STATE OF MICHIGAN
MICHIGAN GEOLOGICAL AND BIOLOGICAL SURVEY

Publication 13. Geological Series 10. Mineral Resources of Michigan with Statistical Tables of production and value of mineral products for 1912 and prior years

PREPARED UNDER THE DIRECTION OF
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LETTER OF TRANSMITTAL.

To the Honorable, the Board of Geological and Biological Survey of the State of Michigan:

Gov. Woodbridge N. Ferris, President.
Hon. Wm. J. McKone, Vice President.
Hon. L. L. Wright, Secretary.

Gentlemen:—Under authority of act number seven, Public Acts of Michigan, Session of 1911, I have the honor to present herewith Publication 13, Geological Series 10, the second of a series of annual statements of the production and value of the mineral products of Michigan.

Very respectfully,
R. C. ALLEN,
Director.

INTRODUCTION.

This is the second of a series of annual statements regarding the mineral industry of the state with statistical tables of production and value of mineral products.

Under a co-operative agreement with the United States Geological Survey reports of production and value of mineral products and other items of information have been received directly from the producers; except in cases of copper, iron, pig iron and coal.

It is not possible in an annual statement of this character to treat all of the various mineral industries in detail. In the preceding volume (Publication 8) there was contributed an important and exhaustive article on the copper industry with briefer and more general surveys of the other mineral industries. For this volume there was prepared a discussion in great detail of the occurrence of oil and gas, together with important deductions concerning areas most likely to yield commercial quantities of these products in this state. Recent activity in drilling for oil and gas not only stimulated the production of this article but contributed directly to the information contained in it. A number of important deep

wells have been drilled and records of these, together with the records of other important borings, are incorporated. It is believed that this discussion will be of very considerable value, particularly to those engaged in an attempt to establish an oil and gas industry in Michigan. On completion it was found advisable to issue this monograph as a separate publication because of space limitations and greater effectiveness in distribution. Those desiring a copy of the work should make application for Publication 14, Geological Series 11. Other mineral industries will be treated in exhaustive manner from year to year.

In addition to the statistical tables there is included herein a complete revised list of the mineral producers of Michigan. The results of the publication of this list a year ago has shown the advisability of keeping the list revised and up to date for annual issue.

Thanks are due to those who have colaborated in the production of this volume. Special thanks are tendered to the mineral producers who have responded so promptly and so generously to requests for statistical data.

R. C. ALLEN,
Director.

Lansing, Michigan, October 9, 1913.

MICHIGAN COPPER INDUSTRY IN 1912.

BY REGINALD E. HORE, MICHIGAN COLLEGE OF MINES.

The year 1912 was a very profitable one for Michigan copper mining companies and employees. Good prices were obtained for the metal and the companies made larger profits while paying higher wages than in previous years. The dividend paying companies made larger disbursements than in 1911 and increased their surplus of assets. Large amounts were spent for construction and development work at the producing mines, and more vigorous examination made of several properties that are not yet productive. Some of the latter have been extensively developed and can be counted on to soon make shipments of ore to the mills. One at least will begin producing in 1913. T wo new companies and one reorganized company, began diamond drilling investigations that are expected to be continued over large acreages.

An unfortunate circumstance, and one most keenly felt by companies whose property is not centrally located, has been the scarcity of suitable labor. In spite of the increased wage offered, many of the companies, during the summer months especially, were unable to secure enough men to permit of very economical operation. This inability to run the mines at capacity prevented the owners from taking full advantage of good copper prices and increased the cost per ton produced. The increase in cost due to labor scarcity, has been partially but not wholly, offset by improvements in methods. Recently there has been more than ordinary attention paid to the improving of efficiency of all departments. New methods and machines and less waste of labor and supplies have materially decreased the cost of breaking and handling the ore underground. Labor saving devices have cut down the rock-house costs. New machinery installed at the mills gives a better recovery from the ore treated. Use of larger furnaces and more mechanical appliances to handle charge and furnace products has lowered the cost of smelting. In spite of the many improvements, the year 1912 will show higher costs per pound of copper produced. This in most cases at least, is due to higher wages paid, and means simply that the mine owners are sharing with the miners the profits of a successful year.

The following tables from statistics collected by the Engineering & Mining Journal show the prices quoted for each month of the past six years and the visible stocks of copper in United States and Europe in each month of 1909, 1910, 1911 and 1912.

A period of four lean years has been succeeded by one of good prices. In October, 1907, after several months of unusually high prices, there was a drop to below 14 cents per pound and until November, 1911, there was only occasionally a higher mark reached and for the year 1911 the average price was below 13 cents. Improved demand for the metal became noticeable in the closing months of 1911 and in June 1912 the price advanced to over 17 cents. The latter part of 1912 has been marked by firmness in price, in spite of uneasiness caused by the Balkan war. A number of authorities, while inclined to believe that the December price cannot be maintained, state that there is good reason to expect fair prices in 1913. During 1912 there was a very large increase in the world's production of copper to meet the increased demands of manufacturers. The increase in United States production was about 150,000,000 pounds, yet no very considerable increase in visible stock was made until late in the year. By November, production had made some advance on consumption and the year closed with fairly large stocks on hand. The year 1913 opened with a poorer market and increased uneasiness in Europe over the Balkan situation.

During 1912 the dividend-paying mining companies paid to shareholders $9,901,875 and added considerable amounts to surplus account. Ahmeek, Baltic, Calumet & Hecla, Champion, Mohawk, Osceola, Quincy, Trimountain and Wolverine all paid larger dividends than in 1911. Dividends paid for the past five years and to date were as follows:

DIVIDENDS PAID BY MICHIGAN COPPER COMPANIES.

	1908	1909	1910	1911	1912	All years.
Ahmeek				100,000	900,000	1,000,000
Atlantic						990,000
Baltic	900,000	1,000,000	1,000,000	500,000	700,000	7,750,000
Calumet & Hecla	2,000,000	2,700,000	2,900,000	2,400,000	4,200,000	120,050,000
Central						2,130,000
Champion	500,000	800,000	900,000	500,000	1,100,000	7,500,000
Cliff						2,518,620
Copper Falls						100,000
Franklin						1,240,000
Kearsarge						160,000
Minnesota						1,820,000
Mohawk	250,000	300,000	200,000	150,000	350,000	2,650,000
Osceola	192,300	769,200	961,500	721,125	1,201,875	10,881,650
Quincy	495,000	440,000	412,500	440,000	550,000	20,430,000
Tamarack						9,420,000
Trimountain	500,000		150,000		300,000	1,250,000
Wolverine	600,000	600,000	600,000	540,000	600,000	7,440,000

In 1912 Copper Range Consolidated, from profits made by ownership of shares of Baltic, Trimountain and Champion Mining companies, distributed $787,382. St. Mary's Canal Mineral Land Co., from profits made from half ownership of Champion Copper Co. and from sales of land distributed $480,000 to shareholders.

Soon after the higher prices became established, the Michigan copper companies increased the wages of the miners. The increase, amounting to about 10% at most mines, was made voluntarily and reflects a willingness on the part of the owners to share profits with employes. During the four lean years wages were necessarily low and yet plenty of men were available. In spite of the higher wage offered there has been considerable difficulty in maintaining efficiency during 1912. Good men being not always obtainable, the companies have in many cases been compelled to keep on their rolls an unusually large percentage of poor and inexperienced workmen. Inability to secure suitable men has made it impossible to run some of the mines at their usual rate and as a result there has been a natural increase in cost per ton due to lower production as well as an increase due to higher wage. It is expected that costs per pound of copper will be from one-fourth to one-half cent higher than in 1911. This is largely to be charged to labor, though greater expenditure for construction has materially increased costs at some mines.

The increased wage has in some cases not been reflected in higher costs, owing to many of the miners having increased in efficiency. Using better machines and operating and caring for them more intelligently the miners can earn larger wages while decreasing the cost per ton. The one-man drills, which have only recently been largely in use, have proved remarkably successful and have been adopted as a standard at several mines. It is therefore possible for the company to pay higher wages, as the saving in labor is much larger than the increased cost of supplies and repairs. The miners are earning much higher wages than the companies could afford to pay under the old conditions. At several mines graduates of the Michigan College of Mines and other colleges are employed as "efficiency" engineers. These men have themselves worked as miners and devote their attention to improving underground practice. They instruct the miners in use and care of the machines, study and compare costs of different methods of mining and handling the ore and guard against waste of air and supplies.

The year 1912 has been marked by unusual amount of construction. Surface equipment has at several mines been much improved. Several large rock-houses equipped for easier and cheaper handling of the ore have been completed. New engines and hoists have been installed to allow of increased production. Many of the mills have been much improved and special attention has been devoted to increasing recovery by finer grinding. The Hardinge conical pebble mill has been found very suitable for grinding the sands and several have been installed. Improvements have also been made in classifiers and jigs. Experiments with low pressure turbines to utilize exhaust steam from the stamps proved very successful and turbines are being installed at the Baltic, and Calumet and Hecla stamp mills. Several of the Calumet & Hecla subsidiary companies have made extensive changes in their mills during the year and better recovery has been obtained by the remodelled plant. An arrangement has been entered into by the Allouez, Centennial, Tamarack, Isle Royale and Superior companies to provide additional milling facilities and the Tamarack and Allouez-Centennial mills are being fitted with new machinery. A railroad spur has been constructed to connect the Superior and Isle Royale mines with the Mineral Range Railroad and the ore from the Superior and some from the Isle Royale will be hauled to the Allouez-Centennial mill for treatment. At present the Superior mine ore is being handled at the Atlantic mill. The Isle Royale has its own mill, but this is working at full capacity and cannot be conveniently enlarged to take care of the desired increase in production.

Development work at the producing mines has been energetically carried on and the cost, as usual, charged to operating expenses. At several mines the amount of such work has been recently exceptionally large. In some of the larger mines this is due to the introduction of different methods of mining the ore. There is a tendency in favor of the plan of working out the lode from the boundary towards the shaft. This method, long in use on the Calumet and Hecla conglomerate lode, necessitates openings being far ahead of stoping operations. In mines where a change to this method is being made, there is now a very large amount of drifting being paid for. At some of the smaller mines development has been larger than present output demands, because of a desire to make substantially greater production. The Franklin and Mass mines have used large sums of money for this purpose and should soon begin to reap the benefit from these preparations. The Lake Mine has just been brought into shape for production and very little stoping has yet been done. At the Hancock, attention has been devoted entirely to development and since running a mill test on ore from No. 3 lode, no shipments have been made. At the Ojibway, a small force has been employed in opening up the lode at lower levels, a mill test carried on in the latter months of 1911 having shown the average values in the earlier opened ground

to be low. At the Superior mine remarkable results have been obtained in opening up the West Lode and the production for the past few months has been largely from this development work. While testing this lode and awaiting milling facilities, stoping operations on the Superior lode have been light. At the LaSalle very little was done during 1912 and the Adventure, Keweenaw, Michigan, and Gratiot were not producers. The latter three were idle. Adventure continued exploration of lodes from the vertical shaft. At the Cliff mine some cross-cutting and drifting was done. Of mines which have never yet figured as producers the ones doing development work during 1912 were Algomah, Houghton, Indiana, Laurium, New Arcadian, New Baltic, North Lake, Oneco, St. Louis, South Lake and White Pine. At Algomah little ore was found. At the Houghton mine the Superior lode was opened up and disclosed good ore similar to that at the Superior mine. At the Indiana copper was encountered at several points but little opening was done as efforts are being concentrated on sinking the shaft to reach the depth from which very promising drill cores were obtained. This should be accomplished early in 1913. At Laurium, New Baltic, St. Louis and Oneco exploration was rewarded occasionally by disclosure of copper ground but no extensive ore-body was developed. At New Arcadian, North Lake and South Lake shaft sinking was started during the year. At White Pine a large quantity of good ore was blocked out and much additional information obtained regarding the faulting of the lodes.

Diamond drilling was carried on by more companies than in 1911 and was particularly successful at the Mayflower and Old Colony properties. A number of remarkable cores were obtained from the Mayflower lode and the companies have good reason to believe that they have found an ore body that will be a large producer. Drilling is being continued to further define the lode and the structural conditions before sinking a shaft. The Naumkeag Copper Co. has two drills working on the property southwest of Houghton which the company was recently incorporated to develop. The Onondago Copper Co. has two drills exploring its recently acquired property in Ontonagon County north of Lake Gogebic. The Keweenaw Consolidated Company has two drills working north of the old Delaware property. Adventure has one drill sinking from the bottom of its 1500 foot shaft and plans to soon start another at the surface. The Algomah continued drilling to locate the Lake lode and put down several holes during the year. Isle Royale did some drilling in the horizon of the Kearsarge lode. Several mines used diamond drills underground during the year and there is a tendency to give increased attention to the probing of foot and hanging walls by diamond drill holes at frequent intervals. Much ore has been found in this way. At some mines drills are kept in constant service on this work and very satisfactory results are obtained. Many years ago the advisability of constantly testing for ore bodies on either side of lodes being worked, was conclusively proven at the Quincy mine. Some properties however, have not yet been well tested in this way, and it is probable that very large additions to ore reserves will result from careful examination of ground on either side of old stopes. During 1912 very satisfactory results were obtained at South Kearsarge mine from deposits in the footwall, and it is likely that some other parts of the Kearsarge lode will show similar deposits.

The output for 1912 shows a falling off on the part of some of the larger producers and substantial increases by a few. The falling off was partly due to diminished values per ton and partly to decrease in tonnage. The decreased production resulted in some mines from ordinary stoping being in poorer parts of the lode; but in other cases it is partly to be charged against changes in method of mining which necessitated much dead work. The tonnage was in nearly all cases less than would have been mined if there had been sufficient men available.

Calumet & Hecla, Quincy, Baltic and Wolverine will show smaller output for 1912 than for the previous year. Ahmeek, Allouez, Centennial, Champion, Trimountain, Isle Royale, Superior, Tamarack, Franklin and Mass will show increased output. The total for the year was nearly the same as that for 1911. The smelter output increased from 219,840,201 pounds in 1911 to 231,112,228 pounds in 1912; but there was no corresponding increase in mine production.

At the Calumet & Hecla, the yield from conglomerate ore totaled much less than in 1911 and this was only partly made up by increased production of amygdaloid ore. The Quincy output fell off about 10%. The Baltic showed a somewhat larger decrease. The Wolverine mined some lower grade ore than usual during the summer and the total production was about 5% lower than in 1911.

The Ahmeek continued its very successful progress and is expected to make notable further increase when No. 3 and No. 4 shaft equipments are completed. Allouez began use of the new hoist at No. 2 shaft during the year and is still gradually increasing production. The year's operations netted the company a very substantial profit and leaves a balance of assets in place of one of liabilities. The Centennial managed to take advantage of good copper prices to some extent and was also a good money maker. The Champion and Trimountain both showed up well during the year and made up for the falling off of production by the Baltic—the third of the Copper Range trio. The Isle Roy ale showed evidence of its vastly improved condition and should soon become a much larger producer. The Superior developed a remarkable second lode and, made some increase while preparing for greater output. The Franklin began the use of new hoisting equipment at No. 1 shaft and made a fairly large output though held back by shortage of men. The Mass also was equipped with additional facilities and shipped a large tonnage while continuing extensive development work. These two mines in 1912 were operated at a profit for the first time in years. The Winona and Victoria both felt the labor shortage acutely, and were unable to take full advantage of good prices.

During the past year, most of the mining companies elected to operate under the provisions of the Employer's Liability and Workmen's Compensation Act of Michigan, which became effective Sept. 1, 1912. The principles striven for in this act are: reasonable compensation at minimum cost for all accidents except the result of wilful fault, certainty of amount, certainty of payment; payment without litigation and prevention of accidents. Fixed sums are paid under the act for any injury which incapacitates an employe for a period of not less than two weeks. Amounts of compensation to be paid in case of death of employe is determined by the extent to which his immediate relatives have been dependent for support on his earnings. If the employe leaves dependents wholly dependent on him, the compensation for fatal injury is a weekly payment of one-half his average weekly wages, but not more than $10 nor less than $4 a week for 300 weeks. For complete disability the compensation is at the same rate for 500 weeks the total not to exceed $4,000.

As stated by the accident industrial board, "the theory of the compensation law is based on the assumption that when a worker is injured in an industry, the loss to him was occasioned by the industry, and that the product of that industry should be charged with his losses, and should pay for them. The law should be supported to the end that injured workmen may receive justice, that employers may have fixed liabilities and escape the embarrassment and expense of damage suits, that the courts be relieved of the time of trying damage suits, that the public treasury be relieved of the expense of these damage suits, that the public be relieved of the expense of caring for the victims of industrial accidents, that more harmonious relations be promoted between employers and employes."

ADVENTURE CONSOLIDATED COPPER CO.

Balance of assets January 1, 1913, $33,634.

During 1912, exploration was continued by crosscuts and drifts at a depth of 1,500 feet. Copper was encountered in several places in a long crosscut south of the shaft and drifts have been run to determine the nature of these deposits. They occur in ground that is much crushed and the structure is too irregular to permit of easy correlation with the copper found in drill cores. Three lodes known as No. 2, No. 3 and No. 4 have been opened by drifts at the 1500-foot level and another lode known as No. 1½ is being opened up at a depth of 1190 ft. No large body of good ore has yet been found. A diamond drill is now in operation at the bottom of the shaft, boring a vertical hole.

AHMEEK MINING COMPANY.

Balance of assets December 31, 1912, $1,379,209.34

The Ahmeek Mine during the past few years has made rapid increase in production with lower costs per pound of copper. In 1911 there was mined 617,204 tons of which 18,655 tons were discarded. The 598,549 tons of ore stamped yielded 15,196,127 pounds copper, or 25.4 pounds per ton, at a cost of 7.17 cents per pound. The net profit for the year was $870,272.94 and the company's first dividend, $2.00 per share, was paid on Nov. 1, 1911.

During 1911 all four shafts were deepened and reached respectively No. 1, 2,281 feet; No. 2, 2,410 feet; No. 3, 1,683 feet; No. 4, 1,687 feet from surface. Good ore was opened up at No. 1 and No. 2 shafts, while lower grade ore was found at No. 3 and No. 4 shafts.

During 1912, development has continued favorable and production considerably increased. Large profits have been made and $900,000 distributed in dividends. Foundations have been laid and the construction of buildings for permanent surface equipment at shafts No. 3 and No. 4 commenced. A rock house with a bin capacity of 2,500 tons in being erected. Material increase in production is to be expected when the new hoists are in operation. The mill is to be enlarged to accommodate four additional stamps, two of which will be contracted for early in 1913.

To determine whether mules can be used to advantage in tramming, two of these animals have been used to haul the cars on one of the levels. Their suitability is not yet proved, and their use at the Ahmeek at present is an experiment only.

During 1912, there was treated 652,260 tons of ore, yielding 16,455,769 pounds copper, or 25.2 pounds per ton at a cost of 7.85 cents. Net profit for the year was $1,465,396.89.

President R. L. Agassiz reports for 1912:

"At No. 1 shaft all openings to the north show ground of average quality. To the south, the same is true of the 15th, 16th and 17th levels, but the 6th, 10th and 14th levels have been poor throughout the year. The 8th level south passed through a disturbed area tributary to a Mohawkite seam, but the ground opened in the last two months of the year has been of average quality. At the end of the year, the shaft showed five feet of good vein on the hanging-wall side. The experiment of tramming by mules is being made on the 12th level, and thus far is giving good results.

"At No. 2 shaft all the openings show average values. The 9th and 13th levels north reached the Mohawk boundary. A transverse fissure north of No. 2 shaft, carrying mass copper, has been opened up for a distance of 219 feet on the 10th level, for 60 feet on the 13th level and for 77 feet on the 14th level, and openings still look very well. The shaft is sinking in the foot-wall.

"At No. 3 and No. 4 shafts all openings at these shafts have shown average values for this end of the mine, as explained in last year's report. The shafts have been connected on the 10th level, and at the end of the year No. 3 was sinking in the lode with average values and No. 4 was in the foot-wall. On account of surface construction at these shafts, drifting was stopped in June and shaft sinking in September. Sinking will be resumed

shortly, but not much work can be done until the permanent plant is in operation."

ALGOMAH MINING COMPANY.

Deficit on January 1, 1913, $12,299.58.

The Algomah, like the other properties of which Stephen R. Dow was president, suffered a considerable financial loss by the failure of Mr. Dow. The company was reorganized after the Dow failure in 1912, with the following officers:

President, R. M. Edwards.
Secretary, Albert L. Wyman.
Treasurer, Henry Holman.

These officers and John C. Watson, J. H. Rice and David E. Dow, directors.

During 1911 exploration was carried on from the shaft and by diamond drill. The drift at the first level was extended south to a point 850 feet from the shaft, and north to a point 1,200 feet from the shaft, or 900 feet south of the first level of the Lake Mine.

At the second level a crosscut was run into the hanging wall—a thick bed of trap.

During 1912 the crosscut has been extended through the trap and drifting done on an amygdaloid which overlies it. This bed contains some copper and is being explored north and south from the crosscut.

Diamond drilling has been carried on throughout the year in an effort to locate definitely the Lake lode. An assessment of $1.00 per share payable January 22, 1912, was called to provide $70,000 for continuation of development work.

By the failure of Mr. Dow the company lost $28,725 which should have been in the treasury at that time. To meet the expenses of continuing explorations from August 1 to December 31, 1912, $12,000 was borrowed and this amount is being increased at the rate of approximately $3,000 per month.

President R. M. Edwards reports of the results of explorations: "A study of the drill cores has as yet given no satisfactory explanation of the conflicting results obtained. Apparently on the northwestern part of the property adjoining the Lake and South Lake in vicinity to drill holes Nos. 5, 6 and 7, there are copper deposits at considerable depth, but which way they dip and where they come to the surface is undetermined. Work on the Lake and South Lake properties which is proceeding as rapidly as possible will later throw light on these questions."

ALLOUEZ MINING COMPANY.

Balance of assets December 31, 1912, $93,564.

The Allouez Mine, after several years of exploration and development, has now entered on what is expected to be a long period of profitable operation. Large sums have been spent in opening up the Kearsarge lode and providing modem and extensive equipment for mining the ore. It is now possible to produce a much larger tonnage and the output is being considerably increased. A large profit is expected from operations during 1912 and lower costs will obtain in the future.

In 1911, the mine produced 294,646 tons of which 6,036 tons were discarded. There was stamped, 288,610 tons of ore yielding 4,780,494 pounds copper, an average of 16.56 pounds per ton. This copper cost 13.30 cents per pound.

During 1911 both shafts were deepened, No. 1 to 3,298 feet and No. 2 to 3,228.5 feet. The openings from No. 1 shaft showed ground of average quality.

Those from No. 2 showed unusually good ore.

At No. 2 shaft there has been recently completed a steel rock house, with large circular storage bins and two 24 inch by 48 inch rock crushers and dumping aprons. A hoisting engine capable of hoisting a 5-ton load from 6,075 feet on the lode, has also been installed.

During 1912 there was treated 333,618 tons ore, yielding 5,525,455 pounds refined copper or 16.56 pounds per ton, at a cost of 13.52 cents per pound. Net profit for the year was $171,264.

The management in reporting operations for the year states:

"The openings from No. 1 shaft have shown about average quality of ground. The shaft itself, after passing through a disturbed area, is bottomed in fair rock.

"The drifts north and south from No. 2 shaft have opened ground fully up to the average of previous year. The shaft, sinking partly in the lode and partly in the foot-wall, showed poor ground during the first half of the year, but during the last half of the year a fair grade of rock was exposed.

"The equipment for No. 2 shaft mentioned in last year's report went into commission during the summer. All necessary railroad connections have been built and the plant is working very satisfactorily. The collar houses at both shafts have been extended to take care of the new man cars now in use. The extension to No. 1 boiler house and a new 120-foot smokestack have been finished and three fire-box boilers installed.

"During the year and pending the final adjustment of the 'milling plan,' charges for stamping were made at cost. The cost of construction was $66,438."

ARCADIAN COPPER COMPANY.

Succeeded by New Arcadian Copper Company.

ARNOLD MINING COMPANY.

Is still idle.

ASHBED MINING COMPANY.

Is still idle.

ATLANTIC MINING COMPANY.

Mine on Atlantic lode is idle. The mill has been in operation treating ore from the Superior Mine; but this custom work has been recently discontinued and the mill is now idle.

BALTIC MINING COMPANY.

Balance of assets December 31, 1912, $306,106.25.

The Baltic Mine had poor years in 1911 and 1912, compared with former years. In 1911 there was stamped 696,795 tons of ore which yielded 15,370,449 pounds copper, an average of 22.06 pounds per ton, at a cost of 9.09 cents per pound. The profit from operations was $530,214.99 and $500,000 was distributed in dividends. During 1912 less copper was produced but $700,000 was paid out.

General Manager F. A. Denton reported early in 1912 on the condition of the mine:

"The new openings at the bottom of No. 3 shaft continued poor, though there are indications of improvement. At the No. 2 shaft and also at No. 4 the year's drifting has been in very good ground. The output of stamp rock was less than last year, due to reduced products from shafts No. 3 and No. 5. As stated in my last report, it is proposed to gradually abandon No 5 shaft and handle its ground through No. 4. We are also making a more determined effort to. extract our ground from the boundaries backward to the shafts for reasons of economy, safety and high extraction. While arranging openings to permit of this, our output suffers temporarily."

During 1912 operations yielded results below the average, but improvement is looked for. The company reports that the openings made during 1912 show distinct improvement, those at No. 2 shaft being exceptionally good.

At the mill preparations are being made for the installation of regrinding apparatus to be driven by low pressure turbines. Mr. A. H. Sawyer says in a recent issue of the Engineering and Mining Journal. "The old section of the Baltic mill at Redridge, Mich., which contains four Nordberg simple steam stamps, is being equipped with a regrinding plant divided into four units, one for each head. The plant is being built in the basement, previously not used, so that no alteration in the mill proper was necessary. Each unit consists of one 8 ft. by 30 in. and one 6ft. by 22 in. Hardinge mill and nine Wilfley concentrating tables. The middlings from the jigs and the middlings and tailings from the finishing tables are fed to the mills by gravity. The mills were built in the shops of the Champion Copper Co. at Painesdale, under the Hardinge patents, but important changes were made in the mechanical design. They will be driven by 50 and 25 h. p. motors, respectively, mounted on the same concrete foundations as the mills."

During 1912 there was stamped 652,433 tons ore yielding 13,373,961 pounds copper or 20.50 pounds per ton. This cost 10.94 cents per pound and was sold at 16.16 cents. Net profit for the year was $697,393 and $700,000 was distributed in dividends.

BOHEMIA MINING COMPANY.

Was idle during 1912.

CALUMET & HECLA MINING COMPANY.

On December 31, 1912, Cash and Quick Assets totaled $11,560,426.47.

Liabilities $844,012.16 in drafts and bills and accounts payable. Notes outstanding, $5,819,000.

During 1911 the company stamped 2,909,972 tons of ore yielding 74,130,977 copper, an average of 25.47 pounds per ton at a cost of 8.52 cents per pound. From the conglomerate lode there was stamped 1,924,480 tons ore yielding 58,469,399 pounds copper or 30.38 pounds per ton at a cost of 8.25 cents per pound. From the Osceola Amygdaloid lode, there was stamped 985,492 tons ore yielding 15,661,578 pounds copper an average of 15.89 pounds per ton at a cost of 9.95 cents per pound. No ore from the Kearsarge lode was stamped.

On December 31, 1911, the operating shafts on the conglomerate lode had reached the following depths. Calumet No. 5 and 6, 6,155 ft.; Calumet No. 4, 7,995 ft.; Calumet No. 2, 6,186 ft.; Slope shaft, 1,588 ft.; Hecla No. 6, 7,578 ft.; Hecla No. 7, 7,666 ft.; South Hecla, No. 8, 6,102 ft.; South Hecla No. 9 and 10, 7,627 ft. During the year shaft and arch pillars were removed from the 27th to the 24th level at Hecla No. 2 shaft, from the 23rd to the 19th level at Hecla No. 3, and from the 9th to the 5th level at South Hecla No. 11.

The company states that the openings in the five forties continue to show ground of about average grade and that at Hecla and South Hecla branches of the ground opened is quite up to the average of 1910. The openings on the Osceola lode were up to the average and large quantities of good ore were found on the foot side of the lode. On the Kearsarge lode development work was continued at No. 21 shaft but no better ground was opened.

During 1912 work has proceeded much as in 1911 but, owing to higher metal prices, this has been a much more profitable year. The production is expected to be somewhat less, however, there being considerable falling off in output of conglomerate ore.

The recrushing plant started in February, 1909, has proven very successful and in 1911 there was treated 477,794 tons of tailings averaging 12.66 pounds copper yielding 2,152,110 pounds copper or 4.50 pounds per ton at a cost of 5.01 cents per pound. Construction of a

new recrushing plant has been started. The foundation and nearly all the steel work for the building, 123 ft. by 432 ft., has been erected. The new plant will be equipped with Hardinge conical pebble mills. The regrinders in the plant now in operation are Chili mills.

After long experimentation, it has been decided to install an electric turbine generator to be driven by the exhaust steam from the stamps. Plans were made for a 7,500 kilowatt unit and contracts for the machinery have been awarded. The foundation and building for the generator are finished and part of the machinery is now on the ground.

During 1912 an important addition has been made at the smelter. Two furnaces designed to have a capacity of 150,000 to 175,000 pounds of refined copper have been built. These are to be run in 48-hour cycles—36 hours for melting and 12 hours for refining. Walker casting machines are used and the copper is cast in the form of anodes. The foundation for a new electrolytic building 155 ft. by 270 ft. has been finished and contracts for the steel work and part of the equipment have been let. With this equipment in operation, it will be possible to recover the silver from smelter products at the Hubbel plant.

The company reports that before the close of the year, it acquired all the stock of the Frontenac, Manitou and St. Louis Companies and acquired the property of the Dana Copper Company. The lands formerly owned by the Manitou-Frontenac and Dana Companies will be known as the "Manitou-Frontenac Branch" and the lands of the St. Louis company as the "St. Louis Branch."

During 1912 on the conglomerate lode there was completed 523 ft. shaft sinking, 10,048 ft. drifts and 614 crosscuts and footwall drifts. Hecla shafts No. 6 and No. 7, were deepened from 7,578 and 7,666 ft. to 7,791.5 and 7,854.0 ft. respectively, and South Hecla shafts No. 9 and No. 10, from 7,627 to 7,740 ft. President Shaw's report says:

"About 12 drills are at work in removing shaft pillars and about 15 drills in cleaning up arches or the 'backs' of old stopes. The drifts in the 5 forties and in the Hecla and South Hecla branches continue to open ground of about the same quality as last year."

On the Osceola lode there was completed 451.0 ft. shaft-sinking, 17,736.5 ft. drifting and 317.5 ft. crosscuts. Shafts No. 14 and No. 16 were deepened from 2,554 to 2,812 ft. and from 2,600 to 3,036 ft. respectively. President Shaw's report says: "There has been practically no change in the character of the openings made this year as compared with the previous year. The footside of the lode continues to yield a large tonnage of rock; fully 25% of the product last year having been mined from footwall stopes. The 6th and 10th levels north of No. 18 shaft have reached the Centennial boundary, and south of No. 13 shaft the 21st and all the levels above have been driven to the boundary of the Osceola Branch of the Osceola Mine. Stoping operations are now being conducted over the entire length of the lode, about 2⅓ miles."

On the Kearsarge lode No. 21 shaft was sunk 20 ft. to a depth of 2291 ft. and 2,120 ft. drifting was done. There was stamped 19,050 tons ore yielding 228,985 pounds copper. Pres. Shaw says of operations on this lode. "The development work at No. 21 shaft has been continued throughout the year, and though no materially better quality of ground has been opened, the rock is more generally mineralized." During 1912 all the producing subsidiary companies, Allouez, Centennial, Isle Royale, Osceola, Superior and Tamarack made profits, the total amounting according to the Boston News Bureau to $3,758,900. Of this amount, the sum of $1,477,500 represents profit on shares held by the C. & H. Company. The company received $15 per share on 24,800 shares Ahmeek and $12 per share on 32,750 Osceola. Further dividend of $7 per share on 24,800 shares Ahmeek and $1 per share on 27,500 Isle Royale will be paid early in 1913, making a total of $966,100. All these companies are in a much better financial position than a year ago. The ownership of shares in the several subsidiary companies was on Dec. 31, 1912 as follows:

	Shares issued.	Shares owned by C. & H. Co.
Ahmeek	50,000	24,200
Allouez	100,000	41,000
Centennial	90,000	41,500
Cliff	60,000	19,400
*Dana	40,000	40,000
*Frontenac	20,000	20,000
Gratiot	100,000	50,100
Isle Royale	150,000	30,500
La Salle	302,977	152,977
Laurium	40,000	37,550
*Manitou	20,000	20,000
Osceola	96,150	32,750
Seneca	20,000	11,207
Superior	100,000	50,100
*St. Louis	40,000	40,000
Tamarack	60,000	19,400
White Pine pfd.	3,792	43,202
White Pine com.	85,320	6,092

*The properties formerly held by these companies were in 1912 acquired by the Calumet and Hecla Mining Co.

In 1912 there was treated 2,806,610 tons ore yielding 67,856,429 pounds copper, an average of 24.18 pounds per ton. 1,746,960 tons Conglomerate ore treated yielded 51,935,245 pounds or 29.73 pounds per ton, at a cost of 8.87 cents per pound. 1,040,600 tons Osceola Amygdaloid ore treated yielded 15,692,199 pounds copper, an average of 15.08 per ton, at a cost of 10.36 pounds per ton. At the crushing plant 481,320 tons of coarse tailings, containing 12.86 pounds copper per ton yielded 2,155,292 pounds copper at a cost, exclusive of smelting and selling, of 4.99 cents. The extraction was 4.48 pounds copper per ton.

The balance sheet as of December 31, 1912 shows assets of $11,560,426.27 against which are charged drafts in transit, $495,260.88; Bills and accounts payable, $348,751.28; notes outstanding, $5,819,000.

During the year there was paid in dividends $4,200,000, making a total of $120,050,000 paid to December 31, 1912. Notes amounting to $2,700,000 were retired. A long period of profitable operation is assured for the Calumet & Hecla mine and the company seems likely to

receive a liberal return on its investments in other properties.

CARP LAKE MINING COMPANY.

This company has recently resumed work on its long idle property in the Porcupine district and is expected to undertake more vigorous exploration next season.

CENTENNIAL COPPER COMPANY.

Balance of liabilities December 31, 1912, $3,549.22.

Development during 1911 resulted in the blocking out of considerable good ore in the northern lower part of the mine and the ore produced was mined at a profit. 86,543 tons were stamped producing 1,493,834 pounds copper, an average of 17.26 pounds per ton, at a cost of 12.69 cents per pound. The profit from operations was $12,411.97 and after deducting interest paid there resulted a net profit of $6,045.62 for the year.

During 1912 the production has been increased and the better price for copper taken advantage of. As in 1911, the most satisfactory results are being obtained in the north drifts from No. 2 shaft. No work was done at No. 1 shaft.

In 1912 there was stamped 106,517 tons ore, yielding 1,742,338 pounds of refined copper, an average of 16.36 pounds per ton, at a cost of 13.46 cents. Net profit for the year was $50,511.

CENTRAL MINE.

Idle.

CHALLENGE MINE.

Idle.

CHAMPION COPPER COMPANY.

Balance of assets December 31, 1912, $943,875.84.

The Champion Mine had a comparatively lean year in 1911, but has since improved greatly. In 1911 there were stamped 734,392 tons of ore yielding 15,639,426 pounds copper, an average of 21.296 pounds per ton at a cost of 9.63 cents per pound. The net profit for the year was $454,588.61 and $500,000 was distributed in dividends.

In 1912 increased production and better prices have resulted in large profits and $1,100,000 has been paid in dividends.

The mine is being developed to the south by long drifts and the territory is showing up well. To facilitate tramming, the mine is now electrically equipped and the cars are hauled to the shaft by motors.

General Manager F. W. Denton reported concerning operations in 1911.

"The reduced output of copper is explained by the lower yield, due probably to a combination of causes. The rock obtained from the drifting was not as rich as during the previous year, which was unusually good, and our stoping has been carried on in leaner rock. While the fluctuation in yield is larger than usual, there is nothing to indicate any serious change in the quality or extent of the ground. The mine is assured of a long and profitable life and has not yet reached its zenith."

The results obtained during 1912 were much better than in the previous year. 765,306 tons of ore was stamped, yielding 17,225,508 pounds of copper, or 22.508 pounds per ton. This cost 8.88 cents per pound and was sold at 16.16 cents. Net profit for the year was $1,251,619, and $1,100,000 was distributed in dividends. The company reports that openings made during 1912 were good at all of the shafts.

CHEROKEE COPPER COMPANY.

Idle.

CLARK MINE.

Idle.

CLIFF MINING COMPANY.

Balance of assets December 31, 1912, $62,571.79.

During 1911 exploration was carried on at a depth of 205 feet by drifts on a lode in the horizon of the Kearsarge amygdaloid. A second parallel lode has also been tested. President R. L. Agassiz reports of operations during 1912:

"The crosscut to the north was driven 154 feet west and encountered the west lode mentioned in last year's report at a distance of 160 ft. This lode was poor where cut and no copper was found in the 40 feet of drifting that was done to the north.

"Drifts on the east lode were extended 50 feet to the south and 288 feet to the north, but with the exception of a small amount of copper at one point, nothing of value was disclosed, the bed being only from 3 to 4 feet wide and poor throughout."

CONTACT COPPER COMPANY.

Balance of assets December 31, 1912, $17,866.

The Contact Copper Co. has continued diamond drilling exploration begun in 1910. Although several amygdaloids and one conglomerate showed small amounts of copper, the beds thus far cut have shown no marked degree of mineralization.

In November, 1912, the company bought all the property of the Elm River Copper Company at public auction.

COPPER CROWN MINING COMPANY.

Idle.

DAKOTAH HEIGHTS COMPANY.

Was absorbed in 1912 by the Naumkeag Copper Co.

COPPER RANGE CONSOLIDATED COMPANY.

Surplus December 31, 1912, $904,137.63.

In 1911 comparatively small profits were made, the production of copper being less than in previous years and the selling price low. Much better results were obtained during 1912 however. In the year 1911 there were produced 37,130,292 pounds of copper which was sold for $4,655,127.03. The net income was $804,560.93 and $1,357,104 was paid out in dividends.

The company has recently made a number of changes at the mines which are expected to improve the efficiency of the working force. Young engineers have been put in charge of much of the work formerly left to mining captains who had much practical experience but little technical education. One-man drills have taken the place of many of the two-man drills, enabling the company to pay higher wages and yet obtain the same tonnage at a much lower cost. Electric motors are now used to haul cars in the longer drifts. A number of the stations have been concreted. At the mills experiments with regrinding mills have been carried on for some time and the construction of a regrinding plant at Freda is now under way. Hardinge conical pebble mills will be used to regrind the sands. Experiments with low pressure turbines to use exhaust steam from the stamps have proven the economy of such practice, and a turbine has been installed to develop the power needed for the new regrinding apparatus.

The past year has proven much more profitable than did 1911, owing to better prices and increase in output of the Champion and Trimountain mines. The Baltic made a lower production than usual however, and the total tonnage was therefore not much increased. The company paid in dividends $788,428 and ended the year with a substantial increase in balance of assets. The income was largely derived from profits made by the Champion, Baltic and Trimountain mining Companies. The Champion paid $1,100,000 during 1912, half of which went to St. Mary's Canal Mineral Land Co. The Baltic paid $700,000 and Trimountain paid $300,000.

The report for 1912 shows that the company's net income was $1,692,566. There was produced 28,967,428 pounds copper at an average cost of 10.51 cents. This copper was sold at 16.16 cents per pound. The average yield per ton was 21.07 pounds of refined copper. The three mines, Baltic, Champion and Trimountain, together produced 37,584,647 pounds copper but only one-half of the Champion is owned by The Copper Range Consolidated Co.

COPPER RANGE COMPANY.

This company owning one-half of the stock of the Champion Copper Co., had a very successful year in 1912. See Champion Copper Co. and Copper Range Consolidated Co. reports.

DANA COPPER COMPANY.

The property was acquired by the Calumet & Hecla Mining Co. and with that of the Frontenac and Manitou companies will be known as the "Manitou-Frontenac branch."

ELM RIVER COPPER COMPANY.

In November all the property was sold at public auction to the Contact Copper Company. The Elm River Copper Company is dissolved and in process of liquidation.

FRANKLIN MINING COMPANY.

Balance of assets December 31, 1912, $41,839.

The failure of the president, Stephen R. Dow, in September, 1912, resulted in severe financial loss to the company. Mr. Dow had used the company's funds in his private business and was unable to return them. The company has been reorganized, Mr. R. M. Edwards, elected president, and Charles G. Rice and Sidney J. Jennings elected to succeed Mr. Dow and Albert Wyman. An assessment of $2 per share was called to provide money to carry on development and construction work.

Aside from the Dow affair and inability to produce the desired tonnage the company has been fairly successful in 1912. New equipment has been put in operation and the mine openings were in better ore than usual. Long stretches of good ore have been developed and the lower levels are regarded as the best in the mine. From the operating shaft a long drift has been run south on the twenty-third level to make connection with No. 3 shaft by raising to the 17th level.

During 1911 there was produced 820,203 pounds copper. The production since the completion of new equipment in February, 1912 has been greatly increased and will be further increased as miners can be secured. Owing to labor troubles however the company has not been able to produce a tonnage near that which the plans call for. To facilitate handling of the ore, loading chutes have been built at the 31st level for all ore from 31st to 27th level and at the 27th level for the six levels above. Instead of filling the skips at each level, the ore is run down through rock chutes to bins from which it is readily drawn off, a skip-load at a time, to a loading bin from which it is then allowed to run into the skip.

The hoist at the operating shaft is of a new type designed by Manager R. M. Edwards. He describes it as follows:

"The new hoisting engine, built to handle a skip carrying ten tons of rock at a depth of 5,000 feet, has been installed and is working. This engine has an air cylinder connected tandem with each of the two steam cylinders. In hoisting, these air cylinders are unloaded and do no

work. On lowering, the steam cylinders are unloaded, the weight of the descending skip turns the engine backwards, the air cylinders are brought into play and furnish resistance necessary to brake the skip on the down trip by compressing air. This air is discharged into the large receivers above mentioned, where it mixes with steam from the boilers and is fed back to the hoist to assist in raising the next skip. The engine was designed to utilize the power generated by the descending skip without the cost of sinking a double compartment shaft and building and maintaining two skip-roads, to avoid the loss of two skips in balance when the empty skip must go to the bottom of the mine in order to get the loaded skip to the dump, and be afterwards hoisted to the level on which it is to be loaded and for a saving in brake shoes. Is has done these things."

In addition to new equipment at the mine, numerous improvements have been made at the mill. New machinery has been installed and much of the old overhauled or rebuilt. An increase in recovery at lower cost is now obtained.

In 1912 there was stamped 176,462 tons, giving 1,710,651 pounds of refined copper, or 9.80 pounds copper per ton.

The company lost $81,393.62 through the failure of S. R. Dow.

FRONTENAC COPPER COMPANY.

Idle.

GLOBE MINE.

Idle.

GRATIOT MINING COMPANY.

Balance of liabilities December 31, 1912, $358,510.57.

No active operations were conducted during 1912. Expenses amounted to $21,554.71 of which $17,688.71 was interest. Receipts from sales of machinery, etc., amounted to $8,584.86.

HANCOCK CONSOLIDATED MINING COMPANY.

The Hancock Mine, after several years of development work, is now nearing the producing stage. During 1911 a test was made of the No. 2 and No. 3 lodes, while No. 2 shaft was being sunk to open up the Pewabic series of lodes. The mill test extended over a period of six and a half months and resulted in the recovery of 18.21 pounds copper per ton of ore stamped. 754,749 pounds copper was produced and sold.

In 1912 the No. 2 shaft was deepened to 4,000 feet. The shaft has cut three promising lodes known as No. 4, No. 5 and No. 6. To open up No. 4 lode, crosscuts were run from the shaft at 26th and 34th levels and others will be run at 36th and 39th levels. Another lode has been recently exposed in a crosscut at the 18th level.

It is expected that the mine will be in shape to begin shipping ore in 1913 and arrangements have been made for the use of one of the stamps of the Lake Milling, Smelting & Refining Company's plant at Point Mills.

Four assessments of $1.00 each were paid on March 1, 1911, May 1, 1911, January 10, 1912 and March 28, 1912, respectively. To provide any further funds that may be needed, arrangements have been made to borrow money instead of making further assessments. If the lodes prove up well, the mine will very soon be self-supporting for it is well equipped to handle a large tonnage.

In the annual report for 1912 General Manager Harris says:

"The principal development work done during the year was confined to the opening of new ground by drifting on No. 3 lode at the 16th, 18th and 27th levels; to driving crosscuts east from the 13th, 18th, 27th, and 34th levels to develop the veins interested at depth in No. 2 shaft; and to the sinking of No. 2 shaft to the objective point, as originally planned.

"Some development work was done during the latter part of the year on a promising looking amygdaloid lode intersected by the 18th level crosscut 735 feet of No. 3 lode, and although the vein is narrow, carrying in width from three to eight feet, it is well mineralized for the entire distance:—150 feet south and 50 feet north of crosscut respectively.

"Drifting will be done on this lode where intersected by crosscuts at the 13th, 27th and 34th levels, and judging from results in the limited amount of drifting done to date, at the 18th level, should be a valuable asset. Crosscuts from the 13th to the 34th level inclusive will command a length of 1,800 feet on the dip of the lode.

"No. 2 shaft was sunk and timbered 804 feet to a point 4,001 feet below the collar. Shaft was bottomed at this depth October 18, since which time work in shaft has been confined to cutting the four necessary stations below the 34th level station, viz: at the 39th, 44th, 49th and 53rd levels, respectively.

"Very good progress was made during the year in sinking the shaft, and in cutting the stations. Four of these stations are completed.

Several of the groups of veins where intersected in the shaft, at and below 3,105 feet, were well mineralized."

HOME COPPER MINING COMPANY,

Idle.

HULBERT MINING COMPANY.

Idle.

HUMBOLDT COPPER COMPANY.

Idle.

HOUGHTON COPPER COMPANY.

During 1912 the results of the exploration have been very good. As the shaft has been found to be too far in the foot wall, it was discontinued at the 623-foot level. A winze has been sunk 200 feet from this level in the lode and disclosed good ore. Drifts north and south have also shown much copper. The ore is very similar to that of the main lode at the Superior Mine and which is supposedly a much altered portion of the Baltic lode.

Owing to the remarkably successful opening up of the west lode at the Superior Mine, some exploration for this lode has been done at the Houghton. Comparatively little has yet been done. The present openings are not very promising, and attention is chiefly confined to the Superior lode.

At the 623-foot level the drifts are being extended and at the 825-foot level drifting has recently been started.

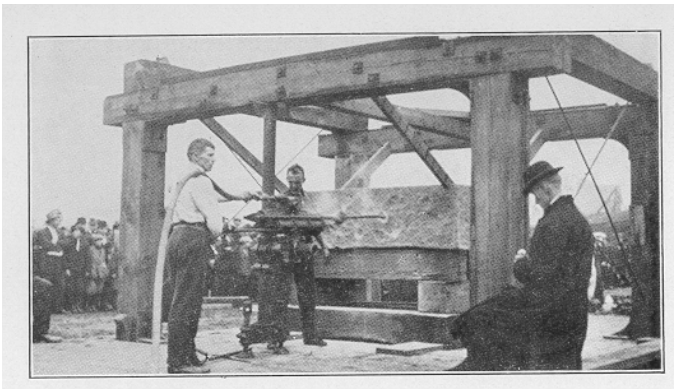

Plate I. A. Machine drill contest, Calumet, 1912. A two-man machine running.

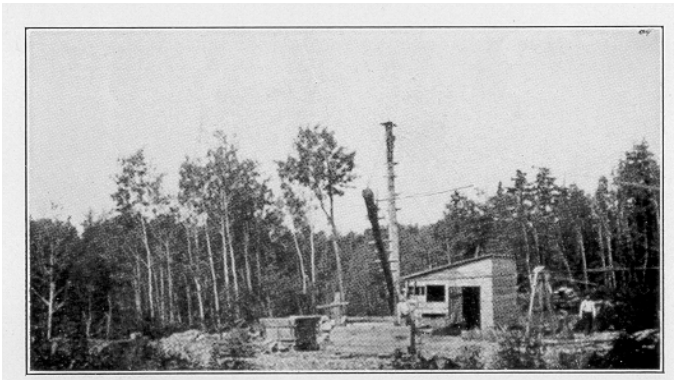

Plate I. B. White Pine No. 2, temporary shaft.

INDIANA MINING COMPANY.

Surplus of assets December 31, 1912, $53,060.23.

The Indiana, like other properties in which he was interested, suffered by the failure of President Dow, but the development work has continued without interruption. Messrs. Charles G. Rice, Sidney J. Jennings and Albert F. Holden have been elected directors to succeed Stephen R. Dow, David E. Dow and Albert L. Wyman. To provide funds to replace the losses made by President Dow, an assessment of $1 per share was called October 16, 1912.

Shaft sinking has been carried on at a fast rate in spite of the rock being unusually hard to drill. For a considerable distance the shaft is in felsite, a very hard rock which has not been encountered in other Michigan copper mines except as boulders in conglomerates.

At a depth of 600 feet, a crosscut was run in to explore a deposit at the bottom of the first felsite mass cut in the shaft. A short drift showed some heavy copper in a much altered margin of the felsite just above a mud seam which separates the felsite from a crushed brown colored trap. The deposit was only opened up for a short distance and then this exploration was discontinued.

In December, 1912 the shaft had been sunk to a depth of over 1,200 feet through felsites, sandstones, traps and amygdaloids. Copper has been found in some of the amygdaloids and in seams in the traps. At a depth of 1,115 feet, a quantity of green copper minerals, carbonate and silicate, was found in the felsite. A little native copper occurs with the green minerals.

As quickly as possible, the shaft is being sunk to open up the deposit from which a remarkable showing of copper was obtained by drilling at a depth of over 1,400 feet.

A number of interesting structural features have been determined while sinking the shaft. In the felsite there is a clay seam which was followed down for a long distance by the shaft. It was wide in the felsite but did not continue into the underlying trap. Mr. Bennett states that so far as could be determined in the shaft, the bedding of the sandstone shows a dip to the northeast instead of to the northwest. The contact between the first felsite and the underlying trap dips to the northeast. The top of the second felsite however slopes to the northwest. In the trap between the felsites there were found almost flat veins, a few inches wide, containing copper with well crystallized calcite. A similar seam at the contact with sandstone showed some native silver and fluorite in addition to copper and calcite.

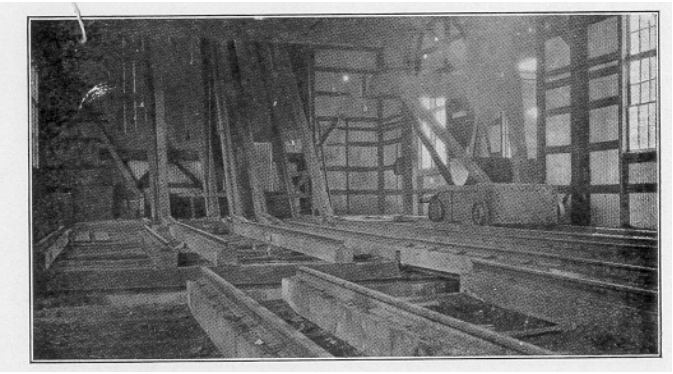

Plate I. C. Collarhouse, Kearsarge Mine, drill car at the right.

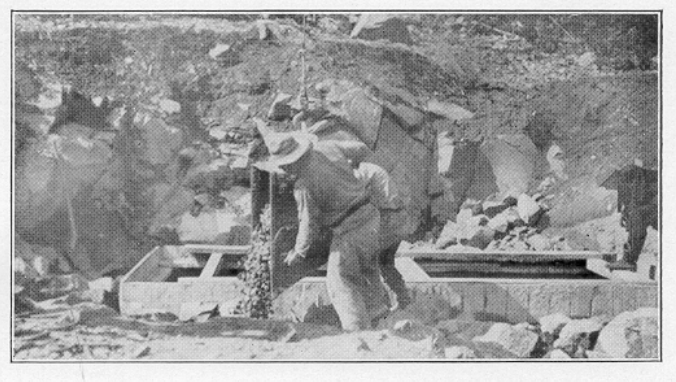

Plate II. A. Making concrete collar, new shaft at North Lake Mine, 1912, Ontonagon county.

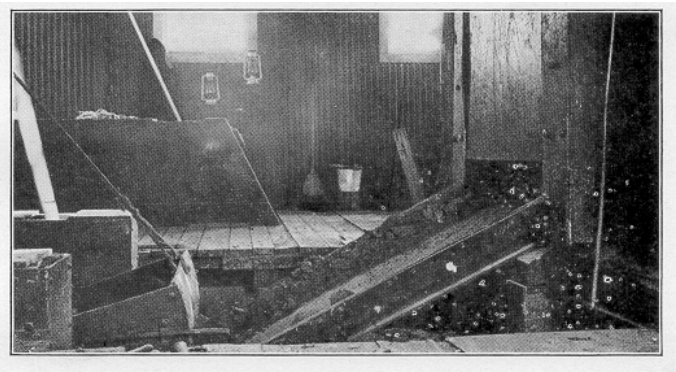

Plate II. B. Crusher feed, Franklin Jr. Mine, No. 1 shaft.

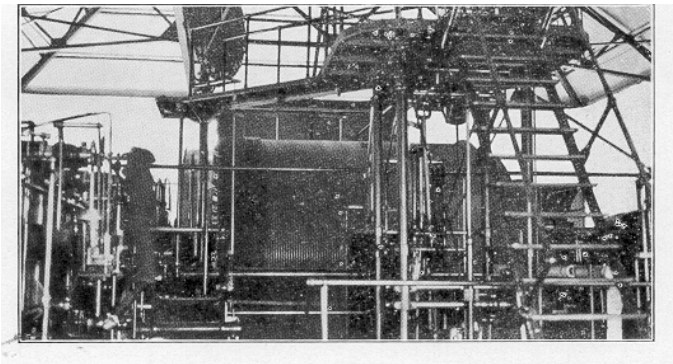

Plate II. C. New hoist at Franklin Jr. Mine, No. 1 shaft.

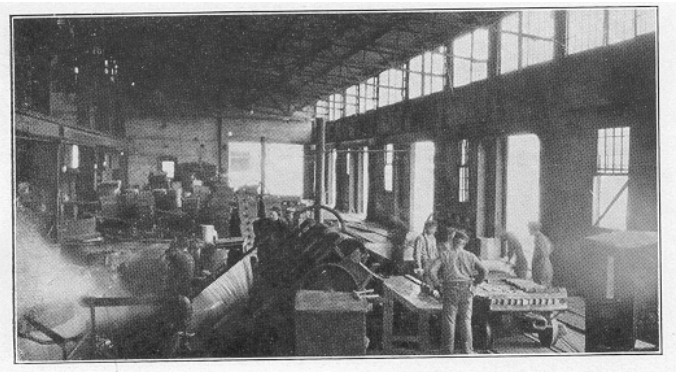

Plate III. A. Cooling and loading ingots, Michigan smelter.

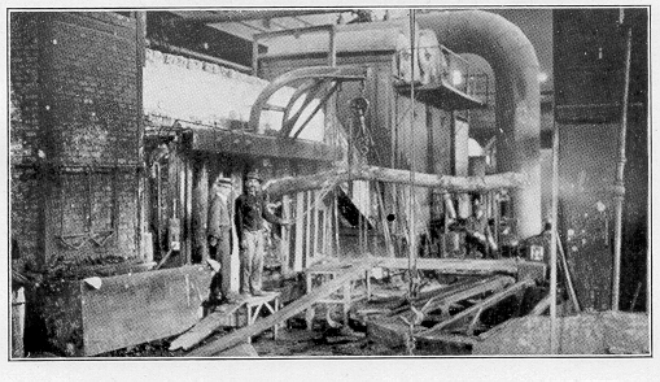

Plate III. B. Reverberatory furnace, Michigan smelter.

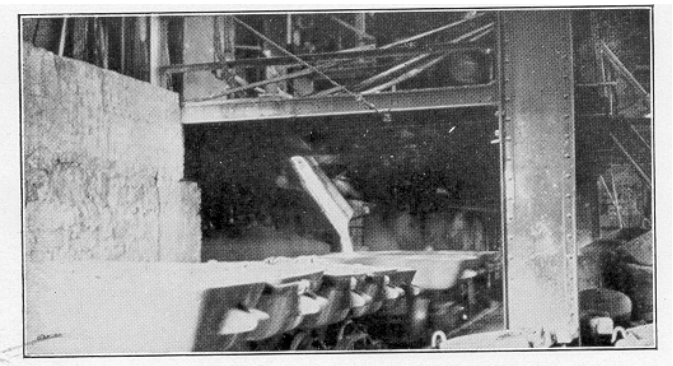

Plate III. C. Pouring slag, Michigan smelter.

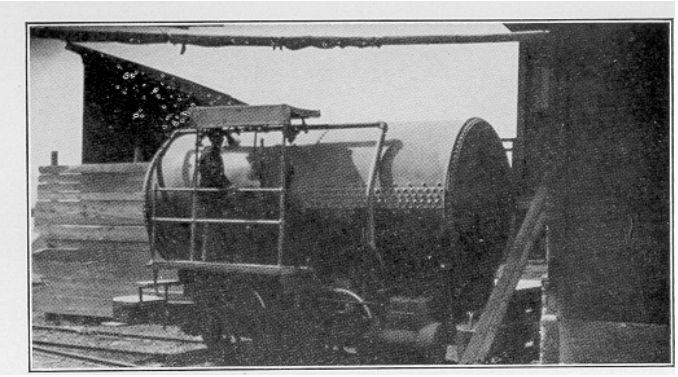

Plate IV. A. Air engine, Victoria Mine.

Plate IV. B. Nonesuch Mine, Ontonagon county, 1912.

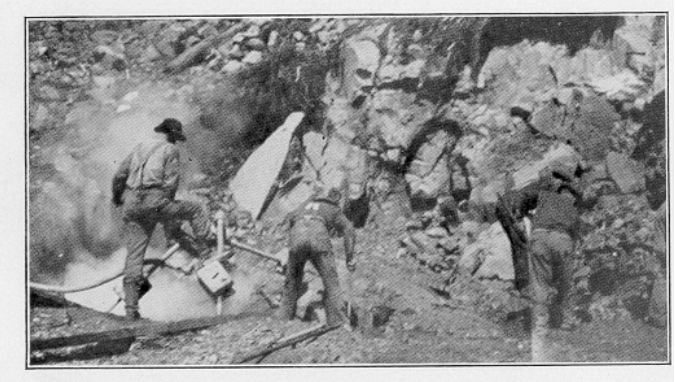

Plate IV. C. Starting excavation for shaft at South Lake Mine, 1912.

ISLAND COPPER COMPANY.

Idle.

ISLE ROYALE COPPER COMPANY.

Balance of assets December 31, 1912, $557,743.48.

The mine has shown remarkable improvement in the last few years and in spite of the low price of copper in 1911, a profit of $156,708.10 was made. There was stamped 457,440 tons ore yielding 7,490,120 pounds of copper, an average of 16.4 pounds per ton, at a cost of 10.85 cents per ton. Considerable sorting was done at the mine and of the rock broken, there was discarded 106,970 tons or 19 per cent. The four operating shafts on the Isle Royale lode were all deepened, No. 2 to 3, 162 feet, No. 4 to 1,517.5 feet, No. 5 to 1,006 feet and No. 6 to 1,234.5 feet. At "A" shaft, an exploration at a lower horizon, a little drifting and crosscutting was done.

During 1912 very satisfactory progress has been made and preparations for substantial increase in output are now well under way. The mine has been opened up more extensively and a new shaft is being cut by sinking and raising. This shaft is south of No. 6 and will command a portion of the lode which has shown up well where opened by long drifts south from No. 6. Raising from these drifts has been started at the 3d, 5th and 7th levels. Sinking from the surface through the overburden was begun but is temporarily stopped. With No. 7 shaft in operation and increased milling facilities a very much greater tonnage can be handled.

Arrangements have been made to purchase for the sum of $140,000 a stock interest in the Lake Milling, Smelting & Refining Company which will assure to. the company the use of two stamps. A spur connecting the Isle Royale Ry. with the Mineral Range Ry. has recently been constructed and shipments to the plant at Point Mills will be possible early in 1913.

In addition to the development of the Isle Royale lode, some exploratory work on other lodes has been done in 1912. At No. 2 shaft, the Grand Portage lode has been opened up for a short distance at the 29th level. In the horizon of the Kearsarge lode, some surface trenching has been carried on during the summer. The developments at the Houghton Mine will also likely lead to exploration in the horizon of the Baltic lode on Isle Royale property.

During 1912 there was stamped 531,105 tons, yielding 8,186,957 pounds of copper, or 15.4 pounds per ton, at a cost of 11.89 cents per pound. Net profit for the year was $419,766.

President Agassiz in his report describes recent results of openings on Grand Portage lode and exploration in horizon of Kearsarge lode as follows:

"On the 29th level at a point 700 feet north of No. 2 shaft a crosscut was driven to the west and at a distance of 125 feet it cut the West or Grand Portage lode, which was found to be 62 feet wide with 14 feet of good copper ground on the foot side and about 13 feet on the hanging side, with the middle of the vein poor. A drill hole 70 feet north of the shaft on the same level showed this vein to carry some copper, and a crosscut has been started at this point. A second drill hole 380 feet north on the 26th level shows good vein matter but no copper values.

"This West or Grand Portage lode was mined by your company in the early days from No. 1 shaft, which has since been abandoned; the results of that work, together with this recent development, made the acquisition of additional territory desirable, and your company has bought, subject to title, the mineral rights underlying the Montezuma lands, approximately 200 acres, for the sum of $100,000, in four payments of $25,000 each, extending over a period of three years. These mineral rights, which your directors believe of value to the company, lie below No. 1 shaft to the north of No. 2 shaft and below the 29th level, and can be mined in large part through No. 2 shaft."

"Exploration by drilling and trenching was undertaken on the supposed horizon of the Kearsarge lode at a point about 2,400 feet from the Isle Royale lode, and directly north from the Huron dam on the S. E. ¼ of the N. E. ¼ of Section 2, and an amygdaloid lode was encountered, which, in the opinion of experts, was the Kearsarge lode. Though some mineralization was shown, no commercial values were found. At a point about 700 feet farther north in the hanging, diamond drilling and trenching disclosed a second amygdaloid vein, which carried good copper values near the surface, but at depth showed poor vein matter with no copper."

KEWEENAW COPPER COMPANY.

On September 3, 1912, this Company offered the stockholders of Phoenix Consolidated Copper Company and the Washington Copper Mining Company an opportunity to exchange their shares of stock in these companies for shares of stock in the Keweenaw Copper Company, on the following basis:

Ten shares of Phoenix for one share of Keweenaw.

Twenty shares of Washington for one share of Keweenaw.

When this exchange of stock is completed the Keweenaw Copper Company will own, including the Ashbed on the lands of the Phoenix Consolidated Copper Company, about thirteen and one-half miles along the strike of the Ashbed lode.

In the past, mining operations on this lode have been conducted on a limited scale and it is believed by the Board of Directors that by extensive developments, that operations on this lode will be profitable, therefore, it has been decided to begin an active campaign of development.

Additional territory, amounting to approximately 5,682 acres have been secured for the Keweenaw Copper Company.

In order to pay for the additional territory acquired, liquidate outstanding indebtedness and provide funds for explorations, an assessment of $2.00 per share has been called.

In December exploratory work, consisting of diamond drilling was commenced, and it is proposed to thoroughly explore the Ashbed lode on the company's lands.

Officers of the company are as follows:

T. F. Cole, President.
Spencer R. Hill, Vice-president.
Thomas Hoatson, Second Vice-president.
C. A. Wright, Secretary and treasurer.
W. J. Uren, General Manager.

Directors:
T. F. Cole, Duluth, Minn.
G. G. Hartley, Duluth, Minn.
James Hoatson, Calumet, Mich.
Thomas Hoatson, Calumet, Mich.
Spencer R. Hill, Boston, Mass.
C. A. Wright, Calumet, Mich.

President T. F. Cole says in his report for 1912:

"During November contract was made for approximately 12,000 feet of diamond drilling on the Ashbed lode and in December the contractor commenced drilling operations with two drills on Section 11, T. 58 N., R, 30 W. The depth of holes on December 31, 1912, was as follows:

"Hole No. 38, 283.5 feet; hole No. 39, 49.0 feet and at these depths had not reached the Ashbed lode.

"The company now controls about 13½ miles along the strike line of the Ashbed lode, and now that exploration is well under way it is proposed for this year to continue diamond drilling along this lode in an easterly direction, and it is hoped that the results obtained will justify us in commencing mining operations.

"The directors were authorized to sell the company's timber at the last annual meeting of stockholders, but as yet no sales have been made.

"The Keweenaw Central railroad was operated at a loss during the past year. Improvement in its earnings is now being shown and it is only a question of time before the territory served by the railroad is opened up and developed when the railroad operations will yield a profit."

LA SALLE COPPER COMPANY.

Balance of Assets December 31, 1911, $261,783.84.

The property has not been very greatly developed recently. During 1911 the new openings were of average character, but the low price of copper did not promise a profit. On Nov. 24, 1911, the following statement was issued by the directors:

"The ground so far opened necessitates a reasonably large tonnage to secure profits at a fair price of copper. The area developed on the Kearsarge lode contiguous to No. 1 shaft, is now adequate for such a tonnage, but the present low price of copper and the lack of suitable stamping facilities make production at a profit impossible. While No. 1 shaft is being suitably equipped, the expense of further development work can well be deferred until conditions warrant production and steps are being taken to temporarily discontinue operations at this point. It is proposed to do some exploratory work on your property east of the Kearsarge lode."

It is now planned to move the equipment from No. 5 and No. 6 shafts to No. 1 and No. 2. Sinking will be resumed at No. 2 and openings extended at No. 1. If the present price of copper holds profitable, production may result from operations in 1913.

President Shaw reports for the year 1912 as follows:

"With the higher prices of copper obtaining it was planned to resume operations last June, but it was impossible to secure a sufficient working force until November.

"The work of unwatering No. 1 shaft, has gone forward satisfactorily, and on December 31 the water level stood 1319 feet from surface, or 90 feet below the 12th level

"No. 2 shaft is also unwatered, and on Dec. 31 the water was lowered to a point 1,586 feet below surface, or 70 feet below the 15th level.

"A cross-section of the formation was made by diamond drilling from a point on the Kearsarge lode 1,650 feet south of No. 2 shaft to the eastern boundary of the company's property. The line of the cross-section was at right angles to the formation, and a total of 322 feet of drilling was done. The work showed this entire zone to be barren of copper, and of the several lodes cut only one of them contained even fair-looking vein matter.

"The shaft houses from Nos. 5 and 6 shafts have been moved to Nos. 1 and 2 shafts, and the erection of the one at No. 2 is nearly completed. The present hoisting

equipment will answer for a short time, but larger hoists will probably be installed in the summer."

LAURIUM MINING COMPANY.

Balance of Assets December 31, 1912, $18,465.42.

Exploration has continued at No. 1 shaft which on December 31, 1912, had reached a depth of 144.4 feet. During 1912 there was accomplished 317.5 feet of sinking and 2,324.7 feet of drifting. The company reported that towards the end of the year there was a slight improvement in copper values. In 1912 the drifting, confined to 11th, 12th and 13th levels showed poorer ground than opened in 1911. The shaft was deepened 114.4 feet and 3, 553.9 feet drifting was done during 1912.

MANITOU MINING COMPANY.

The property was merged with that of the Keweenaw Copper Co. in 1912 and will be explored by diamond drilling.

LAKE COPPER COMPANY.

Balance of assets April 30, 1912, $87,512.91.

Extensive development work has been carried on at the Lake Mine during the past few years and equipment for mining on a large scale has been installed. In March 1912 shipments of ore to the Baltic Mill were begun. These shipments were made to clear a way for the railroad extension to No. 2 shaft and consisted of about 300 tons per day. Recently the shipments from the mine have been increased somewhat but the output is as yet far below the hoisting capacity. The early shipments gave a recovery of about 15.6 pounds copper per ton. No mass was included. Higher recovery has been obtained from more recent shipments. Owing to lack of men, it has not been possible to increase the production and, in December, the output is still about 300 tons per month.

The equipment at No. 2 shaft was completed during 1912 and the old No. 1 shaft has been dismantled. The new rock-house is a large steel building with corrugated iron covering, 124 feet high to the sheave wheels. The ore bin is a circular steel tank 40 feet in diameter and 51 feet high. A second bin, 9 feet by 40 feet, is used to hold rock for concrete. T he new hoist is a 32 inch by 72 inch first motion engine of Norberg make with a double conical drum capable of hoisting ten-ton loads from a depth of 5,000 feet.

In preparation for mining on a large scale, "cutting out" drifts have been run on several levels and rock walls, similar to those at the Baltic Mine, built to enclose and protect the levels. The ore will be mined by the Baltic method if a trial proves satisfactory.

The lode has been found to curve greatly and while striking nearly north at No. 1 shaft, it swings around to nearly due west and strikes directly towards the South Lake property. It has been found that much of the ore is near the foot instead of the hanging and several of the recent drifts follow the foot more closely. The footwall rock is an ophite which is rather readily identified. The hanging wall is more regular, but is not easily distinguished from barren parts of the lode.

Encouraging results have been obtained by exploration of the East lode. This is a narrow lode which has now been opened up by short drifts on several levels. In places it is thin and poor, but several openings show good ore.

The main lode is now extensively developed and the mine should be a much larger producer in 1913. At present a shortage of labor holds back production.

LAKE MILLING, SMELTING & REFINING COMPANY.

In the company's plant at Point Mills there was stamped in 1911, 436,919 tons of ore. For this work the company received $124,082.32 and made a profit of $28,813.29 after paying taxes and spending $3,802.03 for construction. The cost of stamping 436,919 tons was $88,363.46 or about 21.8 cents per ton.

An arrangement has been made to purchase from the Tamarack Mining Co. its two-stamp mill and stock of the Mutual Water, Light and Power Co., which company owns the pumping and lighting equipment of the Osceola and Tamarack Mills. The purchase price will be $230,000. Mr. Quincy A. Shaw reports on the project as follows:

'If this purchase can be made it is planned to remodel these two Tamarack heads, to erect one to three new heads as required, and to remodel two or three of the old heads at the present stamp mill. As fast as the new Tamarack heads are put in commission, at least, an equal number of heads at the present stamp mill will be free for stamping rock from other mines. The present mill site at Point Mills is well located for the shipment of rock from the Superior, Isle Royale and Hancock mines. The present capital stock of the Lake Milling, Smelting and Refining Co., 100,000 shares, which is all owned by the Allouez and Centennial, will be increased to 250,000 shares and 108,000 shares will be sold from time to time to the above-named mines at such prices and in such amounts as conditions warrant, in order to secure funds for this portion of the Tamarack Mill side as well as for the necessary remodeling and erection of new heads.

"The cost of transportation of rock from the mines to the present stamp-mill is a large item in the cost of copper, and this new location will reduce the charges on Centennial and Allouez rock. The plan reserves to Allouez and Centennial a stock interest which assures the right to five stamps and involves no expense, unless at some future time stamping capacity in addition to these five heads is required."

During 1912 preparations have been made to carry out the plans above outlined and they will be in effect in the coming year.

Regarding changes made during 1912, the management reports:

"During the past year Nos. 2 and 3 heads have been remodeled. No. 3 head began stamping Allouez rock on Nov. 11 and No. 2 head should be finished early in March. The wash equipment for both these heads duplicates in general that already in use at Nos. 4, 5 and 6, with the exception that Hardinge conical pebble mills are used instead of Chilean mills. At No. 2 head, space has been allowed for the installation of additional pebble mills in order to secure more economical treatment of Superior rock. An additional boiler has been placed in the boiler house.

"The present location of the boiler house is poor as regards possible extension, disposal of ashes, etc., and a new boiler house will be built on higher ground to the north of the mill. The building will be 51 by 125 feet with a capacity of ten boilers, and contracts for the steel have been given. Foundations have been built for an extension to the mill on the southwest, to be used as a mineral house, which will greatly facilitate the handling of mineral and permit the use of large cars.

"The girders of the steel trestle which connects the new railroad embankment with the mill were found too weak to support the weight of the present locomotives, and additional steel bents with concrete foundations are being put in."

LAKE SHORE MINING COMPANY.

Idle.

LAKE SUPERIOR COPPER COMPANY

Idle.

LAKE SUPERIOR SMELTING CO.

This company treats at its plant at Dollar Bay, the products of the Osceola, Tamarack, Isle Royale and Ahmeek mines. The charges for smelting Osceola concentrates varied during 1911 from $6.50 to $6.80 per ton of mineral. Profits made by the company were in large part used for construction and improvements at the works.

MASS CONSOLIDATED MINING COMPANY.

Balance of assets December 31, 1912, $9,347.76.

The mine has during the past few years, been extensively opened up and equipped for larger production and is now operating at a profit. During 1911 there was produced, largely from development work, and stamped, 73,475 tons of ore yielding 1,326,898 pounds of copper, an average of 17.58 pounds per ton. The rock broken is lower grade but much waste is sorted out in the mine. The results obtained show that careful sorting pays. The work during 1911 and 1912 has been almost entirely on the Butler lode which has been proved to contain long stretches of fairly good ore.

The present operating shafts are "B" and "C." The "A" shaft is no longer used for hoisting as the tributary workings have been connected with "B" shaft at the 6th and 10th levels, and the ore is more economically handled at one shaft.

At "B" shaft there was completed during 1911, 2,503 feet of drifting and at "C" shaft 3,774 feet. The promising character of these openings is indicated by Manager Walker's report.

At "B" shaft development work has been done, on the Butler lode at the 6th, 10th, 11th, 13th and 14th levels and on the Evergreen lode at the 2nd, 6th, 9th and 11th levels. Both lodes have shown favorable stoping ground and the ore reserves have been materially added to.

At "C" shaft, development work has been carried on principally in the Butler lode on the 4th, 5th, 7th, 8th, and 9th levels and the shaft has been sunk an additional 152 feet to the 10th level. The shaft is now bottomed at a depth of 1,275 feet on the incline. The ground opened has been almost uniformly of good grade. The shaft itself was mostly in the lode and showed good copper values as far as it was sunk.

During 1912 these openings have been extended with results similar to those obtained in 1911. "C" shaft has been equipped with a new hoist and rock-house and the production has been increased to about 622 tons per day. A further increase will be made when men are available.

In May, 1912, a meeting of stockholders was held to consider the advisability of selling a portion of the company's lands. It is proposed to organize a new company to take over this land, the stockholders of the Mass company being given the right to subscribe to the new stock. This sale would furnish the Mass company with a satisfactory cash balance for construction and development purposes.

In 1912 there was stamped 132,891 tons of ore yielding 2,045,006 pounds of copper or 15.39 pounds per ton. The cost per pound during the first five months of the year was 18.308 cents, but during the last five months it was 14.462 cents.

The president, J. W. Linnell, states in his report for 1912:

"Your directors feel that they are now justified in expressing to you their opinion that your mine has entered the list of "Successful Producers" and henceforth we will be able to produce copper at a cost below the price at which the metal may reasonably be expected to sell."

Superintendent E. W. Walker reports that:

"At "B" shaft development work has been done on the Butler lode at the 8th, 11th and 13th levels, and on the Evergreen lode at the 6th and 8th levels. As these Evergreen drifts have been driven to the westward, a

material change for the better has occurred in that a considerably greater amount of stamp rock is present in the lode.

"A raise has been put up from the 17th level at an angle of 45° to intersect the Butler lode. This raise is now in the lode at what is approximately the 16th level and shows the lode to be well mineralized and containing a considerable amount of heavy mass copper. The lode also appears to be wider, and, if with further development, these conditions prove to be permanent, it will mean a great deal to the future of the mine as the deepest point previously opened on the Butler lode was at the 14th level.

"At "C" shaft, development has been carried on almost entirely in the Butler lode at the 5th, 7th, 8th and 9th levels. The 5th and 7th levels have been extended a distance of 1,000 feet west from the shaft, and the results have been very satisfactory especially as this is all virgin territory."

Consulting Engineer F. W. Sperr, says: "I believe the mine is capable of producing at twice the rate of the last five months for many years to come; and that the items of cost can be further reduced."

MAYFLOWER MINING COMPANY.

Balance of assets December 31, 1912, $55,646.

Remarkably good results have been obtained by diamond drill explorations during the past two years and, so far as can be determined by drill cores, the company has discovered a thick lode of good ore. During 1911 there were completed three inclined holes, No. 13, 1,846 feet, No. 14, 1,252 feet and No. 15, 1,676 feet and two vertical holes, No. 16, 1,561 feet and No. 17, 1,354 feet. The results obtained by this exploratory work are given by Supt. Geo. Goodale.

"Aside from the mineral values established, probably the most important development of the year's work is the identification of the so-called St. Louis amygdaloid and the St. Louis conglomerate. This latter bed outcrops near the northeast corner of Section 8, and its location across the entire property is established within comparatively narrow limits. The dip of the formations is approximately 50 degrees, and the strike, as so far developed, conforms to a gradual curve, being N. 18½ degrees E. near the southern boundary and increasing to N. 26 degrees E. in the central portion of the property.

"No. 13 hole encountered the St. Louis conglomerate between 1,121 feet and 1,155 feet. Below this horizon the ground was broken and much disorganized, which made diamond drilling a slow and tedious operation, necessitating considerable cementing. Work at this point was finally discontinued at a depth of 1,846 feet.

"No. 14 hole, between the limits 839 feet and 859 feet, cut an amygdaloidal formation which apparently bears a close relation to the copper-bearing amygdaloid previously disclosed in No. 11 hole. This formation exhibits mineralization between 842 feet and 859 feet, that portion between 850 feet and 859 feet showing a fair amount of fine copper continuously distributed.

"No. 15 hole encountered the St. Louis conglomerate from 653 feet to 704 feet. This hole developed two mineralized zones, the most promising of which extends from 1,126 feet to 1,287 feet. This appears to be a more or less mixed trap and amygdaloidal formation. The mineralization appears in the form of "heavy," "small" and "fine" copper and is shown in 48 pieces of the core extending from 1,128 feet to 1,286 feet.

"No. 16 hole disclosed the St. Louis conglomerate between 252 feet and 316 feet, and at greater depths cut two copper-bearing amygdaloidal formations. The first of these, extending from 1,211 feet to 1,239 feet, shows "heavy," "small" and "fine" copper quite uniformly distributed throughout the whole width. This mineralization is of good character and appears in quantity sufficient for commercial exploitation. The lower formation extends from 1,328 feet to 1,443 feet. The portion of this bed below 1,405 feet shows little more than slight mineralization, but that part between 1,328 feet and 1,405 feet indicates an exceptionally rich average value, the mineralization occurring in the form of "heavy," "small," "fine" and "shot" copper quite thoroughly distributed, except in two small, trappy sections.

"No. 17 hole cut the St. Louis conglomerate between 24 feet and 39 feet, at which point it appears as a more or less altered sandstone. At a depth of 948 feet, this hole entered what is apparently the minerized zone shown in hole No. 16, and disclosed this formation as a mixed amygdaloid and trap extending from 948 feet to 1,109 feet. The mineralization is not so "showy" as in No. 16 hole, but portions of the formation exhibit a thorough impregnation with copper of the "small" and "fine" and "heavy" grades. Fifteen assays of the drill cuttings from this formation, between 1,016 feet and 1,088 feet, show copper percentages varying between 0.63 per cent and 3.54 per cent the average for the 72 feet (which includes barren and trappy portions) being 1.33 per cent copper, equal to 26.6 pounds of metallic copper to the ton of rock. This hole was completed at a depth of 1,354 feet on March 5, and drilling in No. 18 hole is expected to begin on March 13th.

"There can be no question of the identity of the mineralized formation, shown in Holes Nos. 16 and 17, and the relation between this bed and the mineralized formation described in Hole No. 15 is very close, and this should be proven by Hole No. 18, located between holes Nos. 16 and 15.

"No possible connection can be established between the Mayflower lode, cut by Holes 15, 16 and 17, and the St. Louis amygdaloid, which is under investigation further south, as the Mayflower lode is several hundred feet geologically below the St. Louis conglomerate, while the St. Louis amygdaloid is several hundred feet above that conglomerate."

During 1912 two drills have been in operation and several additional holes have cut the Mayflower lode. Some of the cores drawn, show much copper in a lode of exceptional width. No. 17 hole shows copper in the core for 72 feet from a depth of 1,016 to 1,088 feet. Another hole, No. 22, 225 feet northeast along the strike shows good cores from 1,024 to 1,107 feet. These holes have been definitely correlated and the good cores of the two holes are confidently believed to be parts of the same amygdaloid—the Mayflower lode. A series of four beds near the lode has been found to occur regularly and to afford a convenient means of identification of the horizons. Some indications of faulting have been found.

In the annual report for 1912, President Paine says:

"During the past year diamond drilling has been carried on continuously and much valuable information obtained. The first part of the year it was found very difficult to tie together the data from different drill holes, but as the work progressed and our knowledge increased, we have been able to a large extent to correlate the more important formations.

"There is considerable drilling still to be done before the question of exploration by means of a shaft can be considered intelligently. The so-called Mayflower lode has up to date been cut in several places where the rock in the drill core was undoubtedly of commercial value and in several other places where it probably was not commercial, but the drilling results as a whole so far can be considered as decidedly encouraging."

Supt. Goodale says:

"The investigations in holes Nos. 18 to 28 have covered a rectangular area of about 1,400 feet in length, measured along the strike of the formations, and about 650 feet in width, the total strike line distance between No. 16 and No. 26 being approximately 1,540 feet. Within this area the developments have indicated three essential features: First, that the mineralized formation disclosed in holes 16 and 17 is not of an accidental nature, but that it is a regularly bedded formation, being one of a series of seven distinct strata lying above and below the so-called "Lower" conglomerate. Second, that this series of formations either has a strike and dip different from that of the St. Louis conglomerate, lying above, or that it has been subject to faulting movement.

"Whether we have one or the other of these conditions, or a combination of the two, has not yet been definitely established. Third, that the mineralized formation shown in holes Nos. 16 and 17, known as the Mayflower lode, and the copper-bearing amygdaloid of hole No. 11, heretofore called the "No. 11 Amygdaloid," are indentical.

"In the development of copper values, the showings made in the several holes drilled during the year indicate a varying width of lode and degree of mineralization. Holes Nos. 27 and 28 have but recently been started; in every one of the others the Mayflower lode has been identified and has in some cases shown an exceptional degree of mineralization, holes Nos. 20 and 22 indicating the best values."

MEADOW MINING COMPANY.

Idle.

MICHIGAN COPPER MINING COMPANY.

Deficit December 31, 1912, $101,351.

The company has not been operating the mine during the past year and the work now being done is of an exploratory nature. A shaft was recently started to open up the Ogima lode. This was encountered at a short distance from the surface. It is intended to do some exploration in the Butler lode from or near this shaft.

During 1911 and 1912 the mine has been worked by tributors. These men are taking out ore from old workings on the "Branch Vein." In 1911 they mined ore yielding 327,773 pounds copper. A small number of men are, in 1912, taking out pillars, etc., in the upper levels.

The production made by tributors in 1912 was 162,590 pounds copper from the Branch vein between B and C shafts.

MOHAWK MINING COMPANY.

Balance of assets December 31, 1912, $897,316.40. The property has been much improved during the past few years by the opening up of the southern part. Good ore has been found in many of the workings tributary to shafts No. 4, No. 5 and No. 6, which command the recently developed portion of the Kearsarge lode. The deeper workings at the north end of the mine are not in such good ore, but during 1911, the drifts north from No. 1 shaft were above the average. The openings at No. 2 shaft were in poorer ground.

During 1911 all five shafts were deepened and 14,428.5 feet of drifting was done. 902,859 tons were hoisted and 100,311 tons were discarded. There was stamped 802,548 tons of ore, yielding 12,091,056 pounds copper, an average of 15.07 pounds per ton. The net profit for the year was $269,506.08.

During 1912 mining has been carried on with still more satisfactory results as the higher price of copper has greatly increased the profit.

The production for the year was 11,995,598 pounds refined copper from 787,941 tons ore, an average of 15.22 pounds per ton. Owing to shortage of trammers during the summer months, the tonnage stamped was about 20,000 tons below normal capacity. Cost was 10.61 cents and average selling price 16.08 cents per pound. Net profit for the year was $656,438 and $350,000 was paid in dividends.

On March 1, 1913 Mr. Fred Smith, agent since the company was organized, resigned his position. Mr.

Theo. Dengler formerly of Atlantic Mine is now in charge of the Mohawk and Wolverine properties.

NATICK COPPER COMPANY.

Idle.

NATIONAL MINING COMPANY.

The property has been idle for several years, but it is reported that exploratory work by diamond drilling may be undertaken in the near future.

NATIVE COPPER COMPANY.

Idle.

NEW ARCADIAN COPPER COMPANY.

Cash on hand April 30, 1913, $624.76.

The company in June, 1912, started a shaft from which to explore lodes cut by diamond drilling. The results thus far obtained are outlined in the following reports of President R. H. Shields and engineer Herman Fesing.

Mr. Shields says:

"The result of the exploratory work at the New Arcadian during the past year is very satisfactory and fully justifies the belief, that, in the territory adjacent to the new shaft now sinking, there are three veins of probable commercial value.

"With the completion of Drill Hole No. 26, all exploration work by diamond drilling was suspended, which will reduce expenses considerably. All work is now being confined to the shaft which has already been sunk to a depth of over 500 feet. It is the present intention of the management to make extensive lateral openings at the 750-foot level, and to install a larger hoist for deeper sinking. No other additions to the present equipment is necessary.

"In regard to the financial condition of the company, it was thought possible that favorable developments at the New Baltic mine would enable this company to realize on a portion of its holdings in the stock of that company and thus avoid an assessment. Recent developments at that mine are of the most encouraging nature. The directors, however, deemed it prudent, for the time being, to negotiate loans to a limited amount, which has been done."

Mr. Fesing says:

"Exploring by diamond drills, as outlined and referred to in previous reports, has been brought to completion; in all, 26 holes have been drilled, aggregating over 26,000 feet, and making almost three complete cross-sections of the property.

"Hole 23, located in the southwest quarter of the southwest quarter of section 30, last report, was completed at a depth of 1,503 feet. In addition to the copper bearing bed cut at 335 feet, noted in last year's report, several other unidentified amygdaloids carrying more or less copper were encountered.

"Hole 24, located 800 feet southeast of Hole 22, was drilled to a depth of 1,388 feet. This hole passed through the vein cut by Hole No. 22, and, while the copper contents were not so rich, the vein itself appeared strong and healthy and of good width.

"Hole No. 25, located near the center of the northeast quarter of section 30, and designed to cut further to the northeast, the same beds encountered in Hole 23, had to be abandoned at a depth of 110 feet, without penetrating the overburden.

"Hole 26, located about 600 feet northeast of Hole 25, was completed at a depth of 643 feet. Some little copper in unidentified amygdaloids was encountered.

"In view of the excellent results obtained in drilling Hole 22, a shaft was started last spring about 200 feet west of the east quarter post of section 17.

"In regard to the location of this shaft, which was of prime importance, consideration was given the position of the rich amygdaloid cut by drill hole No. 22, lying a short distance to the west; also the position of a strong copper bearing amygdaloid vein cut in Hole No. 4 on the adjacent property of the New Baltic, and which crosses the New Arcadian property, a short distance to the east. Consideration was also given to the very promising looking amygdaloid vein cut at a shallow depth in Hole No. 7, and on which some test pitting was done last year with good results. This vein lies almost midway between the other two mentioned. Accordingly, we were convinced that the best location for the shaft would be on the middle vein, as all three veins can be economically developed and mined from this shaft.

"Ground was broken in June, 1912, for a three compartment shaft, and was sunk and timbered full size to a depth of 30 feet. From this point the shaft was reduced to a single department and ladder way.

"While ground was broken for this shaft in June, it was not until August that compressed air could be supplied and on April the shaft had attained a depth of 500 feet.

"When we consider that the vein upon which this shaft is being sunk was opened up on surface by test pits 1,400 feet apart, with a good showing of copper at each place, and that it has shown continual improvement as depth has been attained, both in width and copper contents, it is not unreasonable to expect that future developments on this vein will show gratifying results.

"In all former work at the old Arcadian, exploration was carried to a comparatively shallow depth, not much over 500 feet on an average, and results were not profitable. Different results might have been, obtained at greater depth.

"I would strongly recommend that this shaft be sunk to a reasonable depth, which I would place at not less than 2,000 feet.

"Lateral openings may be made at different depths during the progress of the shaft, to open up and explore all three veins.

"Briefly summarizing, I would say that the present outlook at the New Arcadian is such as to warrant great hope for the future. The shaft is located in what has been proven to be a highly mineralized territory, comprising a large area; railroad facilities are ideal, and there is an ample supply of water. Anyone who will make himself familiar with conditions at the New Arcadian cannot but be favorably impressed, and I feel confident that the developments from the new shaft will be highly gratifying to the stockholders."

NAUMKEAG COPPER COMPANY.

42 Broadway, New York.

This company was incorporated March 21st, 1912, under the laws of Michigan. Its holdings consist of 1,260 acres of mineral land southwest of the village of Houghton, Michigan, comprising the old Dakotah Mining Co., the South Side Mining Co., 160 acres of the St. Mary's Canal Mineral Land Co., the Naumkeag Mining Co., 160 acres in Section 3 of the Sheldon-Douglas lands, and 140 acres in Section 4 of the Pacific Copper Co.'s lands.

The company has an authorized capital of 200,000 shares of the par value of $25. 102,000 shares have been issued, $10 paid; 76,700 being issued for the property and 25,300 for the purpose of putting cash in the treasury.

The officers of the company are:

J. Parke Channing, President.
Sam A. Lewisohn, Vice-president.
E. H. Westlake, Secretary and Treasurer.

These officers and J. H. Susmann, Adolph Lewisohn, Theo. L. Hermann, Frank L. Van Orden, Irving J. Sturgis and Chas. J. Paine, Jr., directors.

The company reports that from the commencement of work on July 1st to the end of the year, the drilling done totaled 6,508 ft. up to the end of the year, four holes were drilled to specified depths, and two others partially drilled, these having been since completed and two others started.

Hole A reached a depth of 1,401 feet, and at 515 feet found good copper on the Hancock No. 3 lode.

Hole B, down 1,378 feet, found practically no copper on the Atlantic lode at 250 feet, and only traces to a little fine down to the bottom of hole. Quincy Pewabic lode showed a little fine copper at 1,295 feet.

Hole C at 970 feet cut 3 inches copper, while D and E revealed mostly traces.

Hole F completed February 15, 1913, showed copper at 483 to 504 feet.

A crosscut in the old adit in South-Side tract near Portage lake was opened for 200 feet, of which 100 showed traces of copper.

Drilling will be continued in southeast portion of property and following the visit of President Channing in the near future, decision will be made as to whether drill work results have been sufficiently encouraging to warrant recommending sinking a shaft.

Cash on hand December 31, 1912, was $232,153, and miscellaneous assets amounted to $20,847.

NEW BALTIC COPPER COMPANY.

Balance January 1, 1913, $23,576.73.

The exploratory shaft begun in 1910, has been deepened and lodes explored by crosscuts and drifts. During 1912 the work was confined to the 500 ft. level. The beds east of the shaft having been found to dip towards the east and off of the property, the exploration is now chiefly west of the shaft. A crosscut has now reached a distance of 1,575 west, having penetrated, according to General Manager Shields, more or less disturbed ground for 1,500 ft. and then entered a copper bearing bed with well defined walls. The crosscut will be continued and this copper bearing bed will be opened by drifts.

Dr. A. C. Lane, former State Geologist, examined the geological conditions at the property for the company and reported as follows:

"The whole formation is much fissured and shattered, and shows a large amount of secondary minerals. No. 8 conglomerate, which passes about 665 feet southeast of the Arcadian lode at that mine, and 3,015 feet southeast of the Wolverine sandstone, seems to continue on this course with only slight deviation as far as Hole Number 4 of your property, but must shortly shift, so, as on the Oneco and Torch Lake properties, to be a mile farther southeast from the Wolverine sandstone, Kearsarge lode, etc. This shift is largely accomplished on your property by faulting and abnormal dips. In and near your shaft the strike is, as recognized by your engineer, about N 10° W, and the dip about 45° to the east. I do not suppose that this holds for any great distance.

"The character of the highly marked amygdaloid and ophite beds is, in my judgment, like those under the St. Louis conglomerate and near the horizon of the Baltic lode,—such beds as are found in the shaft exploring for the Baltic lode in Section 12, Township 54 north, Range 34 west (Fig. 45 of my report for 1909).

"Masses of copper are occasionally found of a character similar to those found in that shaft, and they occasionally show slickensiding, showing that the copper was formed before some of the faulting. This is of importance, for the formation is so much shattered and the water of the mine so fresh, that I am led to believe that the exploration is not deep enough to give a fair test as to the copper-bearing capacity of any lode, for it may

have—there are signs that it has—been either leached or carried down. For such a fair test the shaft should be sunk until the water coming from the rock, uncontaminated with that running down the shaft, has a specific gravity much more than 1. (See the tests and results of Chapter 7 of my report for 1909). That in the Isle Royale Mine, for instance, at the 10th level of No. 6 shaft, in the south end of the mine, has already a specific gravity of 1.050.

"It might be well also to trench a test pit near No. 3 drill hole, or put another drill hole vertically down from the same stand, probably not over 300 ft. deep.

"Copper is noted at 26, 70 and 97 feet in this hole, and below are three conglomerates. Such a hole would test again the copper shown, and, in connection with the outcrops near, enable your engineer, H. W. Fesing, to see if the easterly dip extends back this far, which will help in guiding exploration from the bottom of a deeper shaft."

NEW YORK CONSOLIDATED MINING CO.

Idle.

NONESUCH MINE.

Has been idle for some time, but the owners are preparing to reopen the mine in 1913. Some years ago the Calumet & Hecla Mining Company operated the property under option and mined some good ore but did not take up the option. Tests showed that the ore could be treated economically though considerable of the copper is so fine that it is not easily saved. There is not at present, however, a large quantity of the ore in sight,

NORTH LAKE MINING COMPANY.

Deficit December 31, 1912, $13,835.30.

Owing to the failure of President Dow, the company suffered severe financial loss in 1912. A new board of directors has been chosen and the exploratory work is being carried on with borrowed money. An assessment will probably be called in the near future.

The new officers are:

President, R. M. Edwards.
Secretary, Albert L. Wyman.
Treasurer, Henry Tolman.

These officers and John C. Watson, directors.

The work done in 1911 was by diamond drilling. The No. 12 hole was completed to a depth of 1,340 feet and No. 13 to 1,604 feet. No. 14 hole was abandoned at 512 feet and No. 15 at 514 feet, neither having penetrated the overburden.

The No. 13 hole showed considerable copper and furnished much information regarding structural conditions. Manager R. M. Edwards states in his report.

"No. 13 hole was completed to a depth of 1,604 feet. This hole is located 1,250 feet southeast of hole No. 3 and cuts the same horizon as that cut by No. 3 from the depth of 1,035 to 1,950 ft. The belts intersected by the two holes correlate perfectly; the dip indicated being about 45° to the northwest. No. 13 was drilled vertically and went through overburden for 298 feet. From 392 to 439, it passed through a fine looking amygdaloid, 47 feet thick, showing a little copper with copper in the seams in the trap both above and below it. This bed is the same one that was penetrated by No. 3 hole at depth of 1,137 to 1,170 showing good copper values for ten feet. It was also cut by hole No. 7, 1,417 to 1,440, showing copper for ten feet. Below this amygdaloid hole No. 13 passed through the several beds of sandstone cut by holes Nos. 2 and 7 and at 1,244 encountered an amygdaloid eleven feet thick, which carried commercial copper values for its entire thickness, one piece of core three inches long, being solid copper. This bed correlates perfectly with that found in No. 3 drill hole where the drill was blocked for days by a piece of mass copper, when that hole was being drilled. No. 7 was not quite deep enough to reach this point."

During 1912, shaft sinking has been started. Early in the year, the forest was cut off and a railroad spur from the Copper Range main line constructed. Sinking was started in a rock outcrop near No. 3 drill hole. The shaft is vertical and the intention is to sink it 1,000 feet and, at that depth, to explore all the beds showing copper. The shaft has been sunk about 40 feet and in November, 1912, a new hoist and compressor for the deeper work were being installed.

By the failure of Pres. Dow on September 23, 1912, the company sustained a loss of $160,188 which should have been in the treasury at that time. To meet expenses from August 1 to December 31, 1912, $19,000 was borrowed, and this amount is being increased at the rate of approximately $5,000 per month.

On December 31, the shaft had reached a depth of 63 feet and Pres. Edwards reports that, at a depth of 91 feet, it has intersected the hanging wall of No. 8 conglomