can be wrought as far as atmospheric conditions will permit. The Osceola lode is intersected by cross-cuts from Nos. 1 and 2 shafts and production goes on from this source. The month of May of this year will witness the starting of the company's pumping station, located on the shore of Lake Superior, five miles distant from No. 1 shaft. The plant is undoubtedly the finest in the copper district, and insures the Tamarack and Osceola mines, as well as the villages in which they are located, an ample supply of water for all time to come. Work on this project began in September, 1898, since which date the pipe connections have been laid and securely covered. At the lake a shaft was sunk forty feet and from the bottom an adit was extended through the sandstone formation under Lake Superior for a distance of 480 feet, at which point the bed of the lake was broken into February 17, 1899. The pumping plant will have a capacity of 1,500,000 gallons every 24 hours. The mills of the Tamarack mine are located on the shore of Torch Lake, six miles distant, and railroad facilities are furnished by the Hancock & Calumet railroad. The two mills contain seven stamps, which have a present daily capacity of about 2,400 tons of rock. Some improvements at the old mill, which contains five heads, are under way and when completed it is expected the combined capacity of both mills will be in-

creased to 3,000 tons daily. In addition to a full quota of mine buildings, the company owns 295 dwellings, provided for the accommodation of its employees, which are well and comfortably constructed and rented at a very reasonable rate. The company's coal dock is at Dollar Bay, where, with the Osceola company, it erected a mammoth steel coal shed a few years ago. The capacity of the shed proper is 50,000 tons, with additional outside storage of 50,000 tons more. It is equipped with modern hoisting apparatus which reduces the cost of handling to a minimum.

No. 3 shaft has 12 levels now opened up, with comparatively little ground exhausted in any of them, and at the present rate of opening this reserve can be maintained for many years to come. No. 2 shaft shows eight levels well preserved, so that in point of available supply of stoping ground the mine is in a better position today than at any previous time in its history.

Following is a summary of operations for the year 1898:

Tons of rock hoisted.....	812,983
Tons of rock stamped.....	670,832
Mineral obtained, pounds.....	31,127,623
Cost per ton mined.....	\$1.66
Cost per ton stamped.....	2.01
Cost stamping per ton.....	22 $\frac{402}{1000}$ cents

ASSETS AND LIABILITIES DECEMBER 31, 1898.

Cash in banks, copper on hand.....	\$ 334,911
Accounts receivable and Calumet & Hecla Railroad bonds.....	172,290
250 shares Hancock & Calumet Railroad stock....	25,000
Cash and accounts at mine.....	125,410
Supplies on hand.....	205,162
Wood and timber lands.....	297,989
Lake Superior Smelting Co. stock .....	132,000
	<u>\$1,292,762</u>
Accounts payable at mine.....	\$ 185,735
Accounts payable at Boston.....	213,311
	<u>\$ 399,046</u>
Received for copper (1898).....	\$2,381,388
Total costs.....	1,862,507
Mining profit.....	518,881
Dividends.....	480,000
Surplus.....	38,881
Balance of assets.....	893,717

The Tamarack Mining Company was organized January 13, 1882. The capitalization is \$1,500,000, of which \$780,000 has been called in.

The number of shares is 60,000 of a par value of \$25 each. The total dividends paid to date—as already stated—amount to \$5,670,000. The officers of the company, with headquarters at Boston, are Albert S. Bigelow, president, and W. J. Ladd, secretary and treasurer. The mine officers are, William E. Parnall, superintendent; R. M. Edwards, mining engineer; John T. Reeder, clerk; Thomas Maslin, mining captain; Charles H. Krause, mill superintendent.

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### **Quincy Mining Company.**

The Quincy stands today at the head of the producing amygdaloid mines of Houghton county, a position it has maintained for many years, and with the many improvements under way at present, having a view to increased production, it is doubtful if it will ever lose its acquired position among the mines developed on amygdaloid lodes. Territorial expansion and increased resources has been the motto of the owners of this splendid property, and this in brief has been the main cause of the continued prosperity of the Quincy.

The company was organized in 1848 under a special charter granted by the legislature, with a capital stock of \$200,000, divided into 20,000 shares. It then possessed 627 acres of mineral land, while today it has 2,900 acres, insuring the mine a lease of life probably second to none on the copper range. The Quincy mine is located in town 55 north of range 34 west, which is directly north of the village of Hancock. The company enjoys the enviable distinction of never having called an assessment.

The history of the Quincy dates practically from 1856, when the Pewabic lode was discovered; since which year operations have been conducted on this vein. Four years later the mine began to be worked at a profit, and has been a dividend-earner ever since. The original charter expired in March, 1878, when a new company was formed, with 40,000 shares at a par value of \$25 a share. It was not, however, until the present local management took charge that the Quincy assumed the proud position it now holds among the copper mines of the Lake

Superior region. Its first acquisition of additional territory was made through the purchase by the company of the Pewabic mine, this bringing the Quincy territory up to the south boundary of the Franklin. The negotiation for this deal was opened March 30, 1891, and the property was bought for \$720,000. The next purchase was a large acreage of mineral land lying to the west of and adjoining the Quincy mine, which was bought from the Canal Company. The latest move in the direction of expansion was in 1897, when the Quincy Company bought the Mesnard and Pontiac properties, the price paid being \$38,560. The Pewabic lode traverses the Quincy property for a distance of about two and one-half miles. Its course is north 33 degrees and 32 minutes east. The peculiar changes that have ever characterized the working of the Pewabic lode have been many, and no matter how unfavorable it might have looked at times, it has always been found to recover its productiveness as the work has been pushed, so that after fifty years' of operation confidence in the lode has been thoroughly established, and though there is occasional anxiety there is never the slightest discouragement. The dip of the lode at surface is about 54 degrees.

At present three shafts are in commission, of which No. 4, the most southerly, has been sunk to the fifty-first level, having reached a depth of 4,230 feet. Situated 600 feet north of this shaft is No. 2, which has reached the fifty-third level and has a depth of 4,440 feet. No. 6 shaft, known as the "North Quincy," is located 1,900 feet north of No. 2, and has been sunk to the fiftieth level, a depth of 4,270 feet. The vertical depth of No. 2 shaft is 3,491 feet below the collar of the shaft, or 2,938 feet below the water level of Portage Lake. These shafts are 8x18 feet and contain two skip roads and a ladder way. Six 9-ton skips are in use. The hoisting machinery is of the latest and most improved pattern, capable of handling the heaviest loads in the most expeditious manner, while the rock houses are models of convenience. No. 6 shaft is equipped with a direct acting hoist with 40"x 84" cylinders, 21 foot drum of 13½ foot face. The capacity of the drum is 7,000 feet of 1½ inch rope. The machinery at No. 2 shaft consists of a direct hoist, cylinders 48"x 84", diameter 26 feet. The winding surface of the drum is 13 feet 2 inches and the length over all 15 feet 6 inches. This splendid piece of machinery is capable of hoisting from a depth of 7,500 feet, or nearly a mile and a half.

An important move now under way in the direction of increased production is the sinking of the new No. 7 shaft, which was commenced in December, 1897, and is expected to become a producer about Jan. 1 of the coming year. This shaft, which will be of the same dimensions as the others, is located 876 feet south of No. 4. In extending this shaft a new departure was made. Instead of confining the

work to sinking from surface it is also being carried on by forces working in the south levels which have reached the line of the shaft. In this way the work is being greatly facilitated, and the record last year, of sinking 2,560 feet in this shaft, stands without parallel in the annals of copper mining. This shaft is to be sunk to a depth of about 4,000 feet. The total length of the shafts, winzes and levels in the Quincy aggregates more than forty miles.

The Quincy mine rock differs from the ashbeds, where the entire vein matter is sent to the stamp mill. Here much poor rock is stored away under ground. The ascending skips dump their contents of rock on the screens in the shaft houses, when the fine portion passes through into bins, whence it is sent to the mill, while the heavier portion of the productive rock is selected and crushed and then forwarded to the stamp mill. The Quincy stamp mill is located on the west shore of Torch Lake, and is connected with the mine by the Quincy and Torch Lake railway, a property owned and operated by the Quincy Mining company. The road is equipped with three Brooks mogul engines and a full complement of rolling stock for all purposes. At the stamp mill there are five Allis heads, all with 20" cylinders, capable of treating from 1,800 to 2,000 tons of rock every twenty-four hours, which is about the present output of the mine. The stamp mill is most pleasantly situated, and the broad expanse of water extending from its site will furnish sand room during the life of the mine, or for generations yet to come. Six hundred feet north of the present mill the company is now engaged in the construction of another mill which will contain three stamps—and others will be added in the near future. The new mill will, it is expected, go into commission with the opening of the coming year, when production from No. 7 shaft will begin. The development work now going on at the Quincy fully warrants the belief that when the new mill goes into commission the supply of rock will keep all three stamps in constant operation and the monthly product of the mine will be between 1,200 and 1,300 tons of mineral. The company realizes considerable from the sale of silver, a small part of which is saved in the stamp mill by boys employed for that purpose, and the rest by electrolytic treatment. The receipts from this source in 1897 amounted to \$18,024.95. The company owns 210 dwellings at the mine and 28 at the stamp mill. The surface equipment, such as blacksmith, machine and carpenter shops, is fully up to the modern standard in construction and appliances, and ample for all requirements, while the office, built of Portage Entry red stone, is probably not excelled for completeness of appointments and convenience of arrangement by that of any mining company in the world.

Last summer the Quincy company erected a smelting plant on the

water frontage at Portage Lake, on property acquired from the Pewabic. The smelters are admirably situated, being provided with both rail and lake facilities and every arrangement tending toward economy. The buildings are of Portage Entry red stone. In the main building are four furnaces, each capable of smelting twenty tons of copper per day. Two of these furnaces went into commission on December 1, 1898, and each is now treating about 18 tons of copper daily. Three of these furnaces are in condition for immediate service, while the fourth can be got in shape in a brief time when it becomes necessary. Additional furnaces will be erected when warranted by increased business. The building of this smelter was a move in the direction of economy, and it has resulted in a saving, after taking into consideration the capital invested and the large amount of wear and tear attending such a plant, of fully two dollars per ton, or about \$20,000 a year.

For the year 1898 the mine produced 20,056,942 pounds of mineral, which yielded 16,362,370 pounds of refined copper. The average number of men employed in 1898 was 1,222, during which period the average pay of miners was \$2.10 net per day. The total quantity of rock mined in 1898 was 573,443 tons, of which 555,476 tons were hoisted to surface, and 543,942 tons sent to the stamp mill for treatment. The yield of mineral per fathom of ground broken was 629 pounds and the yield of refined copper 513 pounds. The mineral gave 81.57 per cent ingot copper. The percentage of mineral in the rock stamped was 1.35. The number of tons of rock stamped per head in 24 hours actual running time was 376, and the cost per ton of rock stamped, including pumping, repairs and all other expenses, was 22.28 cents.

From the time of its organization to December 31, 1898, the total expenditures by the company amounted to \$24,723,220; total receipts were \$36,072,495, dividends paid, \$10,120,000. Negotiations are now pending for three heads of stamps, also for a sixteen million-gallon pumping engine. A new air compressor of the most modern type and of sixty-drill capacity was contracted for March 1st of this year, with the Rand Drill Company of New York.

During 1898, No. 2 shaft was sunk from thirty feet below the fifty-first level to the sole of the fifty-third level. No. 4 shaft was sunk from 86 feet below the forty-ninth level to the fifty-first level, and No. 6 from 28 feet below the forty-ninth level to 30 feet below the fifty-first level. The latter shaft, at bottom, is now about 65 feet east of the main lode. The total depths of shafts sunk was 553 feet. The aggregate drifting was 11,512 feet. The drifting at No. 2 shaft was at the fifty-second, fifty-first, fiftieth and forty-ninth levels, north and south. The vein shown in these openings is mostly of fair average size and good quality. The drifting done from No. 4 shaft was at

the fifty-first, fiftieth, forty-ninth, forty-eighth and forty-seventh levels south, and at the forty-first, south, on the hanging branch. The southern parts of these openings, especially those in the vicinity of No. 7 shaft, have improved very much of late, the vein being mostly of good size and promising character, exposing long stretches of stoping ground. The drifting done from No. 6 shaft was at the fifty-first, fiftieth and forty-ninth levels, north and south, and at the forty-eighth, forty-seventh, forty-sixth, forty-fifth and forty-fourth levels north.

The capital stock of the company is \$2,500,000, in 100,000 shares of \$25 each, fully paid and unassessable. Assets January 1, 1899, \$1,229,275.15. The officers of the company, with headquarters in New York, are: Thomas F. Mason, president; T. Henry Mason, vice-president; and William R. Todd, secretary and treasurer. The mine officials are Samuel B. Harris, superintendent; John L. Harris, mining engineer; E. D. Johnson, clerk; Thomas Whittle, mining captain; George Bedell, mill superintendent. James R. Cooper is superintendent of the company's smelters.

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### **Osceola Consolidated Mining Company.**

The organization of this company was perfected in 1873, when mining was commenced on a discovery of conglomerate which was regarded as different from the Calumet & Hecla vein.

The company began operations with an ample mining equipment, but after a few years' work the north ground, which proved to be a continuation of that of the Calumet & Hecla, was well nigh exhausted, while the ground south proved all but worthless. The company then realized that future success depended upon the development of other lodes on the property. Accordingly, explorations were begun and in 1877 the Osceola amygdaloid lode was located some 800 feet east of the Calumet conglomerate. The history of the Osceola mine really dates from this period, and after twenty-two years of successful operation it occupies a position today among the greatest copper producers in the district, a position that it will shortly strengthen, to maintain, in all likelihood, for a generation to come.

The Osceola lode is one of best amygdaloid formations traversing the copper range. It traverses the Osceola property for a distance of

6,200 feet, dipping at an angle of 40 degrees. The lode varies in width from 6 to 30 feet. It is broken, contorted and bunched. Bars of trap rock frequently occur; and, as in all amygdaloid lodes, barren ground intervenes between the productive stretches.

The company is operating four shafts on this lode, of which No. 3, the most northerly, has attained a depth of 3,000 feet. No. 3 is a two-compartment shaft, 6 x 6 feet inside timbers, and contains one skip way and a man-car hoist. It is equipped with a permanent hoisting plant capable of working to a depth of 3,800 feet. The shaft can be extended to a depth of 3,800 feet within the company's lines. South of No. 3 a distance of 600 feet is shaft No. 4, which has attained a depth of 3,600 feet. Many improvements have been made at No. 5 shaft of late which will result in a larger output from this source. It was cut down from surface, thus adding another skip way, and when the new machinery goes into service, which will be in a very short time, the small skips will be succeeded by new ones of six-ton capacity. This shaft has attained a depth of 3,600 feet, and is located 1,300 feet south of No. 4.

What is conceded to be one of the finest shafts ever sunk in the copper district is the new No. 6 shaft at this mine, which will add largely to the company's production. No. 6 is the most southerly shaft on the property, and is distant from No. 5 1,350 feet. No. 6 is 3,400 feet in depth, and, like No. 5, can be extended to a depth of 6,500 feet. In size it is 18.6 x 7 feet inside timbers, and it contains two skip ways and a pipe and ladder way. In point of equipment the shaft is excelled nowhere, and the fact that since the hoist was installed no less than four of the same pattern have been ordered by this company speaks volumes for its capabilities. It consists of a pair of engines of the horizontal type, 32" x 72", with a drum tapering from 12' 6" at the end to 18' 6" upon the straight portion. The possibilities of this shaft, with its levels fully opened up, may be judged of from the fact that it is being equipped with machinery to handle 3,000 tons of rock every 24 hours. It is not believed, however, that the resources of No. 6 will ever be pushed to that, or anything near that, limit. The general equipment of this shaft is in keeping with that already described. The shaft rock house is modernly equipped and is rendering excellent service, and the machinery is installed in a fine building of sandstone. A virgin territory south of No. 6, 1,750 feet in length, is tributary to this shaft and results thus far obtained indicate that it will furnish a uniform and satisfactory production. The new hoist being installed at No. 5 shaft is a duplicate of that above described.

The consolidation of the Osceola with the Kearsarge and Tamarack Junior properties was effected October 26, 1897. Under the plan of consolidation, the Osceola capital stock was increased from 50,000



to 100,000 shares, of the par value of \$25 each. Of this stock 25,000 shares went for the purchase of the Kearsarge, 16,000 for the Tamarack Junior, and 9,000 were allowed to remain in the treasury for subsequent disposal by the directors, the treasury to receive the final proceeds. The amalgamation of this group also included the Iroquois property, and gave a combined area of mineral lands of about 2,000 acres, of which the Osceola furnished 760, Tamarack Junior 120 and the Kearsarge 1,120. The Osceola is south and the Tamarack Junior north of the Calumet & Hecla, while the Kearsarge is north of the Wolverine.

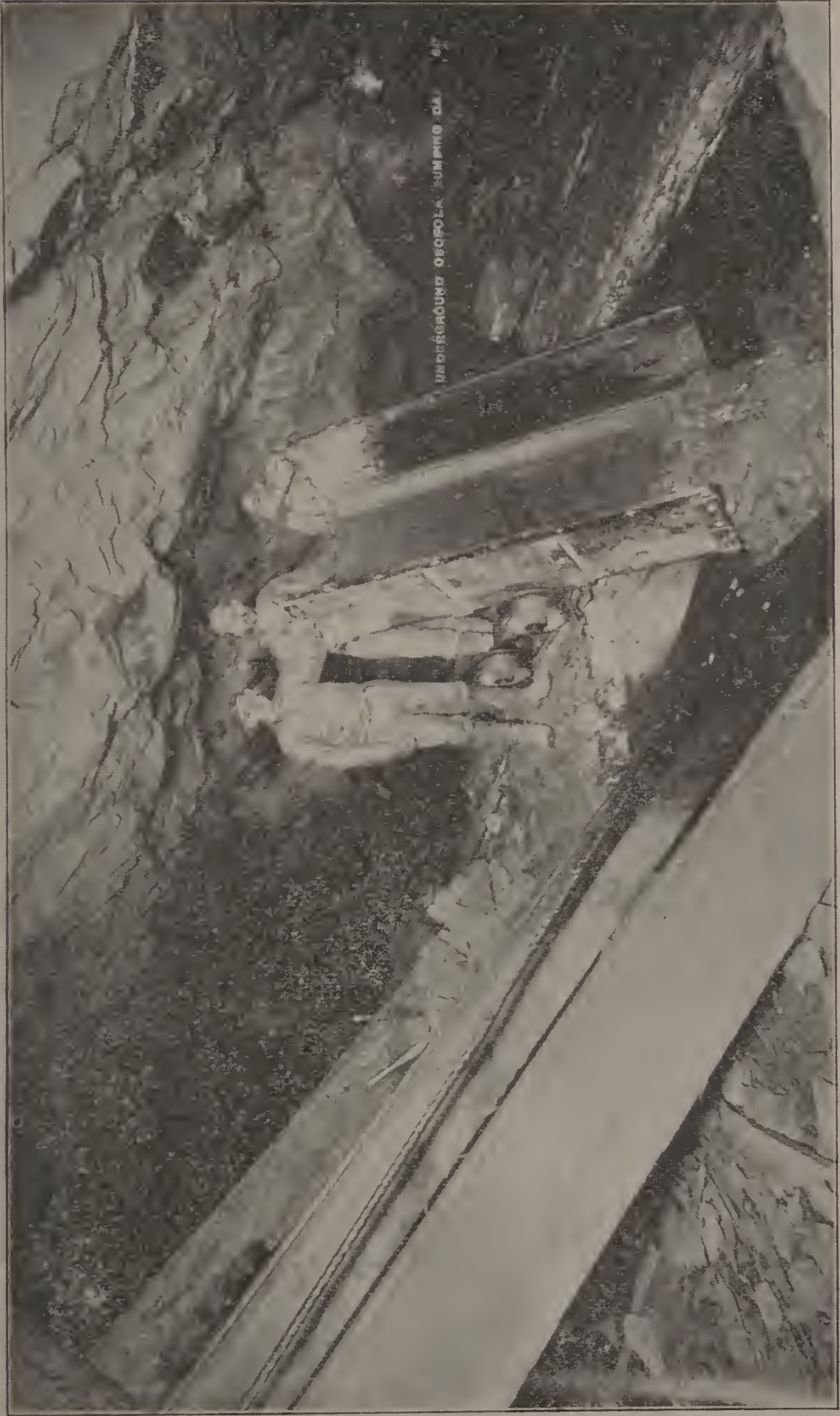
Operations at the Kearsarge are confined to the Kearsarge lode, the same as is being operated at the Wolverine. The proportion of copper in its mineral runs about 86 per cent. The underground workings of the Wolverine and Kearsarge are connected at several levels, this adding to the ventilation and safety of both. At present but one shaft, with a single skip way, is producing from this large territory. This shaft has attained a depth of 2,100 feet and can be extended to a maximum depth of 7,000 feet. The sinking of a three-compartment shaft on the Kearsarge property is under way. This shaft will have tributary to it a large territory and should go into commission about two years hence. Its present depth is 350 feet. The Kearsarge lode traverses the property for a distance of 6,200 feet. The mine is fully equipped for present needs and when thoroughly developed will add materially to the company's production of copper. The dip of the lode is 42 degrees.

The three forties comprising the Tamarack Junior branch of this mine are operated on the Calumet & Hecla conglomerate belt. Nos. 1 and 2 shafts are in operation, the former at a depth of 2,600 feet and the latter 3,200 feet. These shafts can be extended to far greater depths and promise a good and satisfactory yield covering an extended future. The lode traverses the property for a distance of 2,400 feet and dips at an angle of  $37\frac{1}{2}$  degrees. A drawback to this company for some time has been a lack of milling facilities, and to overcome it a splendid three-head stamp mill was recently erected and the machinery is now being installed. The building is 215 x 138 feet, of structural steel lined inside with wood and outside with corrugated iron. The foundations of red sandstone are built upon solid rock, thus insuring the most perfect stability. Under the direction of the mine and mill superintendents, much experimenting has been conducted of late, with a view to obtaining greater mill results. As a consequence some changes are being made in the new machinery being installed. The stamps will be circular in form and will have upright screens of 9-16 inch perforation, instead of 3-16 inch, as are generally in use. The increased perforation allows the copper to be released before it is too

small, and after it leaves the stamp it is received by a discharge which retains the heavier copper and rock. Later the copper is caught in a revolving screen having  $\frac{1}{4}$  inch holes and only the copper passing through these holes finds its way to the jigs. It is estimated that not more than 30 per cent of the former amount of slime will go from these stamps. The jigs are of an improved pattern and were built by the Portage Lake Foundry and Machinery Company. The new mill will likely go into commission during June of the current year, and is expected to be able to treat 1,500 tons of rock every twenty-four hours. The improvements at the new mill are also being duplicated at the old one, which contains six stamps, and when these are finished and both mills are treating rock they will have a combined capacity of not less than 3,500 tons every twenty-four hours.

A new pumping plant for the Tamarack-Osceola mills is fast nearing completion. Water is secured from Torch Lake through an adit extended underneath and will be sent to the mills by a powerful pump, having a capacity of 40,000,000 gallons every twenty-four hours. The building in which this machinery is installed is of structural steel, 35 x 70 feet, covered with corrugated iron and erected on a stone foundation. In addition to the large number of mine buildings, the company owns 200 dwellings.

Last year No. 6 shaft at the Osceola branch was sunk 242 feet. Winzes amounted to 166 feet. There was 2,903 feet of drifting done on the lode north and south of Nos. 4 and 5 shafts, from the thirty-fourth to thirty-sixth levels, inclusive, and 4,520 feet were drifted north and south of No. 6 shaft, from the second to thirty-third level, inclusive; total drifting on the lode of 7,427 feet. At the Kearsarge there is nearly a mile of unexplored territory north of the new No. 3 shaft. The sinking of No. 3 will be accomplished as quickly as possible, when the value of this property will be proven. The openings by winzes and raises last year amounted to 231 feet; cross-cutting, 95 feet; and drifting on the lode on the twelfth, fourteenth, eighteenth, nineteenth, twentieth and twenty-first levels, 2,552 feet. Last year No. 2 shaft at the Tamarack Junior branch was sunk 82 feet. This shaft is now at the twelfth level and is connected with the lode by 184 feet of cross-cuts. Drifting on the lode on the first, seventh, eleventh and twelfth levels amounted to 862 feet. The total opening work in the three branches, exclusive of the 1,544 feet for pillars at the Osceola branch, is 13,083 feet. The company's report for the year ending December 31, 1898, gives the following information:



UNDERGROUND OSCEOLA MINING CO.

UNDERGROUND MINING SCENE, OSCEOLA MINE.

PHOTOGRAPHED BY A. F. ISLER,  
LAKE LINCOLN.



Gross receipts.....	\$ 1,549,820
Total costs.....	1,178,028
Net income.....	371,791
Dividends.....	277,250
Surplus.....	94,541
Balance of assets Dec. 31, 1898.....	655,333
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Rock mined, tons.....	637,608
Rock stamped, tons.....	505,008
Mineral obtained, pounds.....	15,848,928
Cost of stamping, per ton.....	28 $\frac{94}{100}$ cents

ASSETS AND LIABILITIES ARE:

Cash and copper on hand.....	\$ 415,112
Accounts receivable.....	82,802
Cash and accounts receivable at mine.....	34,009
Supplies at mine.....	120,055
Wood and timber lands.....	49,340
Hancock & Calumet Railroad stock.....	75,000
Lake Superior Smelting Co. stock.....	60,000
Total.....	\$ 836,319
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Accounts payable at mine.....	\$ 116,092
Accounts payable at Boston.....	64,893
Balance of assets.....	655,333

The increase of about three cents per ton in the cost of stamping was caused principally by the fact that for nearly six months the coal used at the mill was what was saved from the fire at the Dollar Bay coal shed and was much reduced in steaming quality.

The company was organized in 1873; its capital is \$2,500,000, all of which is called in. The number of shares is 100,000 and the par value \$25 each. Total dividends paid amount to \$2,536,500.

The general offices of the company are in Boston. Albert S. Bigelow is president, and William J. Ladd, secretary and treasurer. The mine officials are: William E. Parnall, superintendent; William Veal, clerk; R. M. Edwards, mining engineer; W. C. Watson, assistant superintendent; J. P. Richards, J. D. Hosking and William Daniells, mining captains; Charles H. Krause, mill superintendent.

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**The Wolverine.**

The Wolverine is the latest property to take a place among the dividend paying copper mines of the Lake district, and is today a splendid money earner on the capital invested in it. Its estate comprises 320 acres of land, of which, however, the company owns the min-

eral right of 280 acres and only the surface right of the other 40. The property joins the Centennial on the east and the Kearsarge branch of the Osceola Consolidated tract on the south.

Work was commenced on this property in September, 1881. In 1890 the mine passed into the hands of its present owners, since which time its development has been rapid and the results achieved fully up to their most sanguine expectations. The source of production is confined wholly to the Kearsarge amygdaloid lode, which traverses the property for a distance of 3,000 feet. Other belts crossing the Wolverine are the Osceola amygdaloid and Kearsarge conglomerate. The Kearsarge amygdaloid is bunchy in character, containing long stretches of poor ground. On the other hand, it is very rich in copper in places, and on the whole the formation is uniform in strength and width. Its average width is fifteen feet, and the dip is 41 degrees. The mine is always kept opened well in advance, a condition necessary for the economic working of an amygdaloid lode, as it provides the opportunity to choose proper stoping ground. When the present company began operating some nine years ago, Nos. 1 and 2 shafts had attained depths of 400 and 500 feet respectively. No available ground was open, and after placing the equipment in working condition sinking and drifting was resumed at No. 2 shaft. No. 1 shaft, however, was started at a point too close to the north boundary of the property and for this reason has not been worked for years. No. 2 shaft is down to the fourteenth level, a depth of 1,300 feet, and is equipped with a hoist that will meet all future requirements.

South of No. 2, a distance of 600 feet, is shaft No. 3, which is now being sunk to the fifteenth level, a depth of 1,400 feet. Nos. 3 and 4 shafts are 8 x 17 feet within timbers. Each contains two skip ways and a ladder and pipe way. No. 3 shaft is supplied with a duplex hoist, which has fulfilled all requirements to date, but which will be replaced in June next by a 24" x 60" duplex direct hoist with 16-foot drum, which will wind 4,000 feet of rope. The new hoist will be capable of working to a depth greater than 4,000 feet. No. 4 shaft is located 1,385 feet south of No. 3. It was started in November, 1895, and its present depth—below the tenth level—is 1,050 feet. No. 4 shaft is fully equipped for all future requirements, its machinery consisting of a 24" x 48" duplex hoist with a 12-foot drum. Nos. 2 and 3 shafts are connected at the fourteenth level. Nos. 3 and 4 shafts are connected at every level to the tenth, inclusive, excepting the third. All the shafts on the property can be sunk to much greater depths, and by the purchase in July, 1898, of 80 acres of land into which the Kearsarge lode dips, the company added a long lease of life to its available mineral ground. The new Rand compressor doing service is a compound air and compound steam machine, capable of supplying power to 30 drills.

In addition to this, the company has a duplex compressor, 16½" x 30", which is held in reserve as an auxiliary. A new engine house and boiler house will be erected at No. 3 shaft within the next few months. The stamp mill contains one stamp of the Ball pattern, capable of treating 300 tons of rock every 24 hours. In addition to this the company has a lease of one head of about similar capacity at the Allouez mill. It is more than probable that the erection of a new and modern stamp mill will receive the attention of this company in the not distant future. The present mineral production, monthly, of about 218 tons, is easily maintained and could probably be considerably increased were more stamping facilities provided.

The mineral yields 87 per cent refined copper, and in this respect the mine is not excelled by any in the district. The mine employs 305 men. During the year ending June 30, 1898, 167,568 tons of rock were hoisted, of which 130,089 tons were sent to the mill for treatment and the balance discarded. The production of mineral for this period was 3,949,045 pounds, which yielded 3,470,927 pounds of refined copper. Two stamps were in commission, the second one, however, running but six months. This shows the percentage of stamp rock in rock hoisted to be 77.633; percentage of mineral in rock hoisted, 1.178; percentage of mineral in rock stamped, 1.517; and percentage of refined copper in rock stamped, 1.334.

The Wolverine has developed a remarkable wealth of copper ground, and the increase in its value during the past year has been entirely consistent, both from the point of production and ability to earn returns on the investment.

The Wolverine Copper Mining Company was organized August 2, 1890, with a capital of \$1,500,000, divided into 60,000 shares of a par value of \$25 each. Of the capital, \$480,000 has been paid in. The company paid its first dividend, amounting to \$60,000, last year, while its last report shows assets amounting to \$218,784.73. The eastern office of the company is in New York. John Stanton is president; J. R. Stanton, secretary and treasurer. The mine officers are, Fred Smith, agent; Charles L. Noetzel, clerk; John Nichols, mining captain; Barnett Shearer, superintendent of machinery.

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### **The Franklin.**

Forty-two years ago the Franklin Mining company began operations on the 160 acres of mineral land comprising the southwest quarter of section 24, town 55, range 34. The old Franklin mine is fast

reaching the end of its career and interest in the company's mining operations, present and future, is rather confined to the Franklin Junior. The old Franklin was worked continuously by the company since 1857, excepting the period from 1870 to 1874, when it was in the hands of tributors.

The property is traversed for its entire length by the Pewabic lode, which has a dip of  $52\frac{1}{2}$  degrees, an average width of eleven feet, and a surface length of 3,750 feet. The lode territory was exhausted some time ago, with the exception of a portion at the north end of the property, which, at the present rate of ground broken, should offer a field for operations for three years to come. The north end of the Franklin will probably show a higher percentage of copper than the mine has yielded for years past, as the ground opened there shows more than average richness. During the past seven years production has been secured from two shafts—Nos. 3 and 5. No. 3 is down to the 32nd level, a depth of 2,800 feet, and No. 5 to the 38th level, a depth of 3,200 feet. The machinery at these shafts is of an old pattern, but meets all requirements and is capable of rendering service during the life of the mine. At present there is no production, owing to the destruction of the company's stamp mill by fire November 26, 1898. Work will be resumed in June, when the new mill is expected to start up. With the mineral entirely exhausted, the old Franklin property will still have considerable value, owing to its location. It may be useful to owners of adjoining properties. To date, the Franklin mine has produced 96,076,155 pounds of refined copper.

By the purchase in 1894 of what is now known as the Franklin Junior property, the company secured a new and greatly extended lease of life. The property comprises 1,360 acres situated in sections 7, 8 and 9, town 55, range 33, and stretches across the mineral range for a distance of two and one-half miles. It was once known as the Albany & Boston and later as the Peninsula. Mining operations are at present confined to the Pewabic lode, which is the most westerly on the property. In order, 475 feet east of this lode, is the Allouez conglomerate, and east of the latter, 1,420 feet, the Calumet conglomerate. The Osceola amygdaloid is 605 feet east of the Calumet conglomerate, and 2,000 feet east of the Osceola is the Kearsarge amygdaloid bed. Work on the Pewabic lode can be conducted to depths ranging from 3,000 to 9,000 feet, according to the location of shafts, while on all other lodes much greater depths can be attained without going off the property. The dip of the lode is  $48\frac{1}{2}$  degrees. Extensive explorations had been conducted up to a year ago on the Osceola, Kearsarge, Calumet and Pewabic lodes. It having been demonstrated that the Pewabic lode can be profitably worked, the company was reorganized in April, 1898, since which time the development of this copper belt has been pushed



with all possible dispatch, and it is now opened by four shafts. Of these the "North" shaft was commenced during October, 1898. It is located 900 feet south of the company's north boundary line and has a depth of 150 feet. "North" shaft will be opened from the bottom as well as from the top, and will probably be completed to the eighth level during the summer of 1899.

This shaft has been found to be well charged, from surface to its present depth, with good stamp rock and heavy barrel work, pieces of the latter being broken out every day. A "rise" coming up from the sixth level is also showing a very good copper-bearing lode and every indication points to the shaft becoming a profitable one. "North" shaft is 22 x 8 feet, and contains two skip tracks. The dimensions of shafts Nos. 2 and 3 are similar, while those of No. 1 shaft, which has a single skip road, are 8 x 12 feet. Nine hundred feet south of "North" shaft is shaft No. 1, now 1,200 feet in depth, or to the twelfth level, where drifting north and south is under way. In this shaft the extent of opening is as follows: First level, 200 feet; fourth level, 800 feet; fifth level, 1,800 feet; sixth level, 900 feet; seventh level, 1,500 feet; eighth level, 1,000 feet; ninth level, 1,100 feet; tenth level, 800 feet; eleventh level, 400 feet; twelfth level, 100 feet. No. 1 will be connected with "North" shaft the coming summer at the fourth, fifth, sixth, seventh, and eighth levels. The lode at No. 1 shaft was found quite narrow at surface but increased gradually with new depths, and in many places it has widened out to ten feet. The product from this source thus far is stamp and barrel work. The openings are favorable and in some places quite rich. Shaft No. 2, located at a distance of 1,000 feet south of No. 1, is extended below the eighth level and has a present depth of about 850 feet. It is connected with No. 1 at the fifth level. These shafts will be connected at the seventh level within a few months and at the eighth before the expiration of the current year. No. 2 has not thus far shown equal copper to No. 1 but the indications are very good and improvement is looked for at lower depths. No. 3 shaft, which is located 1,000 feet south of No. 2, was commenced less than a year ago and has a depth of 250 feet. A good lode is exposed. Nothing is being done at No. 3 shaft at present, as ample ground is being opened at the north end of the mine, and this shaft can be sunk ahead of its requirements any time when wanted. "North" shaft has a temporary equipment. No. 1 has a single hoist capable of working for many years; also a twenty-drill compressor, and a rock shaft house fully equipped and capable of handling 500 tons of rock per day. The boiler house contains five horizontal locomotive boilers capable of furnishing steam power to all parts of the mine except No. 2 shaft. At No. 2 shaft there is under construction a large rock house capable of handling 1,000 tons of rock per day. In addition to this, the boiler house, compressor house and

engine house have been completed and machinery is being installed as follows: A battery of Stirling water-tube boilers of 500 horse power, with a steam pressure of 150 pounds to the inch; an Ingersoll-Sergeant compound air and compound steam compressor of the most modern pattern, which will furnish air for thirty machines; one double direct acting Corliss hoisting engine built by the M. C. Bullock Manufacturing Company, with cylinders 24"x48" and a 12-foot drum, intended to work No. 2 shaft to a depth of 3,000 feet.

The company's new stamp mill is located at Grosse Point on Portage Lake, nine miles from the Franklin Junior, and will be connected with the mine June 1, 1899, by railroad facilities furnished by the Mineral Range railroad. The mill site comprises over 200 acres and has a mile of lake frontage; it is beautifully adapted for building purposes, and offers ample sand room for all time. The mill building is completed and the machinery is being installed. It is a steel structure and will contain four Allis heads, capable of treating 1,500 tons of rock every 24 hours. It is expected that one head will go into commission June 1, and the mill will be working to its full capacity some time during the current year. Sufficient dwellings have been erected by the company to accommodate all of its employees.

The Franklin Mining company was organized April 3, 1857. Its capital is \$2,000,000, divided into 80,000 shares of a par value of \$25 each. It has paid in dividends \$1,240,000. Up to April 20, 1898, when the capitalization was increased from \$1,000,000 to its present figure, the amount called in was \$320,000. The main office is in Boston. Thomas H. Perkins is president and D. L. Demmon secretary and treasurer. The mine officials are: Joshua Hosking, superintendent; Arno Jaeh-nig, clerk; Thomas Dennis, mining captain at the Franklin; Nicholas Clymo, mining captain at Franklin Junior; Edward Warne, mill superintendent.

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### **Atlantic Mining Company.**

For a period of twenty-five years the Atlantic has held the distinction of being the only active mining property on the south side of Portage Lake. The company was organized in 1872, when the South Pewabic and Adams mining properties were consolidated and work on an

enlarged scale was at once instituted. The failure of the South Pewabic and Adams to prove profitable prior to that date was largely due to the fact that not enough rock was mined to yield proper returns, as in the case of this lode it is imperatively essential to success that mining and treatment of the rock shall be conducted on a large scale, and with close attention to economy.

The mineral lands embrace 1,280 acres, comprising the southwest quarter, the west half of the southeast quarter, and the northeast quarter of the southeast quarter of section 4; the north half of section 9; and the northwest quarter of the northwest quarter of section 10, in Adams township; and section 16 in Portage township, Houghton county. In January, 1898, the company purchased sections 2, 3, 4 and 5, in town 53, range 35, on which it is hoped will be found a continuation of the Baltic amygdaloid lode. The belt operated is known as the South Pewabic lode, which traverses the property for a distance of about 6,000 feet. The strike of the belt is north, 50 degrees east; its dip is 54 degrees and the average width about 15 feet. In character it is an amygdaloid, locally termed an "ashbed". The vein matter is chocolate brown in color, and through it the copper is quite uniformly disseminated. Every particle of the rock is sent to the stamp mill, as to select the mill rock would be impossible, owing to its low yield of mineral. The mining of this belt is comparatively simple and but little timbering is required. It is one of the most westerly on the copper range and is the nearest amygdaloid to the Quincy belt now being worked. The foot and hanging walls are trap rock. The shafts in commission are "A," "B," "D," "E" and "F". "A" shaft is a new one, started in the fall of 1897, to develop forty acres of land purchased a short time before, and is the most northerly at the mine. In size it is 9 x 20 feet and has three compartments. "A" shaft is now being sunk to the fourth level and drifts are being extended from the first, second and third levels. The belt opens up very well in this shaft and gives every indication of yielding fully as well, at least, as in the older shafts at the mine. A new hoist was recently installed at this shaft. It was purchased from Fraser & Chalmers, of Chicago, and is a model piece of machinery. It consists of a pair of 26"x48" Corliss engines driving a drum 10 feet in diameter at the small ends and 15 feet 6 inches in the center. It has capacity to lift a total load of nine tons from a depth of 2,000 feet with an incline of 55 degrees. The engines are arranged to be compounded later by adding two high-pressure cylinders, one on the rear of each cylinder now in place. When a greater depth is reached in the shaft these high-pressure cylinders will be added, thereby making the hoist more economical in the use of steam. This engine is operated by steam throughout, reversing links, brakes and throttle valves. The indicators are of the dial type, being ar-

ranged with compensation device to give the indicator hand a variable speed, and keep it at a relative speed with the rope, a condition made necessary on account of the conical drum.

At a distance 1,400 feet south of this shaft is shaft "B," which is 7x14 feet. It contains a double skip road and has been sunk to the twentieth level, a depth of 1,750 feet. In the way of machinery this shaft has a double-drum geared hoist, with a pair of 14"x20" engines capable of working to a depth of 150 feet below the point from which hoisting is now being done. This machinery will be replaced the current year by a hoist ordered in February from Fraser & Chalmers, of Chicago. The new hoist will consist of a pair of 24"x60" Corliss engines, driving a double-cone drum 12 feet in diameter at the ends and 25 2-5 feet at the center. The design is almost identical with that of the hoist at "A" shaft. It is expected that this hoist will lift, with ease, a total of 11 tons from a depth of 4,000 feet.

Located 1,465 feet south is "D" shaft, 9 x 18 feet, which contains three compartments, and has been sunk to the thirtieth level, a depth of 2,600 feet. It is equipped with a pair of 22"x60" engines, with a double conical drum 12 feet in diameter at the small end and 21 feet at the large end. This machinery is capable of working to a depth of 3,000 feet. Located 478 feet south is "F" shaft, which is 9 x 12 feet in size and contains a single skip way. It is sunk to the twenty-sixth level, at which point the depth is 2,350 feet. In equipment "F" shaft has a geared hoist with single cylinder 24"x48" and cylindrical drum 12 feet in diameter. The engine is capable of rendering service at this shaft for the next two years. No rock is hoisted from "E" shaft, which is used for the pumps and air pipe line and as a man-way.

The aggregate of drifts in the mine is about twenty miles. When exploratory work was conducted in 1897, at what is now the Baltic mine, its possibilities attracted the attention of the Atlantic company, which owns section 16 adjoining, lying to the north, and in July of that year exploratory work was begun on that section with a view to locating the Baltic lode. A shaft was sunk to a depth of 60 feet and a cross-cut was extended easterly to locate the Baltic lode. This drift was driven to the Baltic boundary line by the Atlantic company. From that point it was continued into the Baltic property by the Baltic company. At present this drift is in trap rock, and nothing has been found that could be recognized as the Baltic lode; neither was there any conglomerate encountered that would indicate the position of the drift with respect to the formation. The strike of the belts as found in this drift is much nearer north and south than that of the Baltic lode, which would rather indicate that the Baltic had been intersected in the drift, but the line of the conglomerate found in section 15 is still some distance beyond the end of the drift and this conglomerate has

been recognized as the belt which underlies the Baltic vein and has been found on the Baltic property. Should this conglomerate be found within a reasonable distance from the end of the drift, it would indicate that the Baltic lode has been intersected. The Baltic lode being the most easterly amygdaloid ever found to be productive, and the Atlantic being the most westerly, it is fair to assume that any belts lying between these formations would traverse section 16, or the Atlantic property on section 9.

Exploratory work continues as usual at section 16. Several years ago a belt was discovered on section 9, east of the Atlantic, which is believed to be the Kearsarge amygdaloid, and this is likely to receive attention in the near future.

The stamp mill is located on the shore of Lake Superior, nine miles distant from the mine, with which it is connected by a standard gauge road owned and operated by the Atlantic company. The railroad has a full equipment of rolling-stock, including four Baldwin and one Brooks locomotives.

The stamp mill went into commission in 1895. It is a frame building, containing six heads of Ball stamps with 18" cylinders, on solid foundations, and capable of treating 1,800 tons of rock every 24 hours. The water used in the mill is delivered to it by gravity from a dam 52 feet high erected in Salmon Trout river. The mill site is extensive, containing three miles of lake frontage, and additional stamps can be erected when necessary.

The company's coal docks and warehouses are located at Portage Lake, three and one-eight miles distant from the mine. These docks are also connected with the mine by rail facilities owned by the company.

In addition to the shaft and other buildings above referred to, the Atlantic Company owns 220 dwellings, a store, postoffice building, mine office, two compressor houses, change house, barn, three warehouses, carpenter, blacksmith and machine shops, a saw mill, round house, fire engine and hose house and a well equipped fire hall. The company employs 500 men. The production of refined copper up to January 1, 1899, was 82,672,146 pounds. In 1898 the mine produced 5,962,159 pounds of mineral, which yielded 4,377,399 pounds of refined copper. The total rock hoisted during this year was 373,655 tons, of which 370,767 tons was stamped. The amount of mineral per fathom of ground mined was 290 pounds, which yielded 214 pounds of refined copper. The percentage of mineral in the rock stamped was seventy-eight hundredths of one per cent, which yielded fifty-nine hundredths of one per cent of refined copper, which equals 11 4-5 pounds of refined copper per ton of rock. The transportation of rock to the mill, with the shipping of the mineral to the smelters, cost five and one-half

cents per ton. The cost of separating and stamping the rock was 24 cents per ton.

The capital of the company is \$1,000,000, divided into 40,000 shares of a par value of \$25 each. Of the capital, \$980,000 has been paid in. Since the organization of the company, July 18, 1872, it has distributed to its shareholders \$780,000 in dividends. In 1898 the dividends amounted to \$40,000. The balance of assets, as per last report, was \$105,098.87. The general offices of the company are in New York, and the officials are Joseph E. Gay, president, and John Stanton, secretary and treasurer. The mine officials are Frank McM. Stanton, agent; A. D. Edwards, clerk; William S. Trethewey, mining captain; and F. G. Coggin, mill superintendent.

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### **Isle Royale Consolidated.**

The mineral lands of the Isle Royale mark the site of the inauguration of copper mining operations along the shores of Portage Lake nearly a half century ago. The company's lands comprise 1,640 acres, and include the old Grand Portage, Isle Royale and Huron properties, located south of Houghton, each of which was wrought to a considerable extent under primitive methods, producing considerable copper. Measured by mining methods of today, the properties were never equipped or developed, and production was necessarily on a limited scale that eventually brought about a cessation of operations at each.

Work was commenced on the Isle Royale in August, 1852. The company had been incorporated to work at Isle Royale island, where it was engaged for several years previous. Upon its new location the existence of a copper-bearing lode was discovered, and this has since been known as the Isle Royale lode. The location of the lode was determined by the number of Indian diggings which extended along its outcrop. These when explored disclosed a good show of copper. Operations were discontinued in 1870, by which year the mine had produced 9,204,071 pounds of copper.

Operations at the Grand Portage commenced in 1853, on what was

known as the Portage vein, but which is believed to be the Isle Royale lode, the latter being supposed to have faulted at this property. Work was discontinued with the depletion of the original treasury fund, and in 1860 the company was reorganized and work resumed. Its active career was brief, however, and a short time later the mine was turned over to tributors.

In 1879 the property was purchased by Hancock capitalists. Mining operations were resumed, and were continued for several years, during which the stamp mill product was about 45 tons of copper monthly, and this under the old methods of mining and with antiquated mining machinery, while the rock was hauled to the stamp mill by teams.

The history of the old Huron property is quite similar to that of those described above, although the operations there were much more extensive. Work was commenced on this property in 1855, and continued intermittently, and with indifferent success, until within a recent period. The company possessed an old-fashioned inland stamp mill of limited capacity, though large enough for the mine's demands, but for economic reasons the mine suffered the fate of many similar ventures started on a small scale in this district.

With the improved copper situation that set in a few years ago, the value of these properties attracted the attention of Nathan F. Leopold, of Chicago, who, after much trouble, succeeded in securing control of all three, and organized the present company to fully develop them. The property passed into the hands of the new owners a trifle over two years ago, but it was not until July, 1897, that work was commenced. The old mines were found to be shorn of almost everything of value, while the shafts had caved in and filled with refuse of long years' accumulation, so that reopening them was anything but a pleasant or easy task. It was not until October 29, 1897, that miners began work by cutting down from surface and enlarging the old No. 8 shaft at the Grand Portage; this shaft was opened through the old workings to the fourth level, and since then it has been enlarged and extended to its present depth of about 1,000 feet. Sinking to the twelfth level is under way. This shaft is known as No. 1; in size it is 6 x 30 feet, with two skip ways, man car way and pipe and ladder way. Many notable improvements in the way of permanent equipment are in progress at this shaft.

An engine house, built of steel and stone, has been completed and in it has been installed a 25-drill, two-stage, cross-compound compressor. In this building there will also be installed a new cone and straight-faced hoist, designed for a working depth of 6,000 feet. This hoist is to be a duplicate of that at No. 6 shaft at the Osceola, and its delivery at the mine is expected about July 1st of the current year,

In addition to the above, a new boiler house, which will be of stone and steel, also four new 84-inch fire-box boilers, are under contract for early service.

Located 2,280 feet south is shaft No. 2, formerly No. 8 shaft of the old Isle Royale workings. Its dimensions are similar to those of No. 1. It was sunk by the old company to the eighth level, and under the present management mining work was commenced there in January, 1898. This shaft has about the same depth as No. 1 and is at present being extended to the twelfth level, which both shafts had about reached when this description was written.

Extension of the shafts to this level will give practically six levels at each shaft in which drifts will be started into new ground. This will make a total of twenty-four drifts. No. 2 shaft is well equipped for the present needs, though it is more than likely the hoist in use there will soon be superseded by a permanent one similar to that ordered for No. 1 shaft.

The length of the lode on the property is about 9,500 feet and the dip  $56\frac{1}{2}$  degrees. The formation varies in width from seven to thirty feet. The showing in the two shafts under way is very good and gives encouraging promise for the future of the mine. The lode is an amygdaloidal belt of brownish color, with epidote, quartz spar and prehnite well represented in its composition.

The company owns a mill site comprising 80 acres, located west of the mouth of Pilgrim river, on the shore of Portage Lake, about three and one-half miles distant from the mine. Work on the construction of a new stamp mill is looked forward to at an early date, as is also the sinking of additional shafts at the mine. Convenient to No. 2 shaft are located the company's blacksmith, machine and carpenter shops, warehouse, compressor house, offices, and a dry house that ranks among the finest and best-kept of any on the copper range. It owns 36 dwellings, all occupied by employees.

No work of any kind has as yet been done by the company on the old Huron property.

The company was organized February 20, 1897, with a capital of \$2,500,000, divided into 100,000 shares of a par value of \$25 each. Of this amount \$2,000,000 has been paid in. The company had a balance on hand January 1, 1899, of \$845,045. The main office is in Boston. Albert S. Bigelow is president; William J. Ladd, secretary and treasurer. The mine officials are: William E. Parnall, superintendent; H. D. Haddock, clerk; Edward Warmington, mining captain; James E. Richards, master mechanic.



### **Arcadian Copper Company.**

It is not too much to say that no other new mine opened in this district within the past two years has attracted so much attention as the Arcadian. One of the many features creating interest in this property is the fact that the organization of the Arcadian Copper Company marked the advent of Standard Oil Company capital in the field of copper mining. An equally important feature, and one that is more appreciated locally, is the energy and push displayed in getting the mine in condition for regular production. The amount of work done in the space of eight months following the date of the company's organization is without a parallel in the history of copper mining, and the Arcadian, which was an isolated and deserted property a year and a half ago, will be a thoroughly equipped mine and take its place among the list of producers upon a liberal scale before the summer of 1899 has passed by. The attention of Nathan F. Leopold, of Chicago, was attracted to the company's mineral lands many years ago, and in the fall of 1897 he started a force of men at work sinking and drifting in what were then known as the old Concord and Arcadian shafts. In May, 1898, No. 3 shaft was started, and with the opening of the spring of that year the lands were cleared of underbrush and many improvements of a general character inaugurated.

The mineral lands of the Arcadian Company comprise 2,880 acres, and include the old Arcadian, Douglass, Concord, Edwards and other adjoining properties, situate northeast of the Quincy mine in Franklin township. The most westerly lode on the property is the Calumet & Hecla conglomerate, and east of this belt, in the order named, are the Osceola amygdaloid, North Star conglomerate, Kearsarge conglomerate, Kearsarge amygdaloid, Grand Portage amygdaloid, and the Isle Royale amygdaloid, which latter is believed to be the belt upon which mining operations are now conducted. The Isle Royale lode traverses the property across its entire length, a distance of 13,000 feet, and bears the general characteristics of the master amygdaloid belts of the copper range. Its average width is about thirteen feet, and the dip  $56\frac{1}{2}$  degrees.

The shafts have three compartments, containing two skip ways and a pipe and ladder way. Provision is made for the use of skips of six tons capacity. The mine is operating 41 drills. No. 1 is the most southerly shaft on the property. Since June last it has been sunk from a depth of 75 feet to a distance of 235 feet. For this shaft there has been ordered a new hoist capable of working to a depth of 1,200 feet. There has also been ordered the necessary boilers and adjuncts to replace the

present temporary equipment. This shaft can be extended to a depth of 8,200 feet on the company's property. Located at a distance 1,620 feet north is Shaft No. 2, which had a depth of 370 feet when the company commenced operations and has a present depth of 620 feet. This shaft can be extended to a maximum depth of 10,200 feet within the lines of the property. A temporary hoist is doing service at this shaft, which will be replaced within a couple of months by a new 32" x 72" double hoist, capable of working to a depth of 6,000 feet. For this machinery a battery of boilers of 900 horse power has also been ordered. Two compound, two-stage compressors will also be located here, replacing the single stage compressor at No. 3. The latter shaft is located 1,730 feet north of No. 2 and has a depth of 430 feet. It was sunk from surface by the present company and has continually shown well in stamp and heavy copper, as does also No. 2 shaft. Installed at this shaft at present is a hoist capable of working to a depth of 800 feet, and two crown tube boilers, each of 125 horse power. The equipment at this shaft also includes a compressor of forty-drill capacity. A large shaft house, which will form part of the rock shaft house, will be completed this spring. There is also located here a water reservoir with a capacity of 110,000 gallons, which is held in reserve for fire purposes. A stone building conveniently located contains a fire pump arranged to start automatically the instant the fire plugs are opened. This delivers water through a six-inch main to the various shafts and mine buildings. Fire hose connected with the regular water mains are provided in all the mine buildings.

The hoisting machinery at No. 3 shaft will at an early day be replaced by a hoist similar to that at No. 4 shaft, which is located north from this point, at a distance of 1,150 feet. No. 4 shaft has been sunk by the company from a depth of 135 feet to a depth of 550 feet. The maximum depth to which it can be extended on the property is 10,500 feet. A new hoist of the most modern pattern has been ordered for this shaft and will be installed in the near future. It will be a double hoist with cylinders 32" x 72", capable of working to a depth of 6,000 feet. There will also be a triple expansion, three-stage air compressor, with a capacity of from 65 to 70 drills. Both machines will be supplied with steam from a battery of 800 horse-power water tube boilers, operating at 200 pounds' pressure, furnished by the Stirling Company, of Chicago. The hoist and compressor will be condensing, and a large pond will furnish the necessary cooling water. No. 5 shaft, which is located a distance of 1,780 feet south of No. 4, is not at present being operated, but will be the coming summer. The depth of this shaft is 75 feet and the maximum distance to which it can be extended is 6,600 feet. The amount of drifting is as follows: No. 2 shaft, 2,245 feet; No. 3, 1,955 feet; No. 4, 3,130 feet. The total length of openings, old

and new, at the mine is 11,780 feet. New ground is being opened at the rate of 1,500 feet per month, and this is being constantly increased, so that when the mill goes into commission there will be sufficient ground prepared to enable the company to exercise economy in selecting its stoping ground, and at the same time treat fully 1,500 tons of rock every 24 hours.

To insure absolute immunity against danger from fire and consequent stoppage of work in the mine, and also to cut off a large cost for annual repairs, the company has ordered for its four working shafts steel shaft houses 44 x 64 feet, and 86 feet in height from the cap stones to the ridge of the head wheel tower. These buildings will be of heavy steel construction and will contain so little wooden material that the fire risk is practically nil. They will be equipped with two 13"x20" and two 18"x24", latest improved pattern, Blake crushers, driven by a 10"x24" Corliss engine. All large rock will be broken to size fit for the crushers by heavy steam hammers, which will also trim up the mass work. The car tunnels under the building will be adapted to the standard gauge tracks, thus permitting the use of rock cars of double the capacity of those now in use. The engine and boiler houses, as well as the various shops, are built of stone and steel, with a view to permanence as well as to guard against fire. The company is well equipped in the matter of shops, in which respect it will stand comparison with a great many of the older companies. Each shop is 30 x 60 feet, with attic and basement, and all shops are connected by bays 15 x 40 feet, which are used for engine room, stock racks, etc. The machine shop contains a 36" x 40" 10-foot planer, a 32-inch 20-foot lathe, a 24-inch 12-foot lathe, and 18-inch 10-foot lathe, a five-foot radial drill press, besides a number of valuable tools. This will enable the company to make considerable of its machinery. The carpenter and blacksmith shops show the same completeness in the matter of equipment, and at each place work is conducted with every advantage in the way of labor saving appliances. The machinery in the shops is driven by a 10" x 30" Hamilton-Corliss engine, belted to a main shaft from which power is taken by means of friction clutches, so that any shop can be run independent of the others.

For the accommodation of its employees, the company, during the past year, erected four modern residences for the mine officials; two boarding houses, each capable of providing for 75 men; and fifty 6-room dwellings. In addition to this a number of old houses were repaired, improved and rendered serviceable.

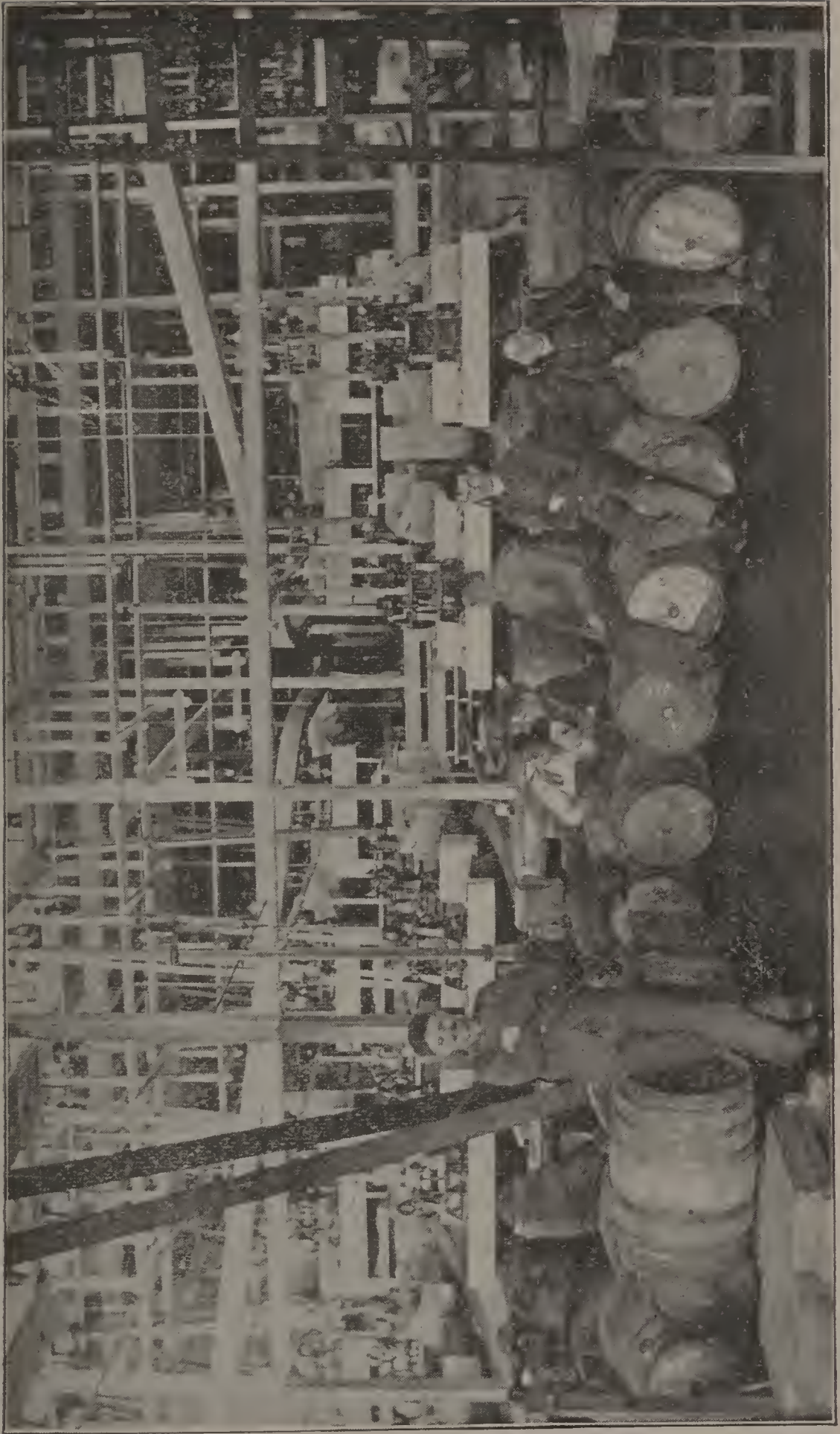
Water for the location is supplied through a steel pipe line 10,600 feet long, reaching to the Boston pond, where a new pumping station has been installed. The tracks of the Mineral Range railroad are extended from its main line into the Arcadian, and the necessary sidings,

yards, etc., are completed and in use. The coming few months will witness the completion of the standard-gauge railway leading from the Arcadian to its new stamp mill at Grosse Point, where the company possesses a most admirable mill site, comprising 406 acres of land with an extensive lake frontage and sand room that will last during the life of the mine. The mill building is a steel structure 132x213 feet. The rock bins are also of steel and the railroad trestles leading to the mill will be of like material. The mill will contain three stamps, all of the very latest design and embodying all improvements up to date. They will have a combined capacity of 1,500 tons daily. One hundred and eight of the latest improved gigs and nine double-decked Fraser & Chalmers' slime tables will be installed. The boiler house is also of steel and corrugated iron, and will contain four 84-inch crown tube boilers, run at 110 pounds pressure, to operate stamps, and one 72-inch crown tube boiler, run at 150 pounds pressure, to operate the pumping engines. These are all arranged for dome draft, leading to a brick-lined, self-supporting stack, seven feet inside diameter and 110 feet high, above a 20-foot masonry stub. The pump house is also of steel and corrugated iron, and will contain a triple-expansion, high-duty pumping engine. Its capacity will be 15,000,000 gallons every 24 hours, a quantity sufficient for six heads of stamps, which the company will no doubt have in operation at no very distant date. The pump house has been made large enough for the installation of an electric lighting plant, should one become necessary. The company has a magnificent dock, 675 feet in length, at this place, and a coal-handling apparatus will be constructed the coming summer. There have also been erected the necessary auxiliary buildings, such as shops, warehouses and stables. A town site has been laid out and the necessary dwellings erected for employees.

It seems incredible that the work outlined above could be accomplished in a space of eight months. At the mine and mill the same unequalled energy is still being displayed, with the result that the company is promised a reward by getting its product on the market while the price of the metal is high.

The Arcadian is an extensive mining property that can be practically wrought to unlimited depths. Copper was produced in large quantities when the old Arcadian was worked, years ago, with primitive methods; and the results obtained at present are highly satisfactory, warranting the belief that before many years the mine will attain a position among the leading amygdaloid lode producers of the Lake region.

The Arcadian Copper Company was organized June 22, 1898, with a capital of \$2,500,000, divided into 100,000 shares of \$25 each. The eastern office is in Boston.



PHOTOGRAPHED BY A. F. ISLER,  
LAKE LINDEN.

INTERIOR OF STAMP MILL.



The officers of the company are: Albert C. Burrage, president; Charles D. Burrage, treasurer; Nathan F. Leopold, general manager. The local officers are: Edgar Kidwell, superintendent; James M. Wilcox, mining captain; Robert H. Shields, clerk; Henry C. Krause, superintendent of stamp mill.

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### **The Baltic.**

It is doubtful if, within the past thirty years, any new mining proposition has attracted so much attention in the early stages of its exploitation as did that presented by the Baltic Mining Company, when it undertook the development of what is now known as the Baltic mine. This was because of the great possibilities of the property indicated by the showing made from the very beginning, the lode where opened disclosing ground remarkably rich in copper. The strength and richness of the Baltic lode quickly came to be a common and engrossing topic of discussion, and attracted innumerable visitors to the property, who were amazed by what they saw, and by their accounts of the promise the Baltic gave of becoming a great mine added to the deep interest taken in the property by the public.

The Baltic was the first of the many mining flotations accomplished during the past two years, and to its splendid appearance, as far as the underground work has gone, is largely due the attention since given the South range, now so thickly dotted with new mines for its entire length, and about to be traversed by a new railroad, which will give the Copper district a second outlet to the outer world.

The mineral lands of the Baltic Company consist of 800 acres in sections 20 and 21. Exploratory work was first done on the property by the late Captain John Ryan in 1882, when the lode was exposed by test pits, and a shaft, now known as No. 1, was sunk to a depth of 66 feet. This shaft exposed a wonderful showing of heavy copper, and the possibilities it disclosed, together with the showing at the test pits, resulted in the purchase of the property from the St. Mary's Canal & Mineral Land Company by the Baltic Mining Company, in November,

1897. Active operations were instituted at the mine the first of the following month. The dense woods were cleared away, the necessary equipment was secured and accommodations for employees were provided. As above stated, No. 1 shaft was then 66 feet in depth. Drifts had been extended from the bottom south for a distance of  $17\frac{1}{2}$  feet, and north 33 feet. The Baltic Company started underground work by extending cross-cuts from each of these drifts. The distances attained were 22 and 21 feet respectively, and these openings were in the vein, except a portion which broke into the hanging wall. This shaft was then straightened and enlarged, and cross-cuts were driven to expose the foot and hanging walls, after which sinking was resumed and a depth of about 220 feet has now been attained, with sinking and drifting at present under way. North of this shaft 630 feet is No. 3 shaft, which has a depth of 170 feet and gives a good showing of stamp rock. This shaft, like the others, is being sunk and its levels opened up as rapidly as possible. No. 4 shaft, 900 feet north of No. 3, is down 165 feet, and at a distance still 900 feet further north is No. 5 shaft, with a present depth of about 100 feet. Shafts 1, 3 and 4 have an aggregate of about 2,100 feet of drifts. The heaviest copper thus far has been secured at No. 1, where many large masses have been taken out, while the best stamp rock has been secured from shafts 3, 4 and 5—which, by the way, are three-compartment shafts, in size 24 x 10. Situated 900 feet north of shaft No. 5 is No. 6, which was sunk from an adit level driven west from the creek. The lode is exposed on the property for a distance of 2,793 feet along the line of strike, a maximum depth of 182 feet. A maximum width of 50 feet is shown as measured at right angles to the vein, and a minimum width of 16 feet. This is, by all odds, the greatest copper-bearing lode, in width, that has ever been discovered in the district.

At No. 1 shaft both walls are exposed, showing a width of lode of 50 feet, while at the other shafts from 16 to 20 feet of vein has been broken and at neither has the hanging wall yet been encountered.

The dip of the lode is found to be between 72 and 74 degrees. In character it is an amygdaloid belt and probably the most easterly yet worked. It is irregular in width, character of the rock, and the form in which the copper occurs. The rock is of medium hardness, greyish in color. It carries considerable calcite, and in some portions of the vein epidote and other associate minerals. Geologists believe the belt to be the Mabbs vein, which was opened a number of years ago a short distance east of the Isle Royale property.

There are about 25,000 tons of rock piled at surface, taken from the new openings, a portion of which is poor and should be selected before it is sent to the mill. The machinery is of a temporary character. Nos. 1, 3, 4 and 5 shafts are equipped with double-cylinder geared



hoists, with suitable boiler plants. Small compressor plants are rendering service at Nos. 1, 3 and 5 shafts.

From a wilderness 18 months ago, the Baltic location has become a hamlet of fair proportions. There are in all 38 buildings on the property, among which are 22 dwellings; a neat school house, where religious services are also conducted; a blacksmith shop, change house, supply house and office, and powder and oil houses.

The remarkable severity of the past winter interfered much with surface improvements, especially with the construction of No. 3 shaft house. There is some talk of the Baltic being about to commence stamping its rock in the very near future, but the openings are not far enough advanced to permit of stoping ground being selected, and to start a mill under present conditions would be contrary to approved methods of modern mining. The first, or adit, level will not permit of immediate stoping, and it is being opened largely to drain off the inflow of surface water to the creek north of No. 6. The second level is not far enough extended in the shafts, and until provision is made for more stoping ground in this part of the mine, starting a stamp mill would be folly, as there would not be opportunity to exercise proper economy in mining and stamping the product.

The capital of the company is \$2,500,000, divided into 100,000 shares of a par value of \$25 each. The amount paid in is \$1,200,000, and the date of the company's organization, November 23, 1897.

The main office of the company is in New York. John Stanton is president; J. R. Stanton, secretary and treasurer. Officers at the mine are: Frank McM. Stanton, agent; A. D. Edwards, clerk; Thomas Rowland, mining captain.

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### **The Winona.**

Ranking among the most promising of the new mining ventures in Houghton county is the Winona property, the development of which from the beginning made in May of last year has been uniformly and in the highest degree encouraging, the lode showing great richness in copper at every point where a sinking on it has been made.

For many years it has been known that the property now being developed by the Winona company carried a copper lode of great value, but lack of railway facilities rendered capital timid about engaging in the expensive undertaking of exploiting it. But when the certainty

that the South range would be provided with one or more railways before the current year closed removed that cause of apprehension, it became easy to interest capital in the enterprise of converting this promising copper property into a producing mine, and the company which now owns it was organized for the purpose of securing and developing it in the fall of last year.

The mineral lands of the company cover a tract of 1,480 acres, comprising the east half of section 19, the west half of 20, the northeast quarter of 20, the west half of the southeast quarter of 20, the northeast quarter of 30, the northwest quarter of 29, the northeast quarter of 32, and three forties in the northwest quarter of 22, all in township 56, range 32. The present company is the successor of a company bearing the same name which was organized in 1864 to develop the property, and which did work that fully established the existence there of a valuable lode.

The veins were very clearly defined by ancient pits which showed that the early miners had worked the outcrops there quite extensively. A shaft was sunk to a limited depth, and from this a comparatively large quantity of mass and barrel copper was secured, but the cost of conducting operations, owing to the isolated location of the property and the difficulty and cost of getting in supplies, caused a cessation of work. In the spring of 1898, William A. Paine of Boston secured an option on the property and at once placed miners at work under the supervision of Captain John Welton to develop the lode. The results were so assuring that he secured control of the property, and six months later, November 7, 1898, the Winona Copper Company was organized, with a capital of \$2,500,000, divided into 100,000 shares of a par value of \$25 each, to develop it. Of the capital \$800,000 has been paid in. F. W. Denton was engaged as mine superintendent. Under his direction the opening of the mine on a broad scale was at once commenced and is now being pushed with the utmost vigor. The extension of two shafts is now well under way. Each of these is 19 x 7 inside timbers and contains two skip ways and a pipe and ladder way.

No. 1 shaft has a present depth of 210 feet. At the first level drifts have been extended north 40 feet and south 100 feet, while at the second level the north drift has been extended 70 feet and the south drift 82 feet. As in the early openings, this shaft continues to yield much barrel work. The greater portion of the vein matter, however, is a splendid stamp rock. The lode is of a good healthy character, bearing a striking resemblance to that at the Quincy, and reveals a mineralization such as calcite, epidote and red oxide. The drifts at the bottom of No. 1 show good stamp rock, while the south drift is also producing barrel copper. No. 2 shaft, located 900 feet south of No. 1, has a depth of 97 feet, and is securely timbered to the

bottom. From this depth a fork has been cut into the footwall and a drift of 20 feet has been extended north. In sinking No. 2, barre work, small masses and stamp rock were found nicely distributed throughout the lode, and it might be stated that thus far no "poor dump" has been started, as everything hoisted is of enough value to warrant sending it to the stamp mill. The lode has been opened by test pits for a distance of 600 feet south of No. 2 shaft, a good show of stamp copper being exposed in the pits. North of No. 1 shaft the lode is opened by three pits a distance of 1,000 feet. Arrangements for starting a third shaft are now about completed, the necessary machinery being already at the mine. The location of this shaft will probably be south of No. 2.

The lode traverses the property for a distance of about  $1\frac{1}{4}$  miles, and dips at an angle of 72 degrees. Its width, as shown by the present openings, is from 14 to 18 feet. The property is also traversed by a number of unexplored amygdaloid and conglomerate belts.

The hoisting engine house, located at an equal distance between shafts Nos. 1 and 2, is a steel, fire-proof building 40 x 40. For these shafts the equipment consists of a double-drum hoist. Each drum is five feet in diameter and carries 700 feet of rope. Room is provided for a duplicate hoist. In this building is also installed an Ingersoll-Sergeant 12-drill compressor. The boiler house is also of steel and in size, 40 x 48. It contains four 80-horse power boilers.

New rock houses at the shafts have just been completed. They are more convenient and permit of greater economy in working than the old, temporary structures. The company has also erected an office, carpenter and blacksmith shops, boarding houses, barns, and other necessary structures. It has now in operation a saw mill, having a capacity of 24,000 feet of lumber daily, and has in stock a supply of 350,000 feet of hemlock and pine logs. The mill will furnish lumber with which to erect new houses for the employees, and also mine timber. A townsite has been platted and a number of dwellings will be erected the coming summer. The survey of the Copper Range railroad, about to be constructed, locates the road a distance of about 1,500 feet from the line of the shafts.

The Winona has a good showing and there is every indication that it will, when developed, be numbered among the valuable mines of the district. The eastern offices of the company are in New York. John Stanton is president; J. W. Hardley, secretary; J. R. Stanton, treasurer.

### The Centennial.

The mineral lands of this company, comprising 640 acres, lie directly north of the Calumet & Hecla. Work was first commenced on the property by the Schoolcraft Mining Company in 1863, when shafts were started on the Calumet conglomerate lode. That company conducted operations at a loss until 1875, and the following year the property passed into the hands of the Centennial Copper Mining Company.

In the latter part of 1880 work was begun by the new company on the Osceola amygdaloid lode. Two shafts were started 600 feet apart, but work was suspended before the value of the lode was thoroughly tested, as is evidenced by the satisfactory showing in these shafts today. The showing at these two shafts was as good as on the same lode at the Osceola at the same depths.

There was never a lack of confidence in the future of the Centennial, and it was no surprise when, in 1896, H. F. Fay visited the property and reported thereon to the directors, suggesting that work be resumed at the mine.

Mr. Fay's visit resulted in the mine again commencing operations, and with James Chynoweth acting as superintendent of the company the first work, that of unwatering No. 6 shaft on the Calumet conglomerate lode, was begun January 15, 1897. The shaft was sunk from the fifth level and drifts were extended north for a distance of 820 feet. Considerable stoping was done at the fourth and fifth levels, but the chute of copper expected to continue to the latter level pinched out below the fourth. Sinking was continued from the fifth level to the twelfth, but nothing valuable was discovered and work has been temporarily suspended at that point. The management, however, has not lost confidence in this lode, and hopes to ultimately find it valuable at a lower depth. At present operations are conducted on the Osceola amygdaloid lode, and the conditions offer every encouragement for the future.

Since work was resumed No. 1 shaft has been reconstructed from top to bottom on the plane of the lode and extended from the third to the eighth level, a depth of 800 feet. No. 2 shaft has been sunk from the fifth to the tenth level, a depth of 1,000 feet. These shafts are at present being extended to greater depths, and drifts opened up at a rate of 650 feet a month, which will be greatly increased so as to have plenty of reserves provided when the contemplated new stamp mill goes into operation.

Among the suggestions made by the company's president when work was resumed was the development of the Kearsarge lode; and to

avoid the disadvantages of a vertical shaft, which would have to be sunk to intersect it on the Centennial property, a forty-acre parcel of land containing the outcrop of this valuable belt was bought from the Canal company in October, 1898. Exploration for the Kearsarge lode was begun December 1, 1898, and when it is located a three-compartment shaft to reach it will be started.

The Calumet conglomerate is the most westerly lode; east of it a distance of 750 feet lies the Osceola amygdaloid; east of the Osceola lode 750 feet lies the Kearsarge conglomerate, and 1,250 feet east of the latter is located the Kearsarge amygdaloid. The dip of the Calumet conglomerate and Osceola lodes is 38 degrees, and the width of the latter is twenty feet.

The present monthly product of the mine is about 60 tons of mineral, which yields about 86 per cent of refined copper. The percentage of mineral from the stamp rock is one and one-third. But little stoping is being done at present, and a large portion of the rock treated comes from new openings.

The satisfactory results achieved in the development of the two shafts on the Osceola lode, together with the prospect of securing good results from the Kearsarge lode, upon which the Wolverine-Kearsarge branch of the Osceola are being wrought and the Mohawk developed, have convinced the management that the mine is entering on the most prosperous stage of its career, and that it would be well to provide it with such equipment as will permit of greatly enlarged operations. The first move in this direction was the purchase of an admirable mill site with three-quarters of a mile frontage on the shore of Torch Lake, about six miles distant from the mine. A modern stamp mill will be erected and a railroad leading to it built the coming summer. Many improvements will be made in the mine equipment and large and powerful hoists will replace the machinery now doing service at Nos. 1 and 2 shafts. In the meantime, the working shafts will be extended and new ground opened up as fast as possible, so that when the new mill is completed three stamps can be continuously supplied with rock. The Centennial gives every evidence of being about to become a reliably profitable mine. The company owns two office buildings; an oil and powder house; carpenter, blacksmith and machine shops; and a stamp mill which has been recently repaired and equipped with new pumps and Hodge improved jigs.

The mine employs 240 men. The local officers are James Chynoweth, superintendent; Charles Chynoweth, clerk; J. Pentecost, mining captain. The capital of the company is \$2,500,000, divided into 100,000 shares of a par value of \$25 each. The eastern office is in Boston. H. F. Fay is president; W. B. Mosman, secretary and treasurer.

### The Old Colony.

The mineral lands of this company comprise 1,200 acres lying north-east of the Calumet & Hecla, in sections 17 and 18, township 56, range 32 west. Exploratory work was begun on the property June 1, 1898, since which date a number of lodes have been found, several of which give much promise. On the first formation discovered, a shaft was extended to a depth of 40 feet, revealing a well defined amygdaloid lode. At present work is confined to the west lode, where two shafts are being sunk at a distance apart of 1,000 feet. Both are provided with the necessary equipment. No. 1 shaft has a present depth of 100 feet and No. 2 of 70 feet. The dip of the lode is 38 degrees and the average width 15 feet. Both shafts show well in mass, stamp and barrel copper.

At a distance of 2,800 feet east of the first mentioned lode a conglomerate formation 40 feet in width was uncovered, which will be given attention later. East of there 700 feet another conglomerate lode of very much promise was located, and east of the latter lode a distance of 500 feet an amygdaloid vein was discovered, upon which a shaft was sunk to a depth of 28 feet, without encountering either the foot or hanging wall. This is believed to be the same lode that was opened up on the St. Louis property years ago, when 40 tons of copper was secured from a comparatively few fathoms of ground. East of this lode 240 feet, still another amygdaloid belt was found. A test pit was sunk to a depth of 10 feet into vein matter, revealing a rock of sparry character and promising appearance.

The two shafts now in operation will be pushed down with all dispatch and the other lodes will be further explored during the coming summer. The property will be traversed by the railway leading from the Centennial to its stamp mill, and will share the Centennial's milling facilities at Torch Lake.

The local officers are James Chynoweth, superintendent; Charles Chynoweth, clerk; Thomas Rapson, mining captain.

The capital of the company is \$2,500,000, divided into 100,000 shares of a par value of \$25 each. Of the capital, \$1,000,000 has been paid in. The main office is in Boston. H. F. Fay is president; W. B. Mosman, secretary and treasurer.

### **The Mayflower.**

The Mayflower is one of the mining companies organized during the current year, and owes its creation largely to the showing made on the Old Colony property. The mineral lands of the company consist of 840 acres lying east of the Kearsarge and Wolverine and north of the Old Colony. The property is traversed by the various lodes on the latter property. The capital of the company is \$2,500,000; the stock being divided into 100,000 shares of a par value of \$25 each. The amount paid in is \$800,000. Henry F. Fay, of Boston, is president; W. B. Mosman, secretary and treasurer; James Chynoweth, superintendent.

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### **The Tecumseh.**

The mineral lands of the Tecumseh embrace 560 acres situated directly south of the Osceola, and are traversed along their length by the Osceola and Kearsarge amygdaloid and Calumet conglomerate belts. Considerable work has been done on the Calumet conglomerate, where a shaft was sunk to a depth of about 600 feet, but the result was a disappointment, as the formation was found to be almost totally barren of copper. Work on this lode was suspended and attention is now being given to the development of the Osceola lode, which has opened so well south of No. 6 shaft on the Osceola property, but a short distance from the Tecumseh workings. The shaft on the Osceola lode contains two skip ways and a ladder way, and is 20 x 7 feet within timbers. It is sunk on the plane of the lode to a depth of 300 feet. At a depth of 500 feet drifting north and south will be commenced, and sinking continued. The shaft seems to be in the center of the lode, and as yet neither foot nor hanging wall is visible. This shaft can be sunk to an unlimited depth.

The shaft house and engine house are completed and the latter is equipped with a single hoist, 16 x 24 feet, capable of working to a depth of 1,500 feet. An order has been placed for a compressor of 15-drill capacity. No. 2 shaft will be started at a point about 1,000 feet north of No. 1 early this spring. The Kearsarge lode lies about 2,000 feet east of the Osceola. Some exploratory work has been done on this vein, and it will likely receive further attention the coming summer.

The company was organized in March, 1880, with a capital of \$1,000,000, divided into 40,000 shares of a par value of \$25 each. Two

undred thousand dollars had been called in up to March 2 of this year, when the capital was increased to \$2,500,000 and the number of shares to 100,000, the par value remaining the same. Of the new stock 20,000 shares were placed in the treasury. The company's office is in Boston. John C. Watson is president; D. L. Demmon, secretary and treasurer. James Chynoweth is superintendent of the mine.

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### **The Tri-mountain.**

The Tri-mountain Copper Company's mineral lands comprise 1,120 acres located directly south of the Baltic and traversed by the Baltic, and, it is believed, the Isle Royale lodes. The former lode has been traced across the length of the property. The preparation of plans for development of the property on an extensive scale is about completed and active operations will commence as soon as the equipment, already ordered, arrives.

The company was organized in January, 1899, with a capitalization of 100,000 shares of a par value of \$25 each. Four hundred thousand dollars was placed in the treasury, with which to carry on mining operations. The eastern offices of the company are in Boston and the officials are H. F. Fay, president; W. B. Mosman, secretary and treasurer; James Chynoweth, mine superintendent.

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### **Rhode Island Mining Company.**

The mining location of the Rhode Island Mining Company is directly north of the Franklin Junior, and comprises 800 acres of land, situated in section 5 and the southwest quarter of section 4, town 55, range 33.

The most westerly lode on the property is the Pewabic, and east of this, in order, are the Albany & Boston amygdaloid, Mesnard epidote, Albany & Boston conglomerate, Calumet conglomerate and the Osceola amygdaloid. The first exploratory work on the property was done in 1864 and 1865, when fully \$10,000 was expended in extending a trench from a point west of the highway east to the Albany & Boston conglomerate, which exposed all the lodes for that distance. The trench



long since caved in, but will most likely be reopened the coming summer. Two shafts were sunk on the Albany & Boston lode, each to the second level. A fairly good showing of copper was revealed, and this lode will likely be given attention by the new company later on.

The recent explorations on the property began in the fall of 1898, when what is now known as No. 1 shaft was started on the Pewabic lode, at a point 270 feet north of the south boundary. This shaft is 7x18 feet inside timbers and contains two skip ways and a pipe and ladder way. Its present depth is 50 feet, and at an additional depth of 100 feet drifts will be driven north and south. The lode is of a very healthy character, and contains quartz, spar and red oxide.

The copper is well distributed, from good stamp rock to small masses. The lode traverses the entire length of the property and dips at an angle of 54 degrees. The width of the lode at the bottom of the shaft is about nine feet, which is much wider than as found near surface. An order has been placed for a new hoist for this shaft and a compressor of 10-drill capacity, of the Rand pattern, is furnishing compressor power. Shaft No. 2 will be started at a point about 1,000 feet north of No. 1, early this spring.

It is the intention of the company to thoroughly explore the several lodes on the property the coming summer at various points, and if results warrant this additional shafts will be started. The company was organized in December, 1898, with a capital of \$2,500,000, divided into 100,000 shares of a par value of \$25 each; \$500,000 of the capital has been paid in.

The eastern office of the company is in New York. Thomas F. Mason is president; William R. Todd, secretary and treasurer. Officers at the mine are: S. B. Harris, superintendent; John L. Harris, mining engineer; E. D. Johnson, clerk; Thomas Whittle, mining captain.

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#### **Oneco Copper Company.**

The Oneco Copper Company was organized in Boston, Dec. 20, 1898, with a capital of \$2,500,000, divided into 100,000 shares having a par value of \$25. John C. Watson, Charles G. Lengfest, Wm. F. Fitzgerald, George N. Towle and Wesley Clark are the board of directors. No cash has been paid in, and while the location of the company's lands has not been given out, it is understood that the organization has in view development of the Hungarian, or Fitzgerald, and adjoining lands, located a short distance east of the Rhode Island, in sections 2, 3 and 10.

### **The Copper Range.**

By far the most important industrial enterprise started in the copper region of Michigan within the past thirty years is that undertaken by the Copper Range company, which was organized to develop a vast stretch of valuable mineral territory south of Houghton and build the Copper Range railroad. This great mining and railroad project originated with Houghton and Boston capitalists, and the organization of the company was effected January 24, of the current year.

The Copper Range company owns about 11,000 acres of virgin mineral territory on the copper range between Houghton and Ontonagon. Exploratory work on these lands is about to start under the direction of Dr. L. L. Hubbard, late state geologist, who is particularly well informed as to their mineral character. It is confidently expected that several valuable copper mines will be developed on these lands, and the belief is fully warranted by the results thus far secured on mineral lands adjoining. The Copper Range company's lands are traversed by all of the master lodes that have made Michigan famous as a producer of native copper, and it is scarcely too much to say that had transportation facilities been supplied the South Range years ago, it would now be dotted with prosperous mines and villages, instead of just entering on the initial steps of its development.

The company has a working capital of \$250,000 set aside especially for the development of its mineral lands, and the explorations will be conducted in an intelligent and systematic manner. Its capital stock is divided into 100,000 shares, of the usual par value. It commenced operations with \$1,000,000 in the treasury. The main office is in Boston. The officers are: William A. Paine, president; Fred Stanwood, secretary and treasurer; Dr. L. L. Hubbard, local manager.

The Copper Range Railroad company is parent of the Copper Range company, and its value to the copper district, opening, as it will in a few months, a stretch of over 30 miles of mining lands which have remained unexplored for years, is beyond computation. For years the needs of this district had been urged on the attention of the trunk lines in the hope that they would tap its valuable timber and mineral territory, but a deaf ear was turned to every plea made until the plan of the combined railroad and land company was conceived, with the result that the line will be built, and equipped with the most modern rolling stock, without the issuance of bonds or the borrowing of a dollar. The success of the enterprise from a financial standpoint is easily assured, as the road will serve the entire chain of mines from Greenland to Houghton; these including the mines of Ontonagon, the Winona, Arctic, Wyandot, Kaukauna, Tri-mountain, Baltic, possibly the Atlantic, of

Houghton county, and the many others that will be developed after the territory through which the road is to be built is provided with transportation facilities.

The company let the contract for construction of the line from Greenland, in Ontonagon county, to Houghton, a distance of 41 miles, on April 3, of this year. The work is to be completed October 20 of the current year, when Houghton county will be afforded a second outlet to the outer world, as connections with the Chicago, Milwaukee & St. Paul road will be made at Greenland. Arrangements for a survey from Houghton to Calumet are being made at this writing, while the steel rails for this piece of track have already been purchased. Contracts have been let by the company for locomotives, cars, etc., all of which are to be of the very latest design and best construction.

The particular mission of the railroad may be said to be to aid in the development of the mining lands through which it will pass. The officers of the railroad company are: James H. Seager, president; William A. Paine, vice-president; Fred Stanwood, secretary and treasurer. The general offices of the company are at Houghton. C. A. Wright is general manager, and Thomas Appleton chief engineer.

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#### **Onondaga Land and Copper Company.**

This company's property is located south of the Isle Royale, and is a continuation of the Isle Royale mineral belt, extending through the village of Houghton to the shore of Portage Lake. The Albion Mining company conducted operations on this property as early as 1853. In 1857 work was suspended and the mine remained idle until purchased in 1860 by the Columbian company, when work was resumed in June of that year. In 1864 the name was changed to the Sheldon & Columbian, and the location extended to Portage Lake. The product obtained in 1865 was 160,988 pounds of mineral, which yielded 71½ per cent of refined copper. With the exception of some tributing, the property has been idle since 1870; and in this connection it might be stated that the tributors were well repaid for their work, securing copper in good quantities. The property is a valuable one, owing to its pleasant location, and affords one of the best residence sites along the shore of Portage Lake. It passed into the hands of the new company within a very recent period. Permanent organization of the Onondaga Land and Copper company had not been effected at this writing.

### **Wyandot Copper Company.**

The tract embraced in the holdings of the Wyandot Company comprises 1,040 acres of mineral land lying immediately east of the Winona property. The tract is made up of the following parcels of land: The south half of section 16; all of section 21; the east half of the southeast quarter of section 20, township 52, north of range 36 west.

The Winona lode passes diagonally across the tract, running a distance of nearly one and three-fourths miles on the Wyandot's land, and this property, like the Winona, is believed to carry most of the principal copper-bearing lodes of the adjacent Ontonagon mines. Though the company organized to develop this property is of but very recent creation, it has the preliminary work well under way. Houses are being erected and active preparation made to develop the property, under the direction of Dr. L. L. Hubbard as consulting engineer.

The company was organized February 1, 1899, with a capital of \$2,500,000, divided into 100,000 shares of a par value of \$25 each. There has been paid in \$800,000, of which \$300,000 has been placed in the treasury, the balance having been applied to acquiring the property. The eastern office of the company is in Boston, and its officers are Henry Stackpole, president; William Otis Gay, secretary and treasurer. Matthew Van Orden of Houghton is managing director.

The proved richness of the Winona lode, on which there is a sinking within 700 feet of the line separating the two properties, gives all but absolute assurance of the value of the Wyandot. Development of the property will be energetically pushed from now on, under a capable management, and competent judges of the prospect for it predict that before the summer is far advanced the Wyandot will rank well up with the Winona in the list of new copper properties on the South range.

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### **The South Range.**

The South Range Mining Company owns over 4,000 acres of mineral land, which includes several tracts between the Atlantic mine on the north and Greenland on the south. March 4, 1899, the capitalization was increased to \$2,500,000 and the number of shares to 100,000. The eastern office is in Boston. R. R. Goodell is president; F. W. Nichols secretary. No mining work is being done on the company's lands at present.

### The Kaukauna.

The mineral lands of the Kaukauna Mining Company take in the Stonington and Shawmut (latterly the Everett) properties, with an adjoining section on the west the whole comprising sections 9 and 10 in township 52, range 36 west, Houghton county, and forming a tract two miles in length by one in width on the South range, lying immediately to the north of the Winona and Wyandot properties. Six mineral-bearing amygdaloid lodes are known to traverse the property, and according to the report on the district of the Michigan Geological Survey the horizon of the Winona lode on the Kaukauna lands should bring the outcrop of the lode about 1,000 feet north of the southeast corner of the tract, 1,200 acres of which would thus have the underlay of that lode. In addition, there are five other copper-bearing lodes on the property, none of which have as yet been identified with the developed lodes lying to the northward in Houghton county, and to the southwestward in Ontonagon county.

It is now believed, and with good reason, that the Winona lode and the Pewabic—on which latter the Quincy, Franklin and Franklin Junior mines have been developed, and on which the Rhode Island is being opened—are identical. This is known as the richest amygdaloid lode ever exploited in the district. The physical characteristics of the Winona and Pewabic rock are so similar that specimens taken from the Winona and Quincy veins at points twenty-five miles apart have been found indistinguishable from one another by persons thoroughly familiar with the Quincy rock.

During the middle sixties a considerable amount of mining work was done on the Everett, or Shawmut, property, two of the unidentified amygdaloid lodes being sunk on, one by means of a shaft put down to a depth of approximately 200 feet on the dip of the lode, while the other was opened by means of an adit, driven a distance of about 80 feet. Both shaft and tunnel were in highly promising copper-bearing ground when operations were discontinued. The suspension of operations, notwithstanding the favorable showing, was because of the failure to find large masses of copper, the mining of the early days being devoted mainly to the exploitation of copper-bearing lodes containing the mineral in that form. Little attention was then paid to the opening of stamp lodes, especially in that district.

The capital stock of the company is divided into 100,000 shares of a par value of \$25 each. A cash working fund of \$300,000 will be placed in the treasury for the development of the mine.

The Copper Range Railroad, which is to be constructed during the present season, and contracts for which have already been let, will pass

within a very short distance of the mine openings of the Kaukauna, and will furnish all needed facilities for handling copper rock, coal, lumber and miscellaneous freight, besides furnishing quick passenger communication between the mine and all important towns of the copper district, from Calumet to Ontonagon. Two favorably located stamp mill sites are now under consideration, at either of which the rock from the mine can be handled with the minimum of cost at the maximum of efficiency.

The company will have substantially the same directorate and local management as the Mass Consolidated Mining Company. It is the intention of the management to begin the work of development at the earliest moment and to push it as rapidly as is consistent with thoroughness and good mining.

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#### **Elm River Copper Mining Company.**

The latest Houghton county copper proposition launched is a company that has acquired ownership of the Hussey-Howe and other lands lying east and northeast of the Kaukauna, and comprising in all some 2,500 acres. The interests in control of the organization are the Standard Oil, St. Mary's Canal and Centennial people. Harry F. Fay will, it is understood, be president of the company, and probably W. B. Mosman secretary and treasurer, while James Chynoweth will be Lake manager. The capitalization will be the usual 100,000 shares, with a par value of \$25 each. There will be deposited in the treasury \$600,000 for a working capital, which is ample evidence that the company intends developing the property on a broad scale. This treasury fund is exceeded by that of but two of the newly organized companies, these being Isle Royale and Miners'.

The rather historic Half-way House on the Ontonagon road is situated on the lands of the company. The new company has every reason to look forward to the development of a profitable mine. The property has been carefully gone over by a corps of engineers and the various lodes have been traced. Some copper has been taken out, and the work of developing some of these lodes will be commenced at once. Orders have been placed for all the necessary machinery, and it is safe to say that the next few months will bring great results from the operations on this valuable property.

### **The Hancock.**

The mineral lands of the Hancock Mining Company consist of 160 acres, located within the borders of the town of Hancock and west of the Quincy. The company, which was formerly the Summit, was organized in 1859, and in 1862 its first production, amounting to 11 tons, was reported. Two shafts were opened on the property. These were intersected by adits extended into the hill side, which afforded drainage for the mine. But little was done in 1863 and 1864. In 1865 the product reached about 100 tons. A period of idleness then ensued, until 1869, when operation of the mine was resumed in a small way. In 1880 control of the property passed into the hands of Edward Ryan, of Hancock, who reorganized the company and changed its name to the Hancock. The mine was then equipped and placed in active operation, with the result that it yielded more copper the year following than during the entire period of its previous operation. The two shafts had been well extended and were furnishing a monthly product of from 45 to 50 tons of copper. In 1885 the price of the metal had dropped to 10 cents per pound. The company also found it would be necessary, in order to continue operations economically and upon a larger scale, to expend a quarter of a million dollars. The gloomy condition of the copper market was far from warranting such an outlay, and the mine was shut down and has since remained idle. The lode on the property is the same as that being wrought at the Quincy. A fissure vein which carries some copper crosses the south end of the property. The mineral value of the property is established, the rock yielding at least one per cent of mineral. The office of the company is at Hancock. Edward Ryan is president; August Mette, secretary and treasurer.

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### **South Side Mining Company.**

The lands of the South Side company are located in section 34, a short distance west of the village of Houghton, and are traversed by the Quincy lode. The property has been idle many years. A reorganization of the company was effected April 11, 1899. The capital is \$1,000,000, divided into 40,000 shares of a par value of \$25 each. At the recent stockholders' meeting, held in Boston, Benjamin A. Lantiqua acted as president, and Charles O. Burbanks as secretary and treasurer.

### **The Miners'.**

The Miners' Copper Company was organized under the laws of New Jersey, in February of the present year, with a capital of \$2,500,000, divided into 100,000 shares of a par value of \$25 each. The company's mineral lands extend from the south boundary of the Isle Royale to the north boundary of the Baltic; the exact description of the lands has not been made public. Included in the company's lands are the Frue and Dodge properties, upon which mining operations on a limited scale were conducted some thirty years ago. Since then nothing in the way of mining has been done. No. 10 shaft at the old Huron, which is located well up to the line of the Miners', showed very well in copper.

The amount paid in is \$2,000,000, and the company will commence operations with a working capital of \$1,000,000. Standard Oil capital is invested in this enterprise. The officials of the company have not yet been elected.

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### **The Standard.**

The organization of the above company is under way at this writing. The lands accredited to the company comprise 1,040 acres in sections 9, 16 and 17, in township 56 north, range 33 west. The location is west of the Tamarack. A conglomerate and several amygdaloid belts traverse the property. The company will be capitalized at \$2,500,000. Stock is being offered at \$15 per share, and it is stated that the company will begin operations with a working capital of \$500,000. The Calumet conglomerate dips into the property and is presumed to underlie it at a depth of about two miles.





## Keweenaw County Properties.

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### Arnold Mining Company.

The mineral lands of the Arnold Mining Company are located north of the Greenstone and extend thence to the shore of Lake Superior. The total area is 3,323 acres, located in sections 1, 2, 7, 10, 11, 12, 13, 14, 15 and 23, town 58, ranges 30 and 31. The Arnold was operated in a small way in the early sixties, but it was not until 1892 that work was begun by the present management. Two years later the mine was shut down in consequence of the general business depression and rather gloomy outlook, but with improved conditions work was resumed in February, 1897.

The property is traversed by more than a dozen fissure veins, many of which have produced large quantities of copper where opened in the past on other properties. These veins vary from 5 to 10 degrees from being due north and south in their course.

The amygdaloid belts traversing the property have shown some productiveness when opened. Work on the Arnold property has, however, been about wholly confined to what is commonly termed the ash-bed, a formation that traverses the company's lands nearly east and west, or about 15 degrees south of west, for a distance of about two and one-half miles, and dips under the bed of Lake Superior at an angle varying from 24 to 30 degrees. The ashbed is a very scoriaceous and comparatively thin lava flow, largely made up of clinkers and scoriaceous masses, commonly described as an unstratified lava flow. From this lode and the Owl Creek fissure the Copper Falls mine, now part of the Arnold property, produced 1,200 tons of refined copper.

The regular producing shaft at the mine is No. 1, which has a depth of 900 feet. The eight levels east and west are opened for distances ranging from 80 to 700 feet. Last fall this shaft was equipped with a pair of Akron Corliss engines with cylinders 20" x 48", and a cone drum 8 x 12 feet, with 11-foot face, grooved to carry 3,500 feet of 1½-inch rope, and fitted with Lane's clutch and brake; also a standard

duplex Rand compressor with air cylinders  $30\frac{1}{2}$  and 20 inches, respectively, and 3-foot stroke, capable of compressing 2,300 cubic feet of free air per minute. The boiler house contains three 120-horse power, safety-tube boilers, built by James Burt, at Ripley, and all necessary pumps for feed and fire purposes. Sinking is under way at No. 2 shaft, which has a present depth of about 250 feet. The underground workings are not as yet connected with those of No. 1 shaft.

The consolidation of the Arnold and Copper Falls properties occurred in January, 1898, when the stock of the former was increased from 40,000 to 60,000 shares, the additional 20,000 shares being applied to the purchase of the latter property. An assessment of \$3 per share on the 40,000 shares of Arnold stock was called at the time of consolidation, and with the funds thus obtained No. 1 shaft was equipped, the Copper Falls mill was put in working order and a railroad was built from the mine to the mill. The stamp mill is located two and one-fourth miles from the mine. The rolling stock with which the railroad is supplied consists of a Baldwin locomotive and 10 large-capacity rock cars. The stamp mill went into commission during the closing months of 1898, but the results were quite disappointing, as the rock, which it had been freely predicted would yield better than one per cent, yielded little better than three-fourths of that in mineral. The productiveness varies from three-fourths to one per cent, while the mineral goes from 77 to 82 per cent of refined copper. The work at the Arnold has demonstrated the ashbed to be a low-grade producer, the successful handling of which would seem to require the treatment of large quantities of rock under the most economic conditions.

The success of the Humboldt, Ashbed and Meadow properties has been looked forward to as dependent on the results achieved at the Arnold, the ashbed traversing the entire group of properties, and all being practically under the same management. The consolidation of these properties, followed by extensive development and the erection of a modern stamp mill at Lake Superior, where large quantities of rock could be treated advantageously, is looked upon by many as the best course the companies can pursue.

One head is working continuously at the Arnold stamp mill and one 12 hours out of 24. The present monthly product is placed at about 50 tons of mineral. The capital of the Arnold is \$1,500,000, divided into 60,000 shares of a par value of \$25 each. The amount realized from assessments and transfer of property is \$596,308. The main office is in Boston. W. F. Fitzgerald is president; John Brooks, secretary and treasurer. At the mine, Wesley Clark is superintendent and John Bennetts clerk.

### **The Allouez.**

The Allouez Mining Company owns about 360 acres in one body, including the forty acquired last year from the Canal company. The lands are situated in Keweenaw county, directly north of the Kearsarge branch of the Osceola. The company also owns, in addition, a large acreage somewhat scattered, and part of it on the mineral range. The property is traversed by the Allouez and Calumet conglomerate and Osceola and Pewabic amygdaloid belts. Former operations, which were quite extensive and covered a long period of time, were confined to the Allouez conglomerate. Three shafts were sunk to depths of about 1,700 feet each, but failure followed upon failure in consequence of the percentage of copper carried by the rock mined being too low. In 1890 some explorations were made on the Calumet conglomerate, but the lode was found poor and work was suspended. Last year a shaft was commenced on the Osceola lode, which is now down 250 feet. In sinking, and some drifting at the first level, a good lode was found, showing the same characteristics as where worked by the Osceola and Centennial companies, but thus far no copper ground of real value has been encountered.

Last summer the territory west of the Allouez conglomerate was explored, exposing eight amygdaloid lodes. The Pewabic lode should run through this territory, if continuous, but the general character of this belt was not shown in any of the lodes opened. Further explorations will be conducted on the property the coming summer. The mine has a well-equipped stamp mill containing three heads, and machinery and general buildings to meet its present needs.

The Allouez Mining Company was organized August 23, 1859. Its capital is \$2,000,000, divided into 80,000 shares, of a par value of \$25. The amount paid in is \$1,536,000, and the company's last report showed assets amounting to \$50,204.38. The office is in New York. William C. Stuart is president; John Stanton, secretary and treasurer. Fred Smith is agent at the mine.

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### **The Mohawk.**

It can be said of the Mohawk that it makes a showing of copper at the two shafts being sunk on that property which has never been surpassed by development work on a copper vein in this district. The mine is easily accorded first place among the newly floated

properties, and the indications point strongly to its becoming a most valuable acquisition to the list of Lake producers. The acreage is large; the lode is that which is yielding so well at the Wolverine, and the company has looked well to the future in laying its plans so that the property may be worked to the very best advantage.

The Mohawk property was formerly known as the Fulton. It comprises 800 acres of land, of which the lode underlies fully 600 acres. The tract is located in town 57, range 32 west, in Keweenaw county. The south side of the property borders nearly upon Houghton county. The Kearsarge amygdaloid lode is the only one thus far exposed on the company's lands. This traverses the property for a distance of about 10,000 feet, or nearly two miles.

Two years ago explorations were commenced on this property. Thirteen test pits were sunk, which exposed the lode on the north end for a distance of more than 4,000 feet. These pits at once attracted considerable attention from the fact that all of them showed great richness in copper. Active mining commenced on the property in November, 1898, when two shafts were started on the north side of the tract. The showing at each of these shafts from surface down is magnificent, and warrants the belief, generally entertained, that the mine will become a large producer. The lode varies in width from 15 to 18 feet and dips at an angle of about 39 degrees. It is uniformly, and in places very richly, charged with copper. The shafts are being opened with all possible dispatch, and the coming summer will very likely see a start made on shafts Nos. 3 and 4. All the shafts will be 17x8 feet inside timbers, and each will contain two skipways, in addition to a ladder and pipe way. The mine will be developed and placed in condition for active production at the earliest possible date, and with this end in view the company made an excellent move in purchasing the Hebard lake frontage, located on Big Traverse bay on the shore of Lake Superior, for a mill site; and also the railroad leading from that point to within three miles of the mine. Excellent sand room, dockage and rail facilities were thus secured. The advantages in the way of transportation are many, while the effect will be a cheapened cost and more extended lake season of navigation than is offered shippers at Portage Lake. The distance from the mine to the mill site is eleven miles. The road will be rebuilt and extended to the mine the coming summer, when work will be commenced on the construction of the company's stamp mill.

The company was organized November 2, 1898, with a capital of \$2,500,000, divided into 100,000 shares of a par value of \$25 each. The amount paid in is \$750,000, and the last report showed assets amounting to \$260,000. The company's office is in New York. John Stanton is president and J. R. Stanton secretary and treasurer. Fred Smith is superintendent of the mine,

### **East Mohawk.**

Arrangements for launching what will be known as the East Mohawk Copper Company are about perfected, though all the negotiations for the mineral lands to be embraced in the proposition had not been closed when this was written. But the lands absolutely secured make a magnificent mineral property. They lie immediately east of the Mohawk and carry both the Mohawk and Old Colony lodes. In addition to the Mohawk and Old Colony lodes, five other lodes—four amygdaloid and one conglomerate—cross the East Mohawk property, none of which have yet been worked on other properties to determine their value. They are of good width and may turn out to be a very valuable addition to the rich lodes already proved up. The East Mohawk territory already secured consists of all of section 25; the east half of 26; the southeast quarter of 23; the south half of the northeast quarter of 23 and the south half of the southwest quarter of 24, town 57, range 32, the whole aggregating 1,280 acres of excellently located mineral lands. Pending negotiations have in view the addition to this great holding of another very valuable tract of mineral territory, amounting to 960 acres, but even without this latter tract the East Mohawk property is one of great prospective value.

But little can be said of the proposition at this time beyond what is given above, except that the property will be in strong hands and will be developed under a management that will need no recommendation to the public beyond the mere announcement of the men who will compose it. The intention of the promoters is to organize the company at once and immediately proceed to develop the Mohawk and Old Colony lodes, the value of these having been already amply proven by work done on the Mohawk and Old Colony properties.

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### **The Phoenix Consolidated.**

The Phoenix Consolidated Copper Company owns 2,240 acres of mineral lands, these embracing the old Phoenix, St. Clair and Garden City properties, with 185 acres on the lake front in addition. The property has a mile and a quarter frontage on Lake Superior, immediately adjoining the port of Eagle River.

There are four fissure veins on the Phoenix property—the New

Phoenix, Robbins, Butler and Armstrong, and it is also traversed by the Calumet conglomerate.

The Phoenix Copper Company was an outgrowth of the old Lake Superior Copper Company, one of the pioneer corporations of the copper region, the originators of which were among the first to take out permits from the War Department after the extinguishment of the Indian title in 1843. Work was commenced the following year on the east bank of Eagle River.

In 1845 a stamp mill, the first in the copper district, was built by the company, only to prove a failure in operation. During 1845 and 1846, 550 tons of copper were produced. The main shaft had been sunk on a pocket of copper and silver, and in an effort to recover the vein a tunnel was run under the river at a depth of 90 feet from the top of the shaft. In this tunnel a crevice, filled with gravel and an accumulation that plainly showed the action of water, was encountered, and in a deeper hole, made by the current of the stream, mingled with other deposits, was found about 18,000 pounds of copper, and some silver. How much silver was never known, it having been largely appropriated by the miners, but one piece weighing nearly nine pounds, which is now in possession of the Philadelphia mint, was secured by the owners.

In 1863 work was commenced on the Phoenix and Robbins veins south of the greenstone. Two years later the capital became exhausted and the company was reorganized. That year the mine produced 244,158 pounds of copper. In 1869 the yield was 400 tons, in 1870 500 tons and in 1871 650 tons of refined copper.

F. G. White was appointed agent in 1872, and in that year the production amounted to 728,359 pounds of refined copper, which sold at 34.71 cents per pound. But even with such a price, the ignorance displayed in handling this valuable mineral deposit made it impossible for the mine to earn the returns that it should have given on the money put into developing it.

It may be truly said that the Phoenix suffered more from general mismanagement than any other mine operated in Keweenaw county. The history of all the work done clearly shows that, with anything like improved appliances and intelligent mining, great success, even in the past, could have been accomplished. As an example of this, it may be stated that at the sixth level the largest mass of copper ever taken from the earth—weighing a trifle over 600 tons—was found. It is well known, too, that before this mass was delivered to surface, more money had been expended in cutting it into convenient pieces and hoisting it than the value of the copper at 26 cents per pound amounted to; when, as a rule, less than a cent a pound added to the value of the copper chips obtained in cutting has always been considered a liberal allow-

ance for cutting and handling copper masses of any size, where due regard has been paid to the openings and facilities for manipulation.

That the mine had great possibilities of success may be seen from Charles E. Wright's report as commissioner of mineral statistics for the year 1880. And while Mr. Wright was not able to cite all the facts, he shows that in the year 1876 alone the mine made a profit of \$107,186. In this connection it can be said that from the years 1872 to 1877, during most of which time Captain W. E. Parnall, now superintendent of the Tamarack and Osceola Mining companies, had full charge of the underground work at the mine, the company paid off a debt of over \$200,000, paid a dividend of \$20,000 and accumulated a surplus fund of \$80,000. Further, it is well understood that a disagreement with reference to the policy of mining between Captain Parnall and the superintendent led to the former resigning his position; after which the same reckless disregard of all accepted methods of mining again placed the mine in the non-earning list.

Aside from the splendid record the mine was able to make, under intelligent direction, on what is known as the mass fissure vein, a large number of well-charged copper-bearing amygdaloids were located by the extensions made on the fissure vein, (which is at right angles to the formation), which can be profitably worked, with a modern stamp mill to treat the rock. This is also true of the St. Clair. Another great feature of this property is the fact that Crocker shaft, being a vertical shaft, has almost attained the depth of intersection with the Calumet conglomerate and the other copper-bearing belts lying immediately under it. In fact, no more certain or legitimate plan of mining could be followed in the copper country today than the extension of the various levels south of Crocker shaft, which would inevitably tap all the well-known copper veins on the Calumet, Centennial, Wolverine, Kearsarge and Mohawk properties. All these veins run through the property and dip to an intersection with Crocker shaft.

Physically, there is no property on the copper range that possesses such natural advantages from every conceivable point of mining as does that now owned by the Phoenix company. A gentle grade of less than two miles leads to the town of Eagle River on Lake Superior, where the most perfect mill sites in the world can be secured. Midway between, or about one mile from the lake, is situated what is known as the ashbed vein, on which the Arnold mine is now doing active mining, and on which the Phoenix mined exclusively for a number of years. This is a well-defined and persistent scoriaceous amygdaloid, and in certain stretches carries copper of high grade. In no place where mining has been done on this belt has more copper been produced to the cubic fathom than on this property. A trial drift was run in from surface east of what is known as Eagle river, and subsequent stoping to the

amount of over 2,000 tons of rock yielded better than 2 per cent of mineral; and while no claim is made that the mile and a quarter in length on which this well-known vein traverses the property will show vein matter of that richness, it is nevertheless a fact that the best mining men on Lake Superior are strongly of the opinion that with up-to-date methods this master lode, or vein, can be made one of the most lasting producers of the Lake Superior region, and that, too, with certain paying results with copper at 10 cents per pound. In no place has this vein been opened and worked where it was not found to average more copper to the ton of rock than the Atlantic mine, and in no place else where it has been opened do the physical advantages for cheap mining compare with those existing on this property.

Contracts are being let for the necessary mining equipment and work will be commenced on the property at once. The corporation has 100,000 shares of a par value of \$25 per share. Of the capital, \$800,000 has been paid in and \$300,000 placed in the treasury for development purposes. John R. Stanton is president of the company, which will have its main office in New York.

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### **The Conglomerate.**

The lands of the Conglomerate Mining Company comprise about 21,000 acres, and include the old Northwest, Pennsylvania, Delaware, Mendota, New Jersey, Maryland and Wyoming properties. The company was organized in October, 1880, and commenced work on its lands the year following. Money was spent lavishly in surface improvements, the amount expended during the first year being no less than \$360,000. The following year a stamp mill was built at Lac La Belle, together with docks, etc., and a railroad seven miles in length was constructed. Operations were confined largely to the conglomerate lode, and the result was a sad disappointment, as well as a lesson, inasmuch as it showed the glaring folly of putting in a complete mine equipment before the value of the property was demonstrated.

Several amygdaloid lodes traverse the property, and work on these was begun last winter, after the mine was understood to have been sold to the Pawnee Mining Company, a new organization. The consummation of the sale was, however, interfered with by S. A. Witherby, of Detroit, who claimed to have a prior option and was ready to close the deal under its terms. The company owns a large quantity of timber, a number of new dwellings, and a mine equipment valued at more than \$600,000. In the event of mining being resumed, operations will be confined to the amygdaloid veins.



### North Cliff.

The mineral lands of the North Cliff Mining Company, 1,026½ acres, lie in Keweenaw county, and are traversed by the ashbed, which runs in a northeasterly direction at the south boundary line of the property, and dips in a northwesterly direction toward Lake Superior. The fissure vein which crosses the ashbed, at nearly a right angle, is a continuation of the main Cliff vein which yielded such remarkable results at the Cliff mine. This fissure vein passes through the property in a northwesterly direction and is believed to cross several amygdaloid lodes that run parallel to the ashbed. The lodes dipping to the north would give the property extensive workings. The property is fairly covered with pine and hardwood, which can be used for fuel and mining purposes; it has over one mile of frontage on Lake Superior, thus giving it ample mill room.

Mining work was inaugurated at the North Cliff in 1858, and continued until 1866. An adit 1,700 feet in length was extended, and connects with the surface at the south end through an incline shaft sunk on the ashbed. At a distance 300 feet further south No. 4 shaft was sunk about 225 feet. North of No. 4 shaft 765 feet No. 2 shaft was sunk to a depth of about 340 feet, and north of this shaft 350 feet No. 1 shaft was sunk about 95 feet, or a little below the adit level. The incline shaft was sunk on the ashbed to the adit level, which was driven on a fissure vein crossing the ashbed at right angles.

At the intersection of the incline shaft with the adit level a drift was driven northeasterly on the ashbed about 50 feet. From No. 2 shaft south to the incline shaft on the ashbed considerable stoping was done in the adit level. Midway between No. 2 shaft and the incline shaft a winze was sunk from the adit to the 20-fathom level and some stoping was done at the 10-fathom level. The latter was driven south 25 feet from No. 2 shaft to connect with the winze, while the 20-fathom level was driven south from No. 2 shaft through the Ashbed about 540 feet to connect with No. 4 shaft. The bulk of this work was for the purpose of developing the ashbed and fissure veins. The ashbed where opened shows a width of about 20 feet and the fissure about four feet. Both veins look strong and healthy.

The work done in this mine showed the fissure vein to be productive in mass and barrel work, and the ashbed in stamp rock. In well-informed mining circles the opinion is held that enough development work has been done at this property to establish that with proper mining appliances and good management it can be worked at a profit.

The commissioner of mineral statistics for the year 1880 said,

among other things, relative to this property: "In the year 1880 the Cliff Copper Company, under the management of O. A. Farwell, sank two shafts on the ashbed to a depth of 50 feet, and developments are declared to be extraordinarily good, the ashbed showing an unusual width and a more than average richness. This work was done on the Cliff property on the southwest quarter of section 25, adjacent to the eastern boundary of the North Cliff property. Captain James Sowden, who was in charge of the development work at the North Cliff property from 1861 to 1866, says: 'The fissure vein at the North Cliff mine has the appearance of the old Cliff vein at the 160-fathom level, which changes from an east to a west dip as it does at the North Cliff. We mined quite a quantity of small masses and barrel work, and indications pointed to a continuance of good copper when operations ceased. We sank the incline shaft on the ashbed and found it much richer than at the Phoenix mine.'" An early resumption of operations at this property is confidently looked forward to.

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### **The Ashbed.**

Located between the old Copper Falls on the east and the Arnold on the west is the mineral territory of the Ashbed Mining Company, comprising 1,143 acres in sections 2, 3, 10, 11, 14 and 15, town 58, range 31. Operations were first commenced here in 1861 by the Petherick Mining Company, and were continued a few years. In 1873 the company purchased the stamp mill of the Indiana Company and the following year shipped 141,199 pounds of refined copper. Lack of water made it impossible to operate the stamp mill steadily the year through, and ultimately brought about a suspension of operations.

The Ashbed Mining Company was reorganized in 1880, when operations were resumed, but with a lack of capital and equipment, and the result was a repetition of the previous experience. The property is traversed by the ashbed lode for a distance of a mile. It also contains several fissure veins from which mass copper in considerable quantities has been taken. The general description of the Arnold applies to this property as regards the ashbed. The company has a number of men prospecting on the property with fairly good results. The fissure veins on the property are believed to be quite valuable.

The capital of the company is \$1,000,000, divided into 40,000 shares of a par value of \$25 each. The amount paid in is \$20,000. The main office is in Boston. Josiah Oakes is president; John Brooks, secretary and treasurer. Wesley Clark is mine superintendent and John Bennetts clerk.

### **The Central.**

While the hum of renewed activity prevailed throughout the entire extent of the copper range the past year, the cessation of mining at but one property was noted, and this the Central, after an active career of more than half a century, the company having been organized November 15, 1854. The lode was opened on the property for a distance of over 3,000 feet, by five shafts. The vein is a vertical fissure, and was discovered in 1854. During the year succeeding, 84½ tons of mineral, which yielded 80 per cent of ingot copper, was secured. In 1855 the net earnings of the company were more than \$7,000. This is notable from the fact that it is the first instance of a copper mine being opened in this district that produced and sold during the first year's operations enough copper to more than pay all the company's expenses for the year.

For some time prior to the suspension of operations last summer, work was confined to the seventeenth, nineteenth, twentieth and twenty-first levels south of No. 2 shaft, in which direction the company has a large territory. During the last few years the mine has been worked at a loss. Hope was entertained that a change for the better in the physical conditions would take place; but, instead, the outlook became more discouraging and the mine was closed.

The company's mining lands are located in section 23, township 58, range 31. It owns in all 21,000 acres of mineral land, part of which is traversed by a number of amygdaloid belts, and it will be no surprise if operations are resumed and the company turns its attention to the development of some of these lodes the coming summer.

The mine has a large equipment, including a stamp mill containing 24 heads of Cornish stamps. It has a capital of \$500,000, divided into 20,000 shares of a par value of \$25 each. The amount paid in is \$100,000 and the stockholders have received dividends aggregating \$1,980,000. The company's last report shows assets amounting to \$20,000. The main office is in New York. Joseph E. Gay is president; John Stanton, secretary and treasurer. Frank McM. Stanton of Atlantic is agent of the mine.

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### **The Winthrop.**

The Winthrop Mining Company worked a fissure vein on the southwest quarter of section 23 and west half of section 26, township 58, range 30, immediately west of the Central. About \$90,000 was expended there in 1852 without bringing the expected results.

### **Meadow Mining Company.**

Lying directly west of the Humboldt, and bordering on the shore of Lake Superior, is the tract of mineral lands of the Meadow Mining company, its holding being  $364\frac{1}{2}$  acres in sections 17 and 20, town 55, range 31. The property was worked to some extent on a fissure vein forty years ago. It is traversed by the ashbed for about half a mile and on this lode mining was commenced by the present company last fall. A shaft  $12\frac{1}{2} \times 6\frac{1}{2}$  feet, in which there is a good showing of copper, is well under way. The lode is similar to that at the Arnold in character. The company has just completed an engine house, shaft house and an employees' dwelling. At the engine house is a double hoist with 9"x12" cylinders and grooved drum, fitted with Lane's clutch and brake, which will wind 540 feet of three-fourth-inch rope. In addition there is also a Rand compressor, 14"x22" cylinders, and a 50-horse power boiler and pumps. The capital of the company is \$1,500,000, divided into 60,000 shares of a par value of \$25 each. The amount paid in is \$75,000. The eastern office is in Boston. W. F. Fitzgerald is president and John Brooks secretary and treasurer. The mine officers are, Wesley Clark, superintendent, and John Bennetts, clerk.

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### **The Washington.**

The Washington Mining Company owns 1,004 acres of mineral lands in town 58, range 29, which are traversed the entire length by the group of ashbeds, and south of these a distance of 600 feet by the Pewabic lode.

Mining operations were commenced on the property July 5, 1898. Considerable trenching was done and a shaft was sunk 30 feet on the Michigan fissure, which discloses a promising vein. An adit 35 feet in length was driven on the Medora fissure, which also offers encouragement, and work will be resumed at these points in a month or so. The Pewabic lode will also be investigated, and orders have been placed for considerable machinery with which to conduct extensive operations the coming summer.

A reorganization of the company is receiving attention at this writing and it is expected that the present capital of \$1,000,000 will be increased to \$2,500,000, and the number of shares from 40,000 to 100,000. In this event a large amount will be placed in the treasury.

### **The Humboldt.**

The Humboldt property lies to the west of the Arnold, and comprises 1,163½ acres situated in sections 16 and 21, in township 58, range 31. The lands carry the ashbed lode for a distance of a mile, and on this formation mining operations were begun during the summer of 1898. The showing is fully as good at the shaft under way, if not better, than in either shaft at the Arnold.

A shaft house and engine house have been erected, and a hoisting engine, compressor, boiler and pumps are installed. The company has also erected a blacksmith shop and several dwellings.

The capital of the company is \$1,000,000, divided into 40,000 shares of a par value of \$25 each. There has been obtained from assessments and real estate \$232,683.76. John C. Watson is president and John Brooks secretary and treasurer, with offices in Boston. Wesley Clark is mine superintendent and John Brooks clerk.

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### **The Ahmeek.**

The mineral lands of the Ahmeek Mining Company comprise 920 acres lying directly west of the Mohawk, and carrying the underlay of the rich Kearsarge vein that is being opened on the latter property; a fact that will likely lead to a resumption of operations on the property ere long. Two shafts were sunk there in the early eighties, but the results were unsatisfactory and work was abandoned.

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### **Eagle Harbor Mining Company.**

The Eagle Harbor Mining Company owns a tract of land about two miles long and a mile and a half wide, located south of the village of Eagle Harbor. It embraces the properties formerly owned by the Eagle Harbor and Waterbury Companies, and is traversed by the ashbed lode, as well as several amygdaloid belts. Some mining work was done on the property from 1850 to 1854, and of late there has been some exploratory work done on the tract.

### **The St. Clair.**

The St. Clair Mining Company owns 138 acres of land adjoining the Phœnix on the west and the Eagle River property on the east. In 1863 the company started operations on a fissure vein about 10 inches wide. Shafts were sunk on the southern slope of the greenstone and the rock was trammed to the old mill at the foot of the bluff.

The company erected a stamp mill with 12 heads in 1872. The panic of 1873 came soon after its completion, work was suspended, and the property went into the hands of the creditors, who held it until 1879, when the company was reorganized with \$1,000,000 of capital. A small assessment was levied and operations were continued for some time in a crude and primitive manner, but without satisfactory results.

The capital stock of the company is divided into 40,000 shares.

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### **Star Mining Company.**

The territory of the Star Mining Company consists of the east half of section 9, town 58, range 28. In 1851 the company commenced operations on a fissure vein south of the greenstone and continued its explorations there until 1857, when two shafts had been sunk, one to a depth of 300 feet, and \$70,000 expended. Work was then abandoned.



## Ontonagon County Properties.

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In the years gone by the only form of copper which possessed any commercial value were the large pieces known as mass copper, and the barrel copper. This was due to the inability of the miners of that day to economically treat the rock for the separation from it of the copper. The only form of stamp mill then used was the small drop stamp of from 800 to 1,000 pounds weight, which had a capacity of from one and one-half to two tons per twenty-four hours.

A few of these mills were located in Ontonagon county, but as a rule were placed at the mines, where the only available water was such as was collected in dams, the result being, in nearly every case, that such mills could not run more than one-tenth of the time and proved commercial failures. Only a very small proportion of the stamp rock in these mines, and that of the richest, was treated. The criticism which applies to the mill practice at that time will also apply to all branches of the mining then done. Compressed air and power drills were used in only a few instances: high explosives came into use but a short time before the mines suspended operations, and in the majority of cases the hoisting and other machinery was of the poorest description. These criticisms are not directed against the management of these mines at that time, but against the then universal practice of attempting large mining operations with little or no working capital, relying on the output of the mine to equip the property and meet all the cost of operating it. That these properties, under such adverse conditions, were able to carry on work year after year, in some cases even accumulating a surplus, is surprising, and indicates what they will be capable of doing under modern methods and with a large working capital at their command.

It would be of no special interest to investigate the methods of mining and milling employed by these old companies, for it is a thing of the past and has given way to more modern practices in all branches: neither would an examination of the old accounts, showing costs, etc., be of much use, save to satisfy one's curiosity. The old companies

labored under serious disadvantages of all kinds, the greatest of these, perhaps, being the lack of adequate working capital. All these old companies practically ceased operations about 1883, and it is since then that the greatest strides in the copper industry, such as the marked improvement in the methods of stamping and concentration of product, with the consequent reduction of cost, have been made. The old Ridge mine accounts show, for example, that the cost of stamping ran as high as \$2.25 per ton of rock, while a recent report of mines in Keweenaw county for the year 1898 shows the cost for stamping, per ton of rock treated, to be less than 25 cents. One thing which is, perhaps, more responsible than anything else for the great reduction in costs of all kinds is the magnitude with which such operations are at present conducted.

A brief outline of the formation and character of the veins in which the copper occurs in the mines of Ontonagon county will possess interest and value as an introduction to the descriptive treatment of the properties in the succeeding pages.

The trap belt, which is locally known as the "copper belt", passes from the northeastern extremity of Keweenaw Point in a general southwesterly direction through the counties of Ontonagon and Gogebic into the state of Wisconsin. This trap belt in Ontonagon county is from two and one-half to four miles wide, and includes several amygdaloid, and at least two or three conglomerate, beds. The general strike of these veins is that of the trap belt, northeast and southwest, and the dip is to the northwest at an angle approximating 46 degrees. Five well defined amygdaloid veins which pass through the properties in this county were formerly worked, and these are the only ones which at present possess any importance. Each of these five veins is locally known by the name of the property on which it received the greatest development. Thus, the most southerly one of the group is known as the Evergreen; the next to the north the Ogima; next the Butler, or Champion; next the Mass, and the most northerly the Knowlton. The general strike and dip of these veins is the same, but some work done on the Mass property indicates a possibility that the Mass, Butler and Ogima veins may possibly come together at some depth, there being a slight convergence in the dip of these three. Still this is only a probability, as a local change in the foot-wall of the veins may be the cause of this apparent convergence.

Native silver and the usual minerals, such as epidote, calcite, etc., are associated with the copper in these veins. The copper occurs in large masses, these sometimes being as much as several hundred tons in weight; in small masses called "barrel copper", and it is also disseminated through the vein material in fine condition, this being known as "stamp rock".



There is much speculation at present regarding the percentage of copper which the Ontonagon veins carry. On this point Mr. E. A. Wetmore of Marquette, a consulting engineer of high standing, who recently made an exhaustive examination of the Mass Consolidated property for the Boston Stock Exchange, preliminary to the listing of the company's stock on that exchange, says, in the course of his report:

“There is, perhaps, no question of greater importance, or one harder for an engineer to determine, in relation to a native copper property, than the average percentage of metal that the rock will carry, and this is particularly true of veins which are classed as ‘mass’ veins. The only way to even approximate the true percentage is by an actual test on a large quantity of the rock. Owing to the conditions surrounding these mines it was impossible to do this, but in looking over the old books and accounts of the different companies I was fortunate enough to find data of actual work extending over a number of years, which gives this result in a satisfactory manner. By taking from these statements the total number of cubic feet of rock broken each year, and the total number of pounds of copper produced, I was able, for the years in which these accounts were kept, to give, approximately, the percentage of copper. Thus, in 1869 I found the percentage to be 2.31; in 1870, 2.70; in 1872, 1.96; in 1873, 1.65; in 1876, 2.62, and in 1877, 2.25. These results are for the old Ridge mine. At the Mass the accounts were not kept in the same manner, but I was able to arrive at a result of 2.32 per cent, which is probably nearly correct, as it agrees very closely with the Ridge results. Whatever difference there may be between the percentage of copper in the Ridge and Mass probably results from the fact that the Mass mine had a small stamp mill of its own, and did not confine its operations to as rich, selected ground as the Ridge. In the future workings of these properties the percentage of copper will necessarily be reduced from the fact that in conducting operations on a so much larger scale great quantities of lower grade rock will be stamped. This, while reducing the percentage will, at the same time, increase the product.”

All the records of the operations of the old companies which worked mines in Ontonagon county years ago—before the properties could be provided with proper transportation facilities, and while modern methods of mining, handling and treating the rock were either unknown or in the experimental stage of their application—go to establish that they will prove wonderful producers when afforded the advantages that were then denied them, and backed, as they now will be, by ample capital. It is entirely safe to predict that the movement for the development of these properties which has sprung from the present demand and high price for copper will bring, as one of its

results, the creation of a valuable copper mining industry in Ontonagon county, with a group of producers established on a solid basis there which will make a marvelous showing as dividend-earners in the very near future.

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### **Adventure Consolidated Mining Company.**

The renewal of mining operations on the Evergreen range in Ontonagon county was inaugurated by the Adventure Consolidated Mining Company. The lands of the company consist of 1,506 acres of mineral territory, and include the old Hilton, Adventure and Knowlton properties, which in the past produced copper in quantities sufficient to justify the new company in taking hold of and working them on a large scale, employing modern methods.

All the known veins of the South Range, otherwise known as the "Evergreen Range", run through these properties. Among them may be mentioned, in their order from north to south, the Knowlton, Mass, Champion (or Butler), Ogima and Evergreen, each well defined and productive of copper, not only where opened in the above mines, but also on adjoining properties. The dip of the lodes which intersect these properties is about 45 degrees. In the old Knowlton mine the strike is north 43 degrees east, while in the Adventure and Hilton it bends to north 75 degrees east.

The Knowlton company was originally organized in 1853. The shafts sunk on this vein never reached any greater depth than 240 feet. The mine had produced down to 1866 about \$240,000 worth of copper. For several years after it was worked at a profit by tributors, who extracted large quantities of copper under the old system of mining. The underground openings comprise three shafts on the Knowlton vein. No. 1 was 100 feet deep, and the other shafts 240 and 200 respectively. The veins outcrop along the high bluff on the Knowlton diagonally across the section for a distance of about a quarter of a mile, while, owing to a divergence of the boundary lines at a depth of 2,000 feet, the levels could be opened for more than a mile in length.

The Knowlton vein was first opened on this property; it has a width ranging from twelve to twenty-eight feet, and is considered the best of the Evergreen Range lodes. The matrix of the vein is epidote, quartz, calcite, chlorite, etc., and the copper occurs in the form of heavy masses, as well as stamp rock, the proportion being about one-third of the former and two-thirds of the latter. Operations have not

as yet been commenced on the Knowlton branch by the new company, but it will undoubtedly receive attention in the near future.

The Adventure is one of the oldest mining properties in the Ontonagon district. It began in 1850 with a capital stock of \$200,000, divided into 1,000 shares. Desultory work was done for years under primitive methods on the Butler vein, from which more or less heavy copper was taken, and within the past year tributors have taken out a twenty-four ton mass from these openings. About nine years ago the old Adventure company sank a shaft on the Knowlton vein to a depth of about 200 feet on the property and drifted about 100 feet on each side on the second level. This work exposed some very rich ground. But owing to the lack of facilities for systematic mining, and the then low price of copper, work was suspended and the mine allowed to fill with water. About two months ago this part of the mine was unwatered and heavy masses of copper are now to be seen lining the roof and sides of the levels above referred to. These levels are now being extended east and west, and about 1,400 feet eastward No. 2 shaft is being sunk from surface near the point of the bluff. All along from the western boundary to No. 2 shaft, a distance of about 2,500 feet, the vein has been well explored by numerous pits and other openings, in all of which its character is about the same as in the first shaft. Operations will commence on the Butler lode during the coming month or so, by which time the necessary mining machinery will have been installed. This vein is 400 feet south of the Knowlton lode on the Adventure, and is more properly a mass copper formation, carrying also a very large proportion of silver.

An adit level on the Butler vein, commenced at the point of the bluff and extending westward, would open up about 2,500 feet of vein with backs 300 feet high. On this property eastward but little exploratory work has been done. However, a few pits have been opened which disclose the same lode characteristics as are found on the western part of the property.

The work will be prosecuted extensively and with vigor on the Knowlton vein, owing to its large proportion of stamp rock, while the other veins will be worked in connection with it and reached through adits and cross-cuts. No. 1 shaft on the Knowlton vein, above referred to, is located 1,000 feet east of the Ridge boundary and the lode at this portion of the mine appears to be as well charged with copper as at any other point on the property.

The eastern portion of the Adventure Consolidated comprises the Hilton property. The old company was organized in 1863, when a couple of small shafts were sunk on what is supposed to be the Mass vein. Later tributors sunk shafts on the Knowlton vein, which produced about the same proportion of copper as was found in this lode

on other properties. No machinery was introduced at the Hilton, and the only hoisting apparatus ever used was a horse-whim, or man-power. The developments made by these crude means proved the undoubted mineral value of the property, and it will now receive proper attention with modern mining appliances.

All the veins traverse the old Adventure and Hilton properties for a distance of about two miles, and shafts can be sunk for about a mile before reaching the boundary line.

The Adventure Consolidated mines are situated in Greenland township, the works being about half a mile from the village of Maple Grove. Railroad connections are furnished by the Chicago, Milwaukee & St. Paul railway, the nearest point being at Greenland station, about two miles distant. A branch will be extended from this road to the mine the coming summer. The Copper Range railroad, to be built this year, will likely have its southern terminus at Greenland.

Work at the Adventure was commenced by the new company in November last. Plans have been matured and machinery has been ordered for opening and working the mine on a large scale. Offices and shops have been built and a number of dwelling and mine buildings are in process of construction. An admirable mill site on the shore of Lake Superior, about four miles east of Ontonagon, has been purchased. By the time the new stamp mill is built the mine openings will be sufficiently advanced to supply it with a full quota of rock.

The local officers are Samuel B. Harris, general manager; B. F. Chynoweth, superintendent; Thomas Trevarrow, mining captain.

The company was organized October 17, 1898, with a capital of \$2,500,000, divided into 100,000 shares of a par value of \$25 each. \$500,000 of the capital has been paid in. The eastern office is in New York. Thomas F. Mason is president and William R. Todd, secretary and treasurer.

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### **The Mass Consolidated.**

The Mass Consolidated Mining Company now owns what was largely the property of several old and well known mining companies, all of which figured more or less in the earlier development of the copper industry on Lake Superior. The properties thus united are the Ridge, the Mass, the Merrimac, the Ogima and the Hazard. In addition to these, quite an acreage of new mineral territory and wood lands has also been acquired. The company now owns something

over 2,500 acres of land, all located in Greenland township, Ontonagon County. The distance from Ontonagon, the nearest harbor on Lake Superior, is twelve miles. A branch of the Chicago, Milwaukee & St. Paul railway, running from Milwaukee to Ontonagon, passes through the company's mineral lands, which is a very important consideration in the opening up of any mining property. A new company, called the Copper Range Railway Company, has made a survey from Portage Lake to Rockland, and construction work on the road has already been started. The D., S. S. & A. R'y has also made a survey of a line from Baraga, on L'Anse Bay, to Rockland. The company, therefore, has the choice of three locations for a mill site: one at Ontonagon, one at Portage Lake, and the third at L'Anse Bay. Local considerations, such as freight rates, favorable site for stamp mill, etc., will determine which location will be selected.

The property is traversed, in their order from north to south, by the Knowlton, Mass, Champion, Ogima and Evergreen lodes, for a distance of about a mile and a half.

The Ridge mine paid out \$100,000 in dividends from the openings on the Butler and Evergreen lodes, and this under the old system of development. At this mine Nos. 1, 2 and 3 shafts were sunk to depths of 100, 600 and 700 feet, respectively, on the Butler lode. A shaft was also sunk 80 feet deep on the Evergreen vein, on the extreme east boundary line of the property, about eight rods from No. 3 shaft, and makes a fine showing of copper, as well as proving the continuance of the lode. This vein can be worked from No. 3 shaft to a depth of over 3,000 feet before reaching the eastern boundary line. It was thought by the old management that the fortieth level could be extended west several hundred feet to the boundary line, and that it would produce several thousand tons of copper from there to surface. Notwithstanding the fact that the Ridge property never had the advantage of modern mining appliances, it has yielded in the past 4,000 tons of copper. The yield per fathom of ground broken has been from 500 to 800 pounds of mineral, yielding eighty per cent ingot copper. The stamp rock of the mine has yielded as high as  $2\frac{1}{2}$  per cent in mineral.

The Evergreen vein greatly resembles the Knowlton in general character, but contains less stamp rock. It varies in width from six to twenty feet and dips at an angle of 45 degrees. The Butler lode lies between the Knowlton and Evergreen belts. It is a wide vein, running sometimes to a width of 30 feet, and contains mass copper principally. This was the most extensively worked vein in the Ontonagon district, it having been explored from the mines at Rockland eastward to the Houghton county line. It was opened in several places on the old Mass property, as well as on the Ogima, Merrimac and Ridge. During 1874 work was started at the Mass mine, when

the company had a capital of \$20,000, and in the five years following \$500,000 worth of copper was produced. Prior to this, in 1864, some work was done on the Evergreen lode, but little was accomplished. During the active period of the mine's existence, following 1874, \$14,000 was realized from assessment and work was started with the extension of a cross-cut through the bluff, opening up all the different veins at a distance of about 100 feet below the surface, where they were found to be regular away from surface overflows. In addition to the different pits on the outcrops of the lodes the several veins were thoroughly examined in this crosscut. The Knowlton vein seemed to afford the greatest proportion of stamp rock from which a regular product could be realized, and future operations were confined to this vein. The wisdom of this policy was demonstrated later by the large product secured from the Knowlton, from the profits of which the company was enabled to purchase hoisting machinery, air compressors and air drills, and to make many improvements and build a stamp mill.

In sinking No. 1 shaft on the Mass to the adit level, forty tons of copper were obtained, while a large amount of heavy copper and rich stamp rock was secured from the stopes on each side. The product from this vein consisted of thirty-five per cent of masses and heavy copper and sixty-five per cent of mineral from the stamp mill. The Knowlton lode continued in this form to the lowest workings. About sixty tons of rock per day was stamped in the mill. The location of the stamp mill was the bank of a small stream on the Mass property, this being, at the time of its erection, the only available site. The stream supplied ample water until the surrounding timber was cut down and consumed for fuel. After this the stream dried up, and the company, being thus deprived of milling facilities, shut down the mine in 1886. Since that year tributors worked the property and shipped several carloads of copper each year from the old stopes.

The other lodes on the Mass property have not been extensively worked. Some work was done on the Butler in surface pits, and some drifting from the tunnel extended across the various lodes. All these openings produced a large proportion of heavy copper but very little stamp rock. In the Mass vein, lying between the Knowlton and Butler lodes, a shaft was sunk to a depth of about 100 feet. This vein is much like that of the Butler in character, it producing heavy copper and but little stamp rock. The dip of the Mass vein is greater than that of the Butler, and it is believed that both veins will unite at a depth of somewhere about 800 feet, when they will form a lode of large proportions.

In December of last year The Mass company selected as its general manager Thomas F. Cole, a mining man of wide experience, who

at once began to formulate his plans for the future operation of the mine. Work was commenced in January of this year at the Ridge branch of the property, and by the following month a large pump was put in service unwatering the mine. At this writing preparations are under way to prosecute work at the Ridge branch just as soon as this can be done. A new hoisting engine has been ordered and large contracts have been let for the necessary timber and fuel. Several new shafts will be started on the property the coming summer. The openings will be extended with the utmost energy, so that the mill, when built, can be supplied with all the rock it can handle.

With the history of the successful operations on the Knowlton vein in the Mass branch and on the Evergreen vein in the Ridge branch, together with the heavy copper and stamp rock that will be available from the Butler and other lodes in all the mines of this group, and with the facilities that can now be afforded for operating the mines, there seems to be no doubt of the great value, as a producer, of this property.

The company owns about twenty dwellings, besides offices, barns and shops. The available machinery consists of two hoisting engines, an air compressor capable of running twelve drills, machine shop with equipment of tools, and sundry small other engines and pumps. The local officers are Thomas F. Cole, general manager; Richard Trezona, mining captain.

The company was organized February 1, 1899, with a capital of \$2,500,000, divided into 100,000 shares of a par value of \$25 each. Of the capital \$800,000 has been paid in. The company's eastern office is in Boston. The officers are Edward E. Floyd, president, and Chas. H. Bennett, secretary and treasurer.

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### **The Michigan.**

The Michigan property embraces 4,780 acres of mineral lands, and presents an immense field for future operations. In addition to the Calico lode, there are several others of a most promising character known to traverse the property. Covering, as this property does, a complete cross-section of the copper range, it necessarily has within its boundaries not only all the lodes which gave the old Minnesota—by which name the mine was formerly known—its greatest reputation, but also all the series of lodes known as the Knowlton, Mass, Champion, Ogima and Evergreen.

The Michigan mine is located within a mile of the Chicago, Milwaukee & St. Paul railway, near the beautiful and historic village of Rockland, once the greatest copper mining camp in the world. The history of the old Minnesota mine is one of great interest, it having been among the first in the district to attract attention in mining circles. In the early fifties it enjoyed comparatively as great a prestige as does the Calumet & Hecla today. The signs of pre-historic mining were first discovered on this property, several pits having been found which contained unmistakable evidence of having been opened centuries ago, while stone hammers and other crude implements are still picked up in the vicinity of the mine.

One of the largest masses of copper ever found, weighing 527 tons, was taken from the Minnesota in 1856. The discovery gave the mine a world-wide reputation. Accounts of the huge masses of native copper found in this mine were published everywhere and almost staggered belief. Masses weighing hundreds of pounds were purchased and taken to Europe as curiosities. The Minnesota affords an instance of the most extraordinary profits derived from a small investment in a legitimate industry, as for every dollar paid in the stockholders received nearly thirty in return. The company was organized in 1848, with a cash capital of \$66,000. All further cost of opening and equipping the mine was met by the sale of its product. This, it should be remembered, was accomplished prior to 1863, when the upper peninsula was without a railway, and when the machine drills, giant powder, high service machinery and the various labor-saving appliances of the present day were undreamed of. At that time hand-drills, black powder and old-style windlasses were in general use.

With its deepest shaft down 1,300 feet, the Minnesota mine suspended operations in 1870. At that time the conglomerate lode, from which the greatest amount of mass copper had been secured, was yielding poorly, and the company was threatened with a deficit. Instead of continuing the development of the property, the directors decided to abandon work, believing the copper vein to have been exhausted. The records of the company show that Superintendent Harris urged the directors to sink the shafts deeper, but work was discontinued even in the light of the knowledge that mass copper was again showing in the bottom of two shafts. It would have been necessary to assess the stockholders in order to continue operations, and those who had been in receipt of fat dividends for years flunked on that proposition, preferring to discontinue operations rather than take the risk of a slight loss. It is firmly believed by those now in possession of the vast property that this decision was a great mistake, as the history of copper mining in this district since shows that some of the richest ground in the leading mines was encountered at great depths. It would, indeed,



be strange if the conglomerate vein in the Minnesota ceased to be productive at a depth of but 1,300 feet. Some of the leading producers of the present day have found the metal but sparingly at a similar depth, and when it is remembered that no lode on the entire range has been exhausted at the lowest depth yet reached, the immense possibilities of the Michigan become at once apparent.

When the old Minnesota was a dividend-payer, the company, like others at that time, was looking for mass copper only. The existence of the stamp rock lodes was well known; but it was not believed it would pay to work them, owing to the lack of facilities for treating the rock, now so readily obtainable. There are many still residing in this section who remember the time when the claim that rock running from two to three per cent could be mined at a profit was treated with derision.

The reports of the mine superintendent show that the developments on the Calico lode and the South Range veins of the property proved that they yielded a great abundance of rock carrying a high percentage of copper.

The official above mentioned, who has long since crossed the dark river, finally prevailed on the company to treat the Calico lode by means of a system of rollers. These were put in at a great expense and afterward proved an entire failure. From the standpoint of today, it is incredible that such a process should have been favored, especially as the Ball stamp was at the time by no means an untried experiment. However, the rolls were a failure, having been poorly constructed, and although the results showed that the rock ran two per cent in mineral, treatment of it by this process was abandoned, proving too costly.

When the Michigan Copper Mining Company was organized last June by Detroit capitalists to develop the Minnesota property, Samuel Brady, the well known mining engineer and expert, was selected to take charge of the work. Mr. Brady was convinced of the commercial value of the Calico lode and at once began operations in the old mine with a view to reaching the old workings on the lode mentioned. This he was finally successful in doing, through the medium of No. 10 shaft in the south vein of the old mine and a cross-cut 140 feet in length from the third level. At the intersection of this cross-cut with the north vein, a cave was taken up and communication established. This exposed a level on the Calico lode about 90 feet in length, in the back of which some little stoping had been done, showing some excellent copper ground. From the back of this level, 55 feet west of the cross-cut, is a winze, affording connection with the second level about 60 feet above. This level is 200 feet in length, and presents a fine opportunity to examine the lode, especially

as a considerable portion of it had been stoped, and a great part of the ground so broken was never removed. It was ascertained that the lode varied in width from 10 to 12 feet, its dip and strike being conformable to the main Minnesota conglomerate. The richest portions of the lode in these old workings appear to be on the footwall side, though the copper frequently makes well to the hanging. The footwall side of the lode is a compact melaphyr, while the hanging, or upper bed, is much more amygdaloidal in character, but carrying with it frequent masses of felsitic rock and occasionally fragments of what appear to be a highly altered sandstone. Intermixed with this bed are frequent masses of epidote and considerable calcite. The peculiar green, reddish and brown colors of this lode have given it the name "Calico". Two shafts, known as "A" and "B", are being sunk on this lode. "A" is a triple-compartment shaft, 7 x 18 feet inside of timbers, and contains two skip ways and a pipe and ladder way.

It has attained a depth of 200 feet, at which point drifting has been commenced east and west on the lode. The drift east 975 feet to "B" shaft is being extended with all possible dispatch. The equipment at "A" shaft consists of a double drum hoist, adequate for all purposes to a depth of from 500 to 600 feet. Since starting work at this point upon the Calico lode this shaft has been continuously in pay ground; evidence of the truth of this statement will be found not only by a careful examination of the ground opened, but also in the handsome pile of rich stamp rock which has accumulated since starting the work of sinking. "B" shaft, which has a present depth of nearly 300 feet, is a double-compartment shaft, 7 x 12 feet inside timbers to a depth of 200 feet. From that point down it has been enlarged to the same dimensions as "A" shaft. Later on it will be cut down from surface to the enlarged size. At the 200-foot level a splendid station has been cut, and drifting has been started east and west on the lode. Both drifts are very promising in character and at present fully support the promise given not only in "A" shaft, but also in the deeper and older workings on the third level, of the uniform mineralization of the lode. The equipment at "B" shaft consists of a battery of two 100-horsepower boilers, operating a single-drum hoist and a compressor having a capacity for from 10 to 12 drills. A great part of "B" shaft has been sunk in the footwall side of the lode and when the cutting of the station at the second level was started no glimpse of the lode had been found for about 60 feet. It is but just to state that the exposures made by this work are fully satisfactory to the management.

The lode traverses the property for a distance of a mile and a quarter. The strike of the lode is north 64 degrees east and the dip 46½ degrees. Indications point to a width of the lode where exposed of from 12 to 14 feet. A recent discovery of old maps discloses the prob-

able existence of another amygdaloid belt which tradition states is a promising stamp vein, and upon which it is the intention of the management to prospect in the very near future.

The coming summer will see considerable done in the way of erecting dwellings and various mine buildings, including machine and carpenter shops.

The Michigan Copper Mining Company was organized June 5, 1898, with a capital of \$2,500,000, divided into 100,000 shares of a par value of \$25. The company's last statement shows assets amounting to \$295,000. The main office is in New York. John Stanton is president; J. W. Hardley, secretary; J. R. Stanton, treasurer.

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### **Victoria Copper Mining Company.**

The Victoria Copper Mining Company owns 2,300 acres of mineral lands, comprising the old Victoria, Sylvan, Glenn, Shirley and Oneida properties, located about four miles west of Rockland and next on the range to the Michigan and National mines.

The earliest copper mining in America was probably done on this property. In 1770 the attention of Alexander Henry was directed here by the existence of a large mass of float copper lying on the bank of the west branch of the Ontonagon river. This mass of copper was held in veneration as an object of worship by the Indians, long before white men invaded this region. After the cession of this territory to the United States government by the Chippewa Indians in 1842, this mass of copper was removed, and was presented to the Smithsonian institute at Washington by a Mr. Eldred. Mr. Henry sunk a shaft through the clay, expecting to strike the copper formation, but it reached the sandstone. With the advent of mild weather the openings caved in for lack of supports and he suspended operations, which had been commenced a century too early. The property is traversed by all the veins of the Evergreen and Minnesota ranges, upon which are situated the Michigan, Adventure, Mass, Belt and other well-known mines.

The old Forest Company, preceding the Victoria Mining Company, was organized in 1850, and commenced operations on a vein that is probably identical with the Evergreen lode, which it closely resembles. At that time the other veins of the series were not known to any extent. Four shafts were sunk, each to a depth of about 250 feet, and were connected with levels. A stamp mill was erected on the west

bank of the Ontonagon river. The mill was connected with the mine by a horse tram-road and incline about a mile and a half long. Considerable stoping was done, and selected rock treated in the mill yielded good results until the mill was accidentally destroyed by fire in 1859. A new mill was constructed, but the advent of the civil war and subsequent business reverses caused a cessation of work; since which mining has been confined to what was done by tributors. During the past 15 years the property has been wholly idle.

The large tract now owned by the Victoria Company is traversed for a mile and a half by lodes which can be wrought to unlimited depths without leaving the company's lines. The character of the Evergreen vein is similar to that of this formation as found elsewhere. At the Victoria it varies from six to twenty feet in width, with the copper forming in bunches, some of which are very rich. The machinery has long since been removed, but will now be replaced by a modern plant, which has already been ordered by the new company. A valuable adjunct to the mine is the Glenn Falls water power, situated on the west branch of the Ontonagon river on the property. This has been estimated by competent engineers at over 4,000-horse power, and it is the intention of the company to utilize it for the generation of power to be used in operating the mine. Captain Thomas Hooper was appointed superintendent of the property recently and is now on the ground arranging for its early development on a large scale.

Surface work under the new company was begun March 1, 1899. The company was organized January 23, 1899, with a capital of \$2,500,000, divided into 100,000 shares of a par value of \$25 each. Of the capital \$700,000 has been paid in. The eastern office of the company is 539 Exchange Building, Boston. Hon. T. B. Dunstan is president; James P. Graves, secretary and treasurer.

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### **The Belt Mine.**

The property known as the Belt mine consists of about 2,000 acres of mineral and timber land, located in Greenland township, Ontonagon county, between the Adventure and Indiana mines, and comprises what was formerly known as the Bohemian and Great Western mines, which were worked in the early days on a small scale. They passed into the hands of the Belt Mining Company by purchase in 1882.

The five veins of the Evergreen range pass through the property, a mile and one half in length, but only three of these have been opened up. The old mining work was done on the Butler vein, on which

two shafts have been sunk to the third level, and have produced several hundred tons of copper. Prior to its sale to the Belt Company, tributors had worked out all the copper ground.

On the Evergreen vein, the most southerly of this group of veins, no systematic mining work has ever been done. Tributors, however, have been very successful there, and from one pit on the outcropping of the vein they took out over sixty tons of mass copper.

The Belt Company decided to open a new mine on the Knowlton vein, the most northerly of the Evergreen Range. On this vein the company did considerable work, sinking three shafts, two of which are connected at the fourth and second levels, one being sunk to the third level. The strike of the Knowlton vein is north 70 degrees east, and its dip 40 degrees toward the northwest.

The vein in the vicinity of Knowlton shaft proved to be of more than ordinary richness, and the ground now in sight in both levels in the west end of the shaft is unusually rich. Under ordinary conditions, the promising appearance of this vein would have induced the foreign owners to continue sinking in the Knowlton shaft for several hundred feet, and to press forward the openings enough to supply the mill with selected rock, and expand the works of the mine so as to render it profitable. But having exhausted their resources in the premature construction of the mill and erection of the mining plant, and being disappointed with the results of stamping unselected rock from the Butler vein, which is not a stamp lode, they declined to make any further expenditure and suspended operations without proving what is considered to be the best part of the property.

During the sinking and drifting in this new mine, the Belt Company took out and sent to the stamp mill 700 tons of rock, which yielded one and one half per cent of refined copper. After this, in 1884, the board of English directors, with their engineer, came over and visited the property. Under their direction several blocks of ground were measured off in different parts of the mine and all the rock mined there was sent to the mill. The result was a yield of copper of over two per cent. The rock also contained some mass and barrel copper, which would have brought its yield up considerably higher.

Satisfied with the test made, the mining captain was told to furnish the mill with the required amount of rock, about two hundred tons per day, but he had not ground opened to produce it, and all the company's money had been spent on the mining plant and surface improvement. The company was working on borrowed capital. Copper had dropped from 20 cents when it commenced mining to 10½ cents, and the company became discouraged, wound up its organization and turned the property over to the bondholders, who foreclosed the mortgage and sold it to the present owners.

A new organization has been formed and the property is now owned by the Arctic Copper Mining Company, which will commence active operations at once.

With the conservative and efficient management which marks the affairs of the Lake mining industries of today, the Belt gives every promise of becoming a profitable producer at an early date, as it has a splendid mining equipment ready for work, all modern and nearly new. The equipment consists of an up-to-date stamp mill, built for three heads of Ball stamps, only one of which has been erected. The mill is supplied with an engine and boiler capable of furnishing power to run the three heads, forty washing machines and two slime tables; also one large pump 14"x24", with water cylinders double, 20"x30".

The Knowlton shaft is equipped with two large hoisting plants and one small one. The Butler vein is provided with a small hoist and rock house with high speed engine, 12"x16", and two Blake rock crushers, a double compressor capable of running 32 drills, with engine and boiler, and seven Rand drills, sawmill complete, a roundhouse with a 20-ton locomotive and a railroad from mine to mill. There are 25 tenable dwelling houses, an agent's house, store and office building, a warehouse, supply house, powder house, school house, boarding house, several barns, machine and blacksmith shops, and all the buildings and machinery are ready for immediate service. Water and timber are abundant on the property. The Chicago, Milwaukee & St. Paul railroad passes within two and one-half miles of the property, and the Copper Range railroad will pass through the property near the mine and mill. There is every reason to believe that the current year will see the Arctic on the list of producing mines.

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### **The National.**

Next to the Minnesota, the National was the greatest copper producer ever developed in Ontonagon county. Its mineral lands embrace 1,852 acres adjoining the Michigan, formerly the Minnesota, on the west, and contain the same rock formations and characteristics as the sister property.

Mining work was commenced there in 1852 on the contact lode between the conglomerate lode and the overhanging trap, and was continued until October, 1870. The outcrop was plainly marked by ancient excavations, from the bottom of one of which the first shaft was sunk.

The property has been idle for about five years. Nine shafts were sunk, of which the deepest, No. 2, had attained a depth of 1,400 feet. In the amygdaloid stamp vein, which lies 140 feet north of the conglomerate lode, one shaft was sunk to a depth of about 700 feet. All these openings produced large quantities of copper, from the sale of which dividends amounting to \$320,000 have been paid.

The company is organized with a capitalization of 40,000 shares of a par value of \$25 each, and is about to be reorganized. It is expected that work will be resumed at an early date.

The machinery consists of a large hoisting engine in place and two others in stock. The stamp mill contains one head and all necessary machinery for treating about 250 tons of rock daily. There is also at the mine a well equipped machine and blacksmith shop, mine offices and a number of desirable dwellings sufficient to furnish accommodations for a large force of men. The property is controlled by D. L. Demmon, of Boston.

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#### **Wahnita Copper Mining Company.**

The Wahnita Copper Mining Company was organized February 9, 1899, with a capital of \$2,500,000, divided into 100,000 shares of a par value of \$25 each. Of the capital \$500,000 is being called in.

The company's lands comprise 400 acres, as follows: South half of northwest quarter of section 8, southwest quarter of section 8 and northwest quarter of section 17, in township 48, range 43. The location is about four miles west of Gogebic lake.

Copper was discovered in an amygdaloid vein traversing the property in 1852, when, and for some time following, explorations were conducted there. The lode was exposed for a distance of 500 feet and is believed to traverse the property for a distance of 3,000 feet. Those who saw the property in its early development speak very well of the showing then made. Captain John Wealton has been placed in charge and work will be commenced at once. The eastern office is in Boston. J. B. Fuller is president, F. H. Clark treasurer, and Henry F. Whitney secretary.

### Other Ontonagon Properties.

The Jeffs Land Company owns about 800 acres of mineral lands in sections 7, 8, 9 and 10, township 50, range 39 west, adjoining the Michigan on the north and west, upon which some work is now being done to prove one of the lodes which traverse the property. Two pits have been sunk on the lode. These sinkings are about half a mile apart, one being on the east half of the southwest quarter, and the other on the west half of the southeast quarter of section 9. There is a good showing of copper in each of these pits. The width of the lode has not yet been determined. The work was begun late in the winter and much trouble was experienced on account of water during the early spring, but it will now be pushed energetically, the company having great confidence in the value of the property. A conglomerate lode crosses the property about one hundred feet north of the lode on which work is now under way, and the lands of the company are traversed by several other lodes which give surface indications of much promise.

During the past two years exploratory work has been conducted at the Halliwell and Carp Lake mines. At the Halliwell three shafts have been sunk on three different lodes that were recently discovered on the property. The mine is equipped with a neat little plant, consisting of a small hoist, air compressor and saw-mill, adequate for the present purposes and enclosed in substantial buildings. Six men are employed and others will be taken on at an early date. The mine is situated about two miles south of Union Bay and eighteen miles west of Ontonagon. It is owned by Cleveland parties, who have great faith in its future.

This mine was set off from a large body of land owned by A. Meads of Marquette and the Halliwell Estate of Cleveland, Ohio. The balance of this body of land, 3,280 acres, lying south and west of the Halliwell mine, will go into a syndicate being formed to examine and open other copper veins that have been found on the land.

The old Carp Lake mine lies north of Carp lake and six miles west of the Halliwell. During the past year the old adit was opened up for a distance of several hundred feet and the lower portions of the mine were unwatered. The workings in this mine are in a fine-grained brown sandstone, in which the copper occurs. A man is now in charge of the property and it is expected that operations will be resumed two months hence. This mine is also owned by Cleveland parties.

Efforts are being made to consolidate and operate other mines in



the county, notably the Lake Superior and Flint Steel. The mineral lands lying easterly from the Belt toward the Winona are being given attention and will be exploited before the season is over. The Nonesuch, lying in the Carp Lake district, and the Norwich and Essex, lying about twelve miles west of Rockland, and other properties in that direction, can also be added to the above list.

The Essex mine, formerly known as the Norwich, has been sold to a syndicate of Boston and Lake men who will at once commence to unwater the workings and develop the mine, being confident that it will prove a very valuable property. The mine was in its early days a great favorite with Lake people, and has produced over five hundred tons of copper. Many masses of from one to ten tons in weight, very clean and pure, were taken out. The west branch of the Ontonagon river runs through the property, providing sufficient water for a large mill.

The Penn property, located two miles west of the Winona, is already being looked over and is certain to have its claims given consideration during the year.

Many of Ontonagon's mines have been successful producers: their lodes are known to contain mass copper and stamp rock in abundance. In no part of the copper district of Lake Superior have the copper veins been more easily traced, nor found to be more persistent in length or depth, or so uniformly rich. Here was the Minnesota mine, which produced one of the largest masses of copper ever found in the world, over 500 tons. At the National, Flint Steel, Mass and Arctic, masses of 100 tons have been found, while at many of the other mines masses of from 10 to 40 tons frequently rewarded the labor of the miner.

Many who are intimately acquainted with the copper ranges in this part of the Lake Superior district maintain that the richest piece of copper territory in the Upper Peninsula lies in Ontonagon county, and that the future great producing mines of the lake region (excepting those on the Calumet lode), will be in the territory lying between the Ontonagon and Mercer Rivers, embracing the group of mines between the Winona and Michigan (formerly Minnesota) properties. Nothing to equal them was found in the early days of copper mining on Lake Superior, and with the modern equipments now being installed, and ample working capital, there is every reason to expect that the Ontonagon properties now entering on a new career under favoring conditions will soon take a place among the great producing and dividend-paying mines of Lake Superior.

## Western Lake Superior District.

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By Kirby Thomas.

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The explorations and developments on the extreme western end of the Lake Superior copper-bearing formation in Douglas county, Wisconsin, during the past year, are sufficiently extensive and promising to demand more than a passing mention in a Review of the Lake Superior Copper Industry. Seven mining companies, with an aggregate capital of \$11,500,000, are actively engaged in developing the properties on the Douglas range, and several more companies and many private holders of property in the Western Lake Superior Copper District are planning active work. The entire Keweenawan formation in northern Wisconsin and along the western edge of Minnesota is being prospected, and a general interest in the new district has been awakened, both locally and in Boston and other localities. The principal activity at this time is along the copper range in Douglas county, Wisconsin. This range, known locally as the Douglas range, is a series of outcropping spurs, of undoubted Keweenawan origin, which form a well defined range, extending in a southwesterly direction across Douglas county, about twelve miles distant from Lake Superior. The explorations and prospecting extend much beyond the Douglas range proper, and include nearly all the western half of the territory indicated as Keweenawan formation on the map from Irving's Monograph V, United States Geological Survey, reproduced at page 176. This map will be more specifically referred to later.

### Somewhat Historical.

When the great rush of people to the then "booming" city of Superior, Wisconsin, began, a little over a decade ago, the facts of the early attempts at copper mining in the Western Lake Superior District had already become history, and until about three years ago "Copper Range" was simply a convenient designation of a prominent

physical feature of the locality. No one except a few of the "old timers" ever thought of there being a veritable store house of treasure at the city's back door, as it were. The Superior boomers did not have time to look beyond the somewhat extensive city limits—and why should they? Did they not have a gold mine in each lot and parcel in the townsite? But townsite booms do not last forever, and as early as 1892 the attention of these energetic city builders at the head of the lakes was turned to the development of the tangible and lasting resources of the surrounding territory. Perhaps the Douglas Copper Range might have been opened up then, and speedily, had it not been for the marvelous discoveries of iron ore on the Mesaba. This range is about sixty miles northwesterly from Superior, and its development attracted for the time the full attention of local capital and enterprise. After a couple of years the large corporations secured complete control of this great natural resource, and the Mesaba took its high place among the greatest iron producing districts of the world under the absolute control of a monopoly. The time had come locally for the exploration of the almost forgotten "Copper Range". In 1894 several local parties set out to prove or disprove the stories of rich copper in the Douglas range. Joseph Huck of Superior made some copper discoveries about this time, in section 10, town 47, range 12. He succeeded in interesting local parties. The land was optioned and a small amount of work was done in the bed of Middle river, where the outcrop was found. About the same time Jas. S. Wallace, a former western miner, began a systematic exploration of the extreme western end of the range. Mr. Wallace associated with him B. J. Van Vleck of Superior, and Monroe Ross and the Culligan Brothers of Dedham, Wisconsin, and secured titles and options on considerable land in town 48, range 14. In the fall of 1895 work was commenced with a small force and continued through the winter.

This was the first actual mining on the Douglas range for over twenty years. The Culligan mine, as the location opened up by Mr. Wallace is now called, proved very promising, and extensive plans for its development were formulated; but the parties in interest disagreed, and bad blood and litigation cut short all plans and tied up, until very recently, one of the best copper prospects in the district. Meanwhile Mr. Van Vleck had become interested in the Huck property. In 1897 Mr. Van Vleck, with George B. Nobles, M. W. Nelson and J. B. Arnold of Superior, organized the North Wisconsin Copper Mining company to operate the Huck discovery. In the summer of the same year that the North Wisconsin company was organized, Charles S. Starkweather, then serving his second term as mayor of Superior, commenced work on the old Wisconsin mine, sometimes called the Edwards, but now known far and wide as the Starkweather

mine. This mine is located in section 2, town 47, range 13. In the spring of 1899 the Starkweather mine passed into the control of the Boston & Lake Superior Copper Mining company, a Boston corporation. The old Percival property was bought by J. B. Arnold and B. J. Van Vleck of Superior and several associates, in the early part of 1897, and in the following summer systematic exploration and development of it was begun. The Percival Copper Mining company, now developing the property, was organized the same year. The Fond du Lac location, in which Mr. Arnold is also interested, was purchased by him in 1894, and is now owned by the Superior & Boston Copper Mining company, organized in the spring of 1899. Early in the summer of 1898 Ernest A. Arnold began explorations on the Moose river, a branch of the St. Croix, emptying into that stream in section 35, town 44, range 13. This location is in the south central part of the county and about 20 miles from the operations on the Douglas range. Some very promising prospects were discovered, and Mr. Arnold and several associates, including Milwaukee parties, secured control of a large area of land in that vicinity—some 30,000 acres—and organized the St. Croix Consolidated Copper Mines. James Bardon, Homer Andrew, Josiah Bond and a number of others from Superior, did considerable exploring there along the copper belt from 1896 to 1898. These recent explorations and developments awakened a lively interest in the prospects of copper mining in the Western District. The geology of the district and the mode of occurrence of the copper were carefully studied; and, generally, a conviction grew upon those interested that there was copper-bearing rock in workable bodies on the Douglas range.

### **Early Attempts at Mining.**

In common with Keweenaw Point, the Western Lake Superior Copper District was, in prehistoric times, the scene of the crude mining operations of the vanished race known as the Mound Builders. Evidences of these very early attempts to make the rocks of this district yield up to man's many uses the red metal are numerous and well authenticated. August Zachau, one of the pioneers of the head of the lakes, many years ago discovered some Mound Builders' pits in section 13, town 47, range 14, just eastward of the present Fond du Lac location. G. R. Stuntz, government surveyor, several years ago found some small pits near the upper falls of the Black river, on the top of one of which was found a rude, broken stone hammer. He also discovered evidences of these earlier mines on Copper Creek, where

the Copper Creek mines have since been developed. These pre-historic relics were all found in town 47, range 14. Other evidences were found in town 47, range 13, on the site of the present Fond du Lac mine. William C. Howenstine, one of the early day copper prospectors, says that there were abundant evidences of mining by these unknown people on the range near the Brule river, where the Percival mine is now located. These evidences seem to indicate that this locality, which to this day abounds in surface nuggets and masses of copper in place, was a favorite mining ground for those pre-historic people. Mr. Howenstine is authority for the statement that considerable masses of the virgin metal, which had been partly removed from the parent rock with a stone maul, were found by the prospectors who came into this locality many years ago, centuries after these very earliest attempts at mining in this territory.

The recorded history of copper mining in this district begins in 1845. About that time the North American Fur Company, John Jacob Astor's enterprise, prospected the Douglas range and did some considerable work at two locations. One mine at the Lower Black River Falls was opened on a somewhat lean vein of grey copper ore. This vein is exposed in the gorge below the falls and is the only occurrence of this kind of ore so far discovered on the range. Some attempts were made at that point to mine a vein impregnated with carbonate of copper. Both of these deposits are low grade and refractory. Some work was also done on the range near the Brule, section 28, town 47, range 10, on land now owned by James Bardon. When abandoned the pit was filled with the trunks of large trees, put in endwise, for what reason is not known. The same company in 1846 and 1847 sank four shafts on the Copper Creek location to depths varying from 30 to 50 feet. The extreme difficulty under which mining operations were conducted at this very early day demanded immediate and very large returns, and no doubt the Fur company was glad to abandon this excursion into mining from the more profitable business of exchanging bad whisky and cheap trinkets for the furs and pelts of the Indians.

After a lapse of nearly ten years another attempt to develop copper mines on the Douglas range was made. In 1855 A. A. Parker and C. C. Kimball, both explorers from Ontonagon, Michigan, secured a location in section 8, town 47, range 13, from the government. A local company, with a capital of \$50,000, was organized and William George Cowell, also a Michigan miner, was secured to take charge of the work. About \$12,000 was expended in sinking two shafts, one to a depth of 40 feet and the other 75 feet. Roads were built and expensive buildings erected. It is worth noting that one of these shafts was inclined to the south, following the bed of the formation. Owing to lack of funds, work was discontinued after two years and the panic of 1857

made it impossible to raise more money. This property was abandoned until the present year, when the Superior & Boston Copper Mining company secured the location and put new life and promise into the proposition. The same year that the Fond du Lac was opened a number of other Michigan miners prospected in that vicinity and pre-empted many locations, some of which have been held to this day by the original prospectors, so great was their faith in the possibilities of the locality.

The general depression in the Lake Superior copper mining industry in the early sixties was felt in Douglas county. With copper at 17½ cents there was no incentive to develop new mines or re-open old ones; but the revival soon came. A steady advance in the price of copper, beginning in December, 1861, when it sold at 27 cents, and continuing until 1864, when it reached the high-water mark and sold at 55 cents, put a new aspect on mining conditions in the entire Lake Superior copper district. Two copper propositions were launched in Douglas county in 1863. The Copper Creek location, to which the American Fur Company had lapsed title, passed into the control of General George B. Sargent of Davenport, Iowa, and James O. Sargent of Boston. The Copper Creek Copper company was organized, most of the stock being taken in Boston. Operations were commenced on an extensive scale. As with the Fond du Lac company, a large portion of the available resources was expended for roads and buildings. George R. Stuntz had charge of the work. Captain R. S. Petherwick, a Michigan miner, was placed in charge of mining operations. The first shaft was sunk at the fork of the creeks to a depth of two levels, 120 feet. A drift was driven 30 feet westerly on the supposed vein. An erroneous impression of the formation prevailed here, the same as in all the other early mining operations of the Douglas range district, except possibly where the one shaft was sunk on the Fond du Lac. That impression was, that the formation dipped to the north, as on Keweenaw Point, when, in fact, the dip is to the south. The work was continued for three years, about \$60,000 being expended. Other shafts and drifts, aggregating 300 feet, were sunk. Some very rich stamp rock and barrel copper were found. Some of the local men who worked at the Copper Creek location are James Bardon, John R. Smith, A. B. McLean, William C. Howenstine and James Russell, all now living in Superior, and Thomas Sexton, now living in Duluth.

In the same year that the Copper Creek Copper Mining company was organized, the Wisconsin Copper Mining company undertook the development of the Edwards' location in section 2, town 47, range 13, now known as the Starkweather. The incorporators were James Edwards, J. Mallory, J. V. V. Platto, J. W. Cary, J. A. Noonan and A. Finch; the capital was 20,000 shares of \$100 each. Most of the money

for the enterprise was secured in Milwaukee. Work was commenced in June, 1863, with Captain James Edwards in charge. About \$14,000 was expended, and all that was accomplished was the sinking of two shafts about 400 feet apart, one 58 and one 52 feet deep. Barrel copper, some of the pieces weighing from 15 to 20 pounds, was taken from the location, and in sinking one shaft 16 feet a half-ton mass of copper was secured.

An interesting tradition is connected with the Wisconsin mine. One Antoine Ambuhl, the original pre-emptor, about 1854, shortly after his pre-emption, came to Superior City and reported that he had found on his location a large mass of copper which he had covered up. He returned to the location and shortly afterward died without disclosing his secret, if he had any. Since that day many prospectors have looked for Ambuhl's find, but it is as yet undiscovered.

It was in 1863, also, that an attempt was made to develop a copper prospect on the north shore in the vicinity of Knife river. A Mr. Saulsbury organized the French River Mining company, and did considerable work.

The great expense of mining and the limited capital brought development work to a stop at the end of two years with the Wisconsin company, and at the end of three years with the Copper Creek company. The general falling in values in copper and the stagnation in the mining industry of the whole Lake Superior district again had its effect on the Douglas range companies; and work on these two properties was not resumed. The Wisconsin company seems to have fallen into the same error in regard to the dip of the formation as the Copper Creek company, although the development work was more limited and the results better.

Nearly ten years elapsed before further work was done on the Douglas range. In the fall of 1873, the Percival Mining company, named after the eminent geologist James G. Percival, commenced work on the east side of the Brule river in section 27, town 48, range 10. The company was controlled by General Sargent, who had moved to Duluth from Iowa. E. McNair of Duluth was in charge of the work. A large amount of surface work and prospecting was done. One shaft was sunk about forty feet. The surface indications were the best yet discovered, and disclosed three distinct veins, one of which was traced nearly 2,000 feet. Considerable coarse copper was blasted out and one keg of it was sent down the lakes and shipped to Bristol, England, the headquarters of the company. The company had plans to utilize the Brule water power, which is available, being within a mile of the location. The Percival location was discovered by William C. Howenstine as early as 1853, but owing to its inaccessibility it was not

investigated until twenty years after. Despite the difficulties of transportation, the rich surface specimens from the location led the Sargent people to finally undertake its development. The work was necessarily very expensive, and does not seem to have been well done. The panic of 1873 crippled the men who were backing the proposition, and the mine was abandoned without any satisfactory determination of the value of the property being arrived at.

This closes the history of the earlier attempts to develop the copper prospects on the Douglas range. All these attempts were made under great disadvantages; transportation facilities were absolutely lacking; the cost of supplies was excessive; and the management in some cases was not all that could be desired. The promoters had extravagant ideas and inadequate capital; stock jobbing was not absent from these early projects; and the value of the district was not established so that outside capital could be interested. Concerning the cost of mining at this early day on the Douglas range, E. T. Sweet says, in Volume III of the Geology of Wisconsin: "The average cost per foot of sinking the shafts and running the drifts at Copper Creek in 1864-5 was \$66. At the Fond du Lac mine in 1856-7 the cost per foot of sinking the shafts was \$120, and it cost to sink the shafts on the Wisconsin location in 1863 \$107 per foot. These figures are extraordinarily high." The work can be done today for one-fifth of that cost. The failure of these early mining enterprises on the Douglas range is only the old story of the early futile attempts to mine on Keweenaw Point. Mr. Irving, in Monograph V, points out other reasons why the Western district has not been developed before. He says, on page 428:

Without the boundaries of the state of Michigan the attempts at copper mining have been but feeble, and utterly inadequate to prove or disprove the existence of workable copper deposits. Unfortunately the country is one covered with heavy drift accumulations, through which only the harder and more enduring, and therefore non-cupriferous, beds ordinarily project. The indications are that but for the overlying sheet of drift this region would be as productive in copper as that of Keweenaw Point. Rounding the turn at the western end of the great Keweenaw synclinal, in the St. Croix valley, we find the drift covering lighter, and here, in the vicinity of Snake and Kettle rivers, and thence northeastward into Douglas county, in Wisconsin, are found plainly bedded diabases and amygdaloids carrying copper with interbedded cupriferous conglomerates. The region is one which in the early days of mining excitement on Lake Superior was so remote and inaccessible that the flood of copper hunters which at that time spread west from Keweenaw Point failed to reach it. It still lies almost wholly unexplored while promising more to the copper hunter than any other portion of the entire extent of the formation outside of the state of Michigan. Further north and east from the district last described lies the copper range of Douglas county, Wisconsin. Copper



has been found along its course in a number of places, chiefly in epidotic altered amygdaloids, and the general structural characters are such as to indicate the possibility of the occurrence of copper in quantity along this belt. Some little mining has been done at several points, but not enough to lead to any satisfactory conclusions.

It should also be noted that the periods of depression in the copper mining industry on the Keweenaw Peninsula, in Michigan, due to a falling copper market, or unfavorable financial conditions, were coincident with the periods of cessation of work on the copper mining properties on the less accessible and newer Douglas range.

The present exploitation of the range is proceeding under entirely different circumstances and conditions, and is in the hands of men who are giving careful study to the geological formation, and are attacking the problems of development under the advice of competent mining engineers. The extensive operations in the exactly identical formations in the Michigan district afford an easily available reference as to the nature of the copper deposits and the most satisfactory methods of working them.

### **Geology of the District.**

The extent of the Keweenawan formation, which includes the eruptive beds in which the Lake Superior copper is found, can be seen on the map opposite page 176. This map is copied from Monograph V, United States Geological Survey, by Irving (1886). The great Keweenawan formation consists of a series of eruptive beds alternating in the upper division with sandstone and conglomerates, the whole lying above the Huronian slates, schists and metamorphic rocks. This formation was probably laid down in substantially horizontal position at the bottom of an ancient sea. Subsequent movement of the earth's crust is supposed to have tilted the beds so as to form a great trough, or synclinal, as it is called by geologists. One edge of the synclinal lies from the end of Keweenaw Point across Michigan, northern Wisconsin, touching the southeasterly corner of Douglas county, flattening out as it extends westward across the Minnesota boundary. On the Keweenaw Peninsula this edge contains the great Michigan copper mines. Where the edge corners Douglas county it is known as the Minong range. The other edge of the trough formed by the elevation of the region to the north forms the Douglas range, and the exposures at Duluth and along the north shore, on Isle Royal, and the exposures in the Nipigon locality. The northern edge is broken by depressions and not as easily traced as the southern edge. The lower beds of the Keweenawan for-

mation consist mainly of coarsely crystalline gabbros, from twenty to fifty feet thick. After four or five thousand feet of these flows had spread out in horizontal sheets over this Lake Superior region, the eruption became somewhat different in chemical character, more frequent and with thinner flows. These constitute the middle series of the Keweenaw formation and most of the copper mines are located in this division. The upper series consist of alternating eruptives and sandstone or conglomerates. The absolute identity of the formation in the western Lake Superior district with that in the Keweenaw Point region is proven by very eminent authorities. On page 139, Monograph V, Mr. Irving, referring to the identity of the eruptive rocks of the St. Croix (Wisconsin) district and the Keweenaw Point formation, says: "This identification is also indisputable; it is so because of the absolute identity in nature and structure of the rocks of the region, and because the Keweenaw belts have been followed continuously from the eastern end of Keweenaw Point, Michigan, to the St. Croix river, Wisconsin. The predominate fine-grained basic rocks of the two regions are so completely the same in mineral composition, even to the alteration-products, that thin sections of rocks from the two districts placed side by side are not distinguishable from one another. The rocks of the two regions present precisely the same amygdaloidal, pseudo-amygdaloidal, and compact phases. The amygdules are made of the same minerals in both, associated in the same ways. Native copper occurs in the St. Croix valley in the same manner, and with the same associates, as on Keweenaw Point. Almost everywhere the St. Croix valley rocks present precisely the same bedded structure as seen in those of Keweenaw Point. The evidence for all the distance between Keweenaw Point and the St. Croix is just as strong as that ever appealed to to prove the continuity of geological formations anywhere. From Keweenaw Point to the St. Croix, the formation has been traced mile by mile." E. T. Sweet, of the Wisconsin Geological Survey, says, in Volume III of the report of that survey, page 331: "Undoubted Keweenaw rocks are found in Douglas county, twelve or fifteen miles southeast from the eastern end of the St. Louis river slates. They extend entirely across the country, outcropping in a more or less broken line, and forming the well known Douglas copper range." Professor T. C. Chamberlin, now holding the chair of Geology in the Chicago University, says (Vol. III, Wisconsin Geological Reports, page 357): "The St. Croix valley and Douglas range formation is not only the equivalent, as the name implies, of the great copper-bearing terrane of Keweenaw Point, but it is directly continuous with it and forms its western prolongation. It is difficult to assign any satisfactory reason why an igneous overflow should be richer in a metal at a given

point than at any other, and still more difficult to understand how a succession of such overflows, separated by considerable periods of time, should be exceptionally rich in the same region. Theoretically, therefore, there is little or no reason for believing that the igneous rocks of one district are less rich in copper than in other portions."

The question of identity is further established by the corroborative evidence of practical men who have compared the rocks of the two localities recently, and who have examined the formation as disclosed in the shafts of the propositions now being opened up on the Douglas range.

### **Mining Facilities.**

The Douglas range is located about fifteen miles from Superior, the seat of a large lake commerce and a railroad point of importance. It is paralleled by the Northern Pacific and South Shore & Atlantic railroads, and crossed by the Omaha and the Great Northern roads. The whole district which is being developed is easily accessible to railroads. The country is well watered and in the Douglas range districts the several large rivers and streams which cross the formation afford unlimited water power and ample water convenient to the mining properties. Wood and fuel are abundant and cheap, and supplies can be easily procured at Superior or Duluth. The whole district is easily accessible to prospective investors and for mining purposes, no prospect being more than half a day's trip from a railroad station.

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### **The Percival Mine.**

The Percival is the most easterly of the developed properties on the Douglas range, and the highest in the Keweenawan series of the Range locations. The property is organized as the Percival Copper Mining Company, and has a capital stock of \$1,000,000, with shares of \$1.00 par value. The officers are: E. P. Mackey, of Gordon, Wis., president; I. P. Estes, of Pierre, S. D., vice-president; B. J. Van Vleck, of Superior, secretary and treasurer and manager. There have been 400,000 shares placed in the treasury for development purposes. The company owns 800 acres lying in town 48, range 10. The land covers two miles along the strike of the Percival lode, and includes within its bounda-

ries two miles of the Brule River. The Brule River falls 200 feet in passing through the company's property, and is easily available for power for mining, compressor drills, hoisting, pumping, and for a stamp mill. The location affords mill sites by which the water can be fed by gravity into the top of the mill. The Northern Pacific Railroad runs three miles south of the property.

This property was thoroughly and intelligently explored in 1898, and the present work, preliminary to making the Percival a producing mine, is being pushed with great vigor. When development work was begun last fall a trench was started north at right angles to the strike of the formation. Within 40 feet a cupriferous amygdaloidal belt was crossed, which, from surface indications, promised better than anything previously shown, and an inclined shaft was started which from the first yielded rock very rich in copper. This shaft is at present (April 25) down 56 feet and is going down night and day. A new shaft has been started 500 feet east of No. 1; at intervals west of No. 1 shaft the lode has been uncovered for a distance of 600 feet, showing rock of the most promising character. Fine camps have been built, and an equipment suitable for all present needs has been purchased and is on the ground. A crew of 20 men, which will soon be increased, is steadily employed. It is the intention to sink the No. 1 shaft 200 feet, cross-cutting the lode about every 50 feet; when the shaft has reached the depth stated drifting will be done along the lode both east and west for a sufficient distance to give an estimate of the character of the deposit at that depth. A crosscut will also be run north and south across the formation some hundred feet each way to determine the value of other parallel copper-bearing lodes which look very promising on the surface. No. 2 shaft will be sunk to a sufficient depth to show the lode at that point and then other shafts will be put down 500 feet apart until the lode has been shown up for from 2,000 to 2,500 feet.

The formation is very regular, having a hanging wall of diabase separated from the mineral by a clay gangue. The lode is from 16 to 20 feet in width and is heavily charged with native copper. An average of many samples of the rock panned gives a value of from 2 to 3 per cent of copper. Some portions of the main lode run as high as 6 per cent. Four parallel lodes are found on the property. These have a general northeasterly trend and dip to the south at a comparatively low angle, about 45 degrees. Some of the lodes have been traced 2,000 feet on the surface. The lodes are all amygdaloidal and carry much prehnite, calcite, epidote and laumontite. The No. 1 shaft carries also much quartz in geodes and "vugs". The surface explorations have uncovered in places several masses of copper weighing from 20 to 30 pounds.

### North Wisconsin.

The first of the present-day companies to organize was the North Wisconsin Copper Mining Company. The North Wisconsin location is in section 10, town 47, range 12. The company also has an option on sections 3 and 9 in the same town. The capital stock of the company is 500,000 shares, \$1.00 par value. The officers are M. W. Nelson, president; J. B. Van Vleck, vice-president; F. A. Woodward, secretary and treasurer, all of Superior, Wisconsin. The copper-bearing formation is exposed in this locality by the erosion of Middle River, a stream of considerable size which crosses the company's land. The trend of the formation is about 15 degrees north of east, with a dip of about 65 degrees to the south. The cupriforous belt is a regular amygdaloidal bed from 10 to 16 feet wide, carrying native copper associated with prehnite, chlorite and some calcite. Two other amygdaloidal belts carrying copper have also been disclosed lying north of and nearly parallel to the main belt. The main copper belt has been traced for nearly a quarter of a mile, and absolutely identified for a distance of 500 feet eastward from the No. 1 discovery shaft. Considerable preliminary surface work was done on the property to locate the copper-bearing formation and establish the trend and character of the amygdaloidal belts. The No. 1 shaft in the bed of Middle River was sunk one level and cross-cuts were driven north and south to show the width of the lode. Drifts were then driven twenty-five feet along the lode eastward and also about the same distance westward. The whole lode carries copper, but not uniformly. The east drift shows a face about six feet which averages by assay over one per cent, with a pay streak about two feet wide yielding about three per cent. The No. 5 shaft is on the same lode, 500 feet farther east. The lode shows the same width and trend at this point and is more clearly defined and richer. This shaft is down about 50 feet. The other work has been on the smaller lodes paralleling the main lode and south of it. These seem to have a higher dip than the main lode, and it is thought that with depth the lodes will all unite and form a strong, richly mineralized vein. The North Wisconsin lode is claimed by some authorities to be a fissure vein heading with the formation. The work done at present is not sufficient to establish this point. The company has a good organization. Ample buildings have been provided and the transportation facilities are excellent, the mine being within three miles of three main lines of railroad. The Middle River supplies ample water for milling, and water power with a 20-foot head is available at the mine.

### **The Starkweather Mine.**

The old Wisconsin location, which three years ago was opened up by Charles S. Starkweather, then mayor of Superior, has passed into control of the Boston & Lake Superior Copper Mining Company, a Boston company of which the officers are: President, Henry Ives Turner, Boston; secretary, B. C. Cooke, Superior; treasurer, C. H. Cobb, Boston. The capital stock is \$1,250,000, divided into 50,000 shares of \$25 each. The property has always shown much promise. A well defined lode bearing northeasterly and dipping 75 degrees to the south exists. This lode yields coarse copper and some masses, and is well mineralized. The country rock is a fine-grained diabase, and the lode is an epidotic amygdaloid with calcite and prehnite associated with the copper. Two shafts, one 70 feet deep and the other 60, have been sunk on the property, also a number of pits to locate the lode. The 60-foot shaft cuts the lode and shows in the section about a six-foot lode, yielding, on an average assay, nearly one per cent of copper. A second lode parallel to the first is shown by test-pitting. This also bears copper at the surface. The property is located in section 2, town 47, range 13, in the same locality as the North Wisconsin and the Fond du Lac, and has like excellent transportation facilities.

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### **The Fond du Lac.**

The old Fond du Lac location, which was selected by the earliest prospectors from Ontonagon, Michigan, as a favored locality for copper, is now owned by the Superior & Boston Copper Mining Company. This company has a capital of \$1,500,000 with the shares of a par value of \$1.00. The officers are: Joseph Tuteur, president; A. S. Andrews, vice-president; Ernest A. Arnold, treasurer; M. C. French, secretary; all of Superior, Wisconsin. The company owns 320 acres in section 8, town 47, range 13. Captain John M. Thomas of Calumet, Michigan, has been engaged to take charge of the work of development. Three lodes cross the property. The Parker, or No. 1, lode is from 10 to 12 feet wide, extending across the property from the center of the section in a northeasterly direction. There is a shaft down 60 feet on this lode. The dip of the formation and of the lode, or bed,







are the same, the angle being 45 degrees to the south. Average assays of the vein show that it carries three-eighths of one per cent copper, and the pay streak, nearly three feet wide, runs two per cent. The lode is about 10 feet wide and extends parallel with No. 1, one-fourth of a mile north. This lode carries copper from footwall to hanging. The hanging and foot walls are clearly defined. The vein matter is an epidotic amygdaloid. The pay streak in this vein is about two and one-half feet wide and carries copper in large nuggets, some of them weighing a half pound or more, others the size of a pea, and they appear to be evenly distributed. The balance of the lode carries copper in very fine particles. The shaft is 75 feet deep, and shows better at bottom than at the surface. Lode No. 3 is further north. It is about two feet wide and carries various ores of copper at the surface. The matter is amygdaloid. The country rock is a melaphyr. The location is situated four miles from the Nemadji river, which would furnish an abundance of water for stamp mills and other purposes connected with mining, and is only six miles from Allouez bay, one of the branches of Superior harbor. The Duluth, South Shore & Atlantic Railway runs within one and one-half miles of the property: the Chicago, St. Paul, Minnesota & Omaha Railway line is but half a mile distant, and a spur five miles in length from the Great Northern would reach the property. The company has made plans to push development work under the direction of Captain Thomas. Of the capital stock, 500,000 shares are set aside for development purposes. Enough surface work will be done to determine the exact extent and nature of the lode as far as practicable. The shafts already down will be extended and the formation crosscut to determine the course and value of the lodes.

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### **The Culligan.**

This property is in section 31, town 47, range 14. No work has been done on it for several years. An effort is being made to straighten out the difficulties between parties interested in it, and organize a company to develop it. The copper-bearing bed is exposed in a creek gully, and shows an epidotic amygdaloid with shot copper. The direction of the amygdaloid seems to be about 20 degrees north of east; its width at the exposure is about 6 feet. The lode has been traced 200 feet on the surface. This is the farthest west of any of the prospects on the Douglas range and lies lowest in the copper-bearing series on the range. Not enough work has been done to determine the extent or value of the prospect.

### **St. Croix Consolidated Copper Mines.**

This company is incorporated under the laws of Wisconsin with a capital stock of \$2,500,000, shares \$1 each. The company is officered by Milwaukee and eastern capitalists. The lands of the company and the preparation thereof have been handled by Ernest A. Arnold of Superior, Wisconsin. The company has a body of land exceeding 20,000 acres in townships 43, 44, 45, ranges 13, 14, 15 west, respectively; and in the adjoining townships in Pine county, in range 16 west. In general, the lands of the company lie just north of the St. Croix river and westward from the central part of Douglas county.

This corporation is organized as a promoting and development company, it not being the intention of the parties associated in it that it shall engage in mining. One-half of the capital stock has been placed in the treasury for the purpose of securing other lands and interests in lands within the copper belt in the St. Croix locality. The company has engaged a corps of competent prospectors to determine the value of the different prospects on its lands. These will then be presented to capitalists and companies interested in copper mining propositions. The lands of the company lie wholly on the Keweenawan formation and are situated relatively in the same position on this formation as is the mining zone on the Keweenawan peninsula.

The St. Croix locality is drained by streams very close together crossing the formation, and in the beds of the creeks and streams the members of the series are well exposed for long stretches; thus a cross-section of the series as exposed in this way shows, approaching the locality from the south, first, the sandstone and conglomerates of the Upper Division of the Keweenawan series; succeeding these in order are beds of shale, then a well defined bed of diabase (the greenstone of the Michigan region): then a well defined melaphyr belt, followed by alternating beds of melaphyr and conglomerates. The most northerly beds are coarser and mostly diabase. The whole series in this locality is amygdaloidal and carries native copper and the associate minerals of copper in nearly every exposure.

The beds of the formation are comparatively thin and regular and the whole formation in this locality is continuous and undisturbed. The dip of the beds is southeast at a low angle, about 12 to 20 degrees.

The most promising rocks lie directly below the first diabase member and constitute a clearly defined amygdaloidal melaphyr belt. There seems to be little doubt but that this belt corresponds geologically with the belt in the Michigan district in which most of the productive mines are found. Professor T. C. Chamberlin in Irving's Mon-

ograph, referring to the melaphyr from this St. Croix belt, says: "This is the typical Keweenaw Point melaphyr and identical with stratum 108 of the Eagle River section." In the quotation in a preceding paragraph in this article, Irving says: "The St. Croix district in the vicinity of Snake and Kettle rivers and thence northeastward into Douglas county still lies almost wholly unexplored, while promising more to the copper hunter than any other portion of the formation outside the state of Michigan."

The company has at least ten prospects on the lands it now owns and the promoters are confident that a small amount of intelligent work will develop promising prospects in many other localities. The St. Croix district is well watered, easily accessible, and undoubtedly promises very much in the development of the copper mining industry in the Western Lake Superior district.

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### **The Bardon.**

A promising prospect at the Upper Black River Falls which James Bardon is developing is known as the Bardon mine. It is in section 28, town 47, range 14. This prospect was discovered by Professor A. H. Hanschett, one of the early Minnesota geologists, about 30 years ago, when the Copper Creek operations were under way. A little work was done and some fine specimens of copper were obtained. Knowledge of the exact locality of this mine was lost until about two years ago, when Mr. Bardon made re-search for it, assisted by the recollections of some of the men who had worked at Copper Creek when the locality was visited by Professor Hanschett. The old pits were found and some prospecting was done, with very satisfactory results. Work on the prospect will be commenced this summer. The property is owned by Mr. Bardon and includes 300 acres. The copper occurs in an amygdaloidal formation.

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### **The Cascade Copper Mining Company.**

The only company operating east of the Brule river on the Douglas range is the Cascade Copper Mining Company. This company, now in process of organization, is controlled largely by Superior capital. Walter Fowler secured the land and is in charge of the organization and development. The company has 400 acres in section 23, town 48,

range 10. The capital stock of the company is 100,000 shares, \$25 per share. The main lode of the Percival, which crosses the Brule river in a northeasterly direction, runs across the Cascade property and outcrops in two places, showing some rich rock, with coarse and barrel copper. This property joins the Percival on the northeast and the Brule river runs through it for half a mile, affording ample water and power for the mine. The company will commence exploratory work at once.

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### **The John Jacob Astor Mine.**

The old mine of the North American Fur Company in section 28, town 48, range 10 will be opened up this summer. The land belongs to James Bardon, who will thoroughly examine and prospect it. This prospect lies just west of the Percival mine on the Douglas range.

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### **The Copper King.**

Early in 1899 the Copper King Mining and Townsite Company was organized, with a capital of \$1,000,000, to purchase and develop a copper prospect just south of the North Wisconsin mine. The company owns 160 acres and has options on adjoining land. Some outcroppings of amygdaloid, bearing copper, similar to those on the North Wisconsin vein, are on the property. It is proposed to begin work there. The North Wisconsin vein, which dips south, is probably accessible on this property. The company is also interested in a townsite which will be located on the line of the Duluth, South Shore & Atlantic Railroad, and on its holdings. The officers of the company are F. J. Wildner, president; George S. Doud, vice-president; H. W. Nichols, secretary; W. B. McGibbon, treasurer, all of Superior, Wisconsin.

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### **The Catlin.**

The Catlin location is adjacent to the Starkweather on the south. Several shallow pits have been sunk. The copper occurs in fine particles in a pinkish amygdaloidal rock. Not enough work has been done on this prospect to determine the extent of the lode.

### **The Badger.**

Another new company which expects to do some extensive work this year is the Badger Copper Mining Company. This company owns 210 acres in section 8, town 47, range 12, adjoining the North Wisconsin on the west. The officers of the company are: President, B. J. Van Vleck; secretary, F. H. Ruger; both of Superior. The capital is \$2,500,000, one-third of the capital stock, which has a par value of \$1.00 a share, being in the treasury for development purposes. The main lode of the North Wisconsin crosses the property. Some preliminary explorations show very satisfactory results.

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### **Minong Range.**

The Minong Range has attracted the attention of the prospectors during recent months. Some promising discoveries have been made in town 43, range 10, in Douglas county. Across the line in Bayfield county are located the Montrose and Great Western prospects, which were partially opened up about ten years ago. The Montrose is located in section 12, town 44, range 9. An amygdaloid and a conglomerate lode, both copper-bearing, are found on the property. The assays show from two-thirds of 1 per cent to 3 per cent copper and some silver. The original company went under in the panic of 1893. The property is now under option to a company which proposes to further develop it. The Great Western, which is near the Montrose, is a property on which local parties have done some work.

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### **North Shore Copper Mining Company.**

During the past few years several parties have been at work on the copper prospects on the north shore of the lake above Duluth about twenty miles. The formation is identical with the Douglas range and a continuation of it. A company is now at work at Knife river.

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### **The Copper Creek.**

The lands of the old Copper Creek Mining Company are under option to a syndicate of which Elmer E. Barton is the head. Arrangements are being made to prospect and develop this property at once.

The old workings will be reopened, and sufficient work done at once to locate the lode which gave so much encouragement to the early-day miners in that locality.

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### Other Localities.

On the Snake and Kettle Rivers in Minnesota the Keweenaw rocks have been prospected for copper with some promise. The formation at Taylor's Falls in Wisconsin has been worked to some extent. Several prospects in Burnett county, notably at Trade Lake, are likely to be tested the coming summer. The whole Keweenawan formation, from the Michigan line across northern Wisconsin into Minnesota, shows at many places outcroppings of copper which will be investigated during the current year.



## Lake Superior North Shore Minerals.

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By Horace J. Stevens.

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In the western half of the southern shore of Lake Superior is stretched one of the greatest mineral districts of the known world, the section named being pre-eminent in the production of both copper and iron, while gold, silver, lead and other metals are found in considerable quantities. The northern shore of Lake Superior is, perhaps, equally rich in mineral wealth—its metalliferous resources are known to be vast in quantity and widely distributed in area—but it has lacked the stimulus of Yankee capital and Yankee enterprise in the development of its mineral deposits. The international boundary line, roughly speaking, bisects the lake, although Minnesota owns a portion of the northern shore. Canada is a country of large area but comparatively scant population, and greater in undeveloped resources than in available wealth. Had the showing of mineral values of the north shore been made on the southern shore, far greater development would certainly have been reached by the present time.

A brief reference to mineral deposits other than those of copper may be pardoned. The Mesaba and Vermilion iron ranges of Minnesota, which lie between Lake Superior and the head waters of the Mississippi, and to the northward of Duluth, have a future competitor in the Atikokan iron district of Algoma. The report has gone forth, presumably from interested sources, that all Atikokan ores contain titanitic acid, the element titanium being of most refractory nature and preventing the successful reduction of ores into the composition of which it largely enters. That titanitic ores exist in the Atikokan cannot be denied; but they are also found largely in Minnesota, and in years probably not far distant the Atikokan iron range of Canada will be found supplementing the product of the Marquette, Menominee, Gogebic, Vermilion and Mesaba iron ranges, which lie within the boundaries of the United States, on the shore of Lake Superior.

The Rainy Lake, or Seine River, gold district, the best mines of which are located on the Canadian side of the international boundary line, gives promise of great future development. Several of the mines,

notably the Sultana, have long since passed the experimental stage and pay dividends regularly.

There is also gold in the neighborhood of Fort William and Port Arthur. These thriving towns of the Canadian Northwest are located upon Thunder Bay, eighty miles north of Houghton as the crow flies, and, in addition to their commercial importance and mineral wealth, afford some of the most magnificent scenery to be found upon the American continent. Thunder Cape, the island of the Sleeping Giant, and the peculiar flattened dome known as Table Mountain, are each more than a quarter of a mile in height, the two former rising sheer from the water in stupendous, perpendicular masses of basalt. The Kakabeka Falls of the Kaministiquia river, near Fort William, are also of marvelous beauty. Were this favored district within the regular routes of the summer tourist, its many charms would be as famous as they deserve to be.

There are many indications of mineral wealth about the Pigeon river, which forms the boundary line between Minnesota and the Province of Ontario. To the eastward of Port Arthur lie the celebrated silver mines of the Rabbit Mountain district. These mines were extensively worked by a Detroit company some twelve or fifteen years ago, but the fall in the price of silver caused a complete cessation of mining some years since. Silver Islet, lying just off Thunder Cape, was once considered the richest silver mine in the world, and during the few years before it was engulfed by the encroaching waters of Lake Superior it added a million dollars in white metal to the wealth of the world.

On Michipicoten Island, Lake Superior, an appanage of the district of Algoma, province of Ontario, extensive development work is now under way by the "Standard Oil" copper interests. This island carries a continuation of the Keweenaw copper formation, with the important distinction that the copper-bearing lodes are all located on the reverse fold of the synclinal, whereby the dip of the copper-bearing beds is to the southward instead of to the northward, as on the Keweenaw peninsula. Private advices recently received by the writer are to the effect that of the two shafts now being sunk on the island, one is of almost phenomenal richness in native copper.

Another mineral district in Canada that bids fair to soon receive no little attention is found in the neighborhood of Lake Timagami. This lake has about five hundred miles of coast line and contains fourteen hundred islands. It is considered by sportsmen and others who have been there the most beautiful sheet of water in North America. Last fall large deposits of gold-bearing mispickel ore, copper and iron were discovered in its neighborhood, and the district is now regarded as affording a most alluring field for prospectors. The ore is of low



grade, and the deposits would have to be worked on an extensive scale to ensure profitable results. This would call for a heavy investment of capital, but with proper skill and management the returns would be sure and ample. The lake is about thirty miles west of the Upper Ottawa river, near the Canadian boundary between the provinces of Ontario and Quebec. It lies north of the Soo line of railway, and about half way between Sault Ste. Marie and Montreal.

Early in the latter half of the present century, when the pioneer mines of Michigan were beginning to demonstrate their wonderful richness, the first copper mine of the Canadian Northwest was opened. This was located on the Canadian shore of the Sainte Marie river, the stream which empties Lake Superior into Lake Huron, and which all experienced judges of scenery rank with the Thousand Islands of the St. Lawrence for beauty of land and water, shore and island, sky and stream. This property, known as the Bruce mines, developed extensive deposits of copper ore, yellow and grey sulphurets. Appliances for smelting, and even for matting, were lacking in those days, and it was necessary to select the richer ore by hand-picking and ship the resulting product to Swansea for smelting. The expense of mining in a new and wild country was necessarily great, while the cost of shipping the ore down the Sainte Marie river, through Lakes Huron, St. Clair, Erie and Ontario, with their connecting rivers, through the shallow Welland Canal, down the turbulent St. Lawrence, a stream in itself 2,000 miles in length, through the Lachine rapids, a veritable marine graveyard, with the cost of trans-shipment at Quebec for the long voyage across the stormy Atlantic to Wales, proved greater than the mines could bear. The property was worked quite extensively at various periods but never with financial success, although the production of copper was by no means inconsiderable. The Bruce mines are at present owned by Lord Douglas of Hawick, as the title appears in Burk's and De Brett's peerages, but the gentleman in question is known in America as Lord Sholto Douglas. This affable scion of nobility has within the past year made quite frequent visits to the Michigan copper district, with a view to posting himself upon American copper mining methods, and now has plans well under way for the early resumption of mining at his property upon a large and thoroughly modern scale, and with the advantages, never before enjoyed by the mines, of ample capital and Yankee mining machinery.

The most successful mines on the north shore of Lake Superior, if not the richest and most profitable in British America outside of Dawson City and its environs, is located at Sudbury, seventy miles east of Sault Ste. Marie, on the Canadian Pacific Railway. The mines are owned by a Cleveland company in which John D. Rockefeller is a large shareholder. That the Sudbury mines have not attracted great

attention in both Canada and the United States is due partly to their location, which is not on the line of extensive travel, but principally to the disinclination for publicity of the owners. They have a good thing—one of the best, in a moderate way, to be found anywhere—and they are naturally averse to notoriety. The Sudbury properties are known as nickel mines, but copper is a very extensive by-product—so great a one, in fact, that were no nickel whatever saved from this ore the copper alone, at present market prices, would return handsome profits. It is probable that the Sudbury ores yield about the same percentage of copper—70 pounds per ton—as is secured from the rock of the Calumet & Hecla mine, this supposition being based upon extensive assays from a neighboring property, the "Great Lakes", the least productive assay of which has given 68 pounds of copper to the ton.

The Sudbury ores are matted at the mines, being roasted in large heaps near the shafts, the resulting sulphur fumes being as marked in the atmosphere as is the case near the great smelters at Butte, Anaconda and Great Falls, where the Montana cupriferous ores are reduced.

The matte of the Sudbury mines is shipped to this country for smelting; and upon this point a very sharp "difference of opinion" has arisen between the owners of the mines and the Canadian officials. The 1898 report of the Sudbury company shows that the expenses of operation were, approximately, \$400,000, while the value of the product reached \$950,000, giving an ostensible profit of over half a million dollars on last year's operations. This report has been sharply criticised by the Canadian official in charge of the Bureau of Mines and Minerals, that authority going so far as to say over his own signature that the value of the metals produced at Sudbury last year was far in excess of the amount reported, adducing custom-house figures which have led him to infer that the actual mineral production was practically double what the company reported. If he be right, the profits last year must have reached nearly one and a half millions. Leaving the reticent owners and the irate Canadian official to fight out the controversy with pen and ink, or otherwise, the comfortable fact remains that the Sudbury, at the lowest calculation of profits, ranked last year among the fifty most profitable mines of the world, a truth which does more to establish the importance of the mineral values of the north shore of Lake Superior than reams of written paper or tons of printed documents.

### **The Great Lakes Property.**

In the neighborhood of Sudbury there are perhaps a half dozen other mines and prospects not owned by the Cleveland syndicate, which

by the way, controls the American supply of nickel as securely as the Standard Oil Company controls the refining and marketing of American petroleum. Of these adjacent properties, the most promising is that owned by the Great Lakes Company, in which John McKinley, of Duluth, is interested. The Great Lakes Company has gone about its development work in a systematic manner, having the benefit of Mr. McKinley's experience, he having been one of the half dozen men who were most prominent early in the present decade in the opening and development of the Mesaba iron range, now the most productive iron ore district in the world.

Among the numerous assays made of copper ores from the Great Lakes property, perhaps the most important and fairest average analysis is that of Professor Anton Graf, the government expert who is in charge of the armor-plate tests for the department of war. The rock assayed was secured by sampling the copper-ore bed across the entire width, every effort being made to secure average, rather than exceptionally rich, specimens. Professor Graf's assay returned, per ton of ore, 68 pounds of copper, 30 pounds of nickel, 9 ounces of silver and \$4.15 in gold. As nickel now sells at 38 cents per pound, just double the price of copper, the resulting values are equivalent to about \$33 per ton, or the equivalent of  $8\frac{1}{2}$  per cent copper in a Michigan mine, figuring the metal at the current price of 19 cents per pound. The actual percentages per ton are not quite three and one-half per cent in copper and exactly one and one half per cent in nickel, which, as that metal is double the value of copper, is equivalent to three per cent of copper.

The property of The Great Lakes Copper Company is situated in the township of Davis, district of Nipissing, province of Ontario, Canada, and is about twenty-five miles east of northeast from Sudbury, and fifteen miles north from Markstay, on the Canadian Pacific Railway. The property contains about 2,300 acres, to which the title is perfect.

There are numerous outcroppings on the property from which samples may be taken, and by means of which the general trend of the mineral-bearing veins and deposits may be traced. The veins thus far discovered are as follows: On the north half of lots 9 and 10 of the third concession is a vein of white quartz averaging six feet in width and trending about north 60 degrees west. Branching from this body similar veins, varying in width from 10 to 24 feet, have been found parallel with each other and striking about east and west. The principal vein has been traced for over one-quarter of a mile. So far as sampled and assayed, these veins show a value of \$8 and over per ton in gold, with two per cent of copper. On the south half of the above described lots is found another vein trending about north 20 degrees east, and known as the Mt. Etna vein. A shaft located

about the centre of lot 9 has been sunk to a depth of 40 feet, and out of this shaft a large amount of almost pure yellow copper sulphuret has been taken. This rich ore gave an average value of about twenty-five per cent in copper. The pay streak is about five feet wide, but the vein is mineralized throughout for the full width of fifteen feet. About 2,000 feet from this shaft in a westerly direction on the vein is the Mt. Etna shaft, on which work is now in progress at a depth of about 40 feet. The vein at this point is about 15 feet wide between walls of silicious diorite, and is a beautiful brecciated formation of soft, black dioritic feldspar, white sugary quartz, with a large amount of copper sulphuret. This vein is nearly vertical. The assays give from five to seven per cent in copper, with a by-product of gold sufficient to pay the cost of production. The mineral in this vein can be mined very cheaply, and the surface conditions are such as to facilitate concentration or reduction operations.

On lots 9 and 10 of the property occur very large deposits. The ores exposed are a third of a mile in width and a mile in length. From this particular deposit assays show a value of 4 per cent in copper and \$6 and over per ton in gold. Many test pits were sunk on this particular deposit, and the showing proves it to be thoroughly mineralized.

Another similar deposit exists on the north end of lots 12 and 13 of the first concession. This deposit would appear to cover about 100 acres of the property. From this deposit no assays have been made, but it bears a full resemblance to the former, and is apparently as richly mineralized. Panning tests of the crushed rock show gold to exist quite abundantly in this large deposit, in addition to a high percentage of copper.

A prominent mining man who recently visited this property expressed the opinion that it presents most extraordinary facilities for quarrying out the ores, as a face elevation can be easily secured from 80 to 100 feet high, where the ores can be stoped off at an extremely low cost. In general, these deposits carry iron in approximately sufficient quantity for fluxing, and some lime is present in the form of calspar. The large percentage of sulphur contained in these ores could readily be made of commercial value if proper appliances for saving it were employed.

The country generally is a wooded region, so that fuel can be cheaply obtained. Two large water powers exist within four or five miles of the principal workings. A good road connects the property with the railroad at Markstay, and nine miles of roads have been made on the land for the purpose of securing timber and for other uses. The general formation of the country is such that a branch railroad to connect the property with the Canadian Pacific could be constructed cheaply and with very easy grades.

There are at present working on the property about forty-five men, and camp accommodations have been provided for about seventy-five. Two good blacksmith shops have been built and equipped, stables and store houses for storing supplies have been put up, and all other essentials for the conduct of operations on a large scale have been provided. The management has recently stocked the property with provisions and mining supplies in sufficient quantity to permit of operations being carried on extensively this season.

The company will be organized under the laws of Michigan (which are exceptionally fair and safe for investors), with a capital of 100,000 shares, having a par value of \$10 each. One quarter of the total issue of stock, viz., 25,000 shares, will be offered for public subscription, and the total proceeds from the sale of this amount of stock will be placed in the treasury for working capital. The company will immediately proceed to put the property in condition for the production of gold and copper on a large scale. With the immense bodies of ore already exposed, and deposits of such extent so placed that they can be easily mined, there are years of work in sight there for a smelter of the largest capacity, and but little difficulty should be experienced in putting the property in condition to earn handsome dividends for the company's shareholders. The Great Lakes' property is owned by and its development will be under the direction of American mining men of experience and ability, and with ample capital at their command it may be confidently expected that they will make it a large and profitable producer at a not distant day.

The mineral resources of the north shore of Lake Superior, in iron, copper, gold, silver and nickel are of such great promise, and have given such large and satisfactory returns upon meager investments of labor and capital, that there is no rashness in the prediction that within another decade the mines of Northwestern Ontario will enable that district to rank among the really great mining fields of the world.



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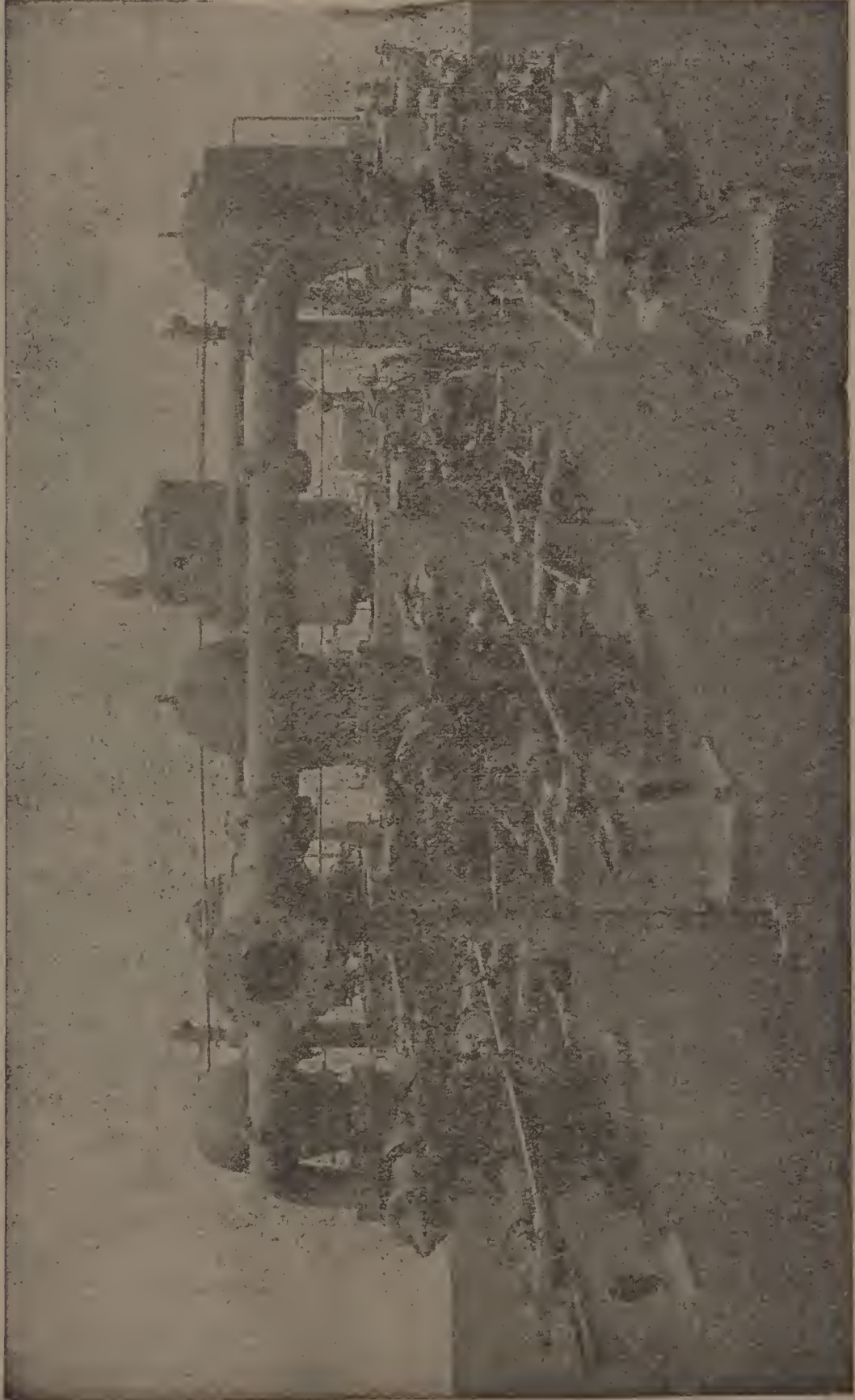
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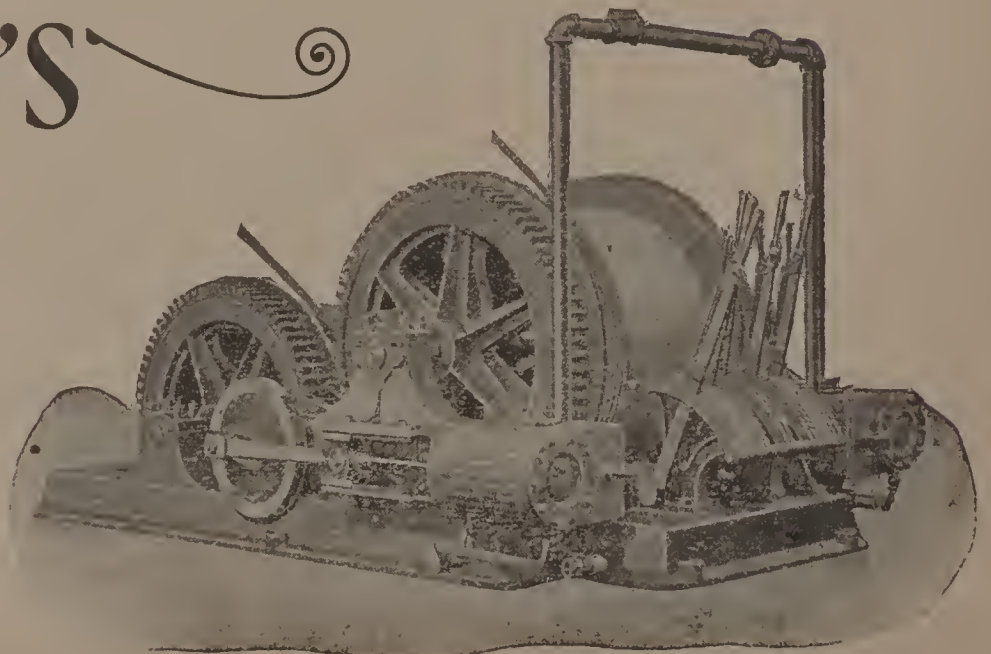
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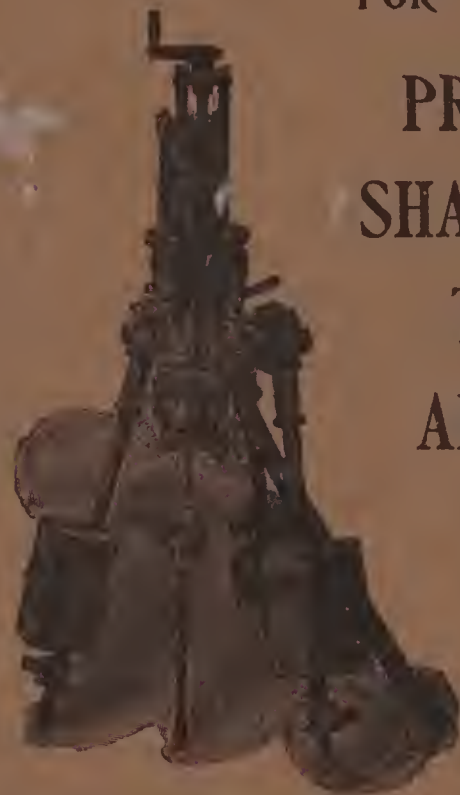
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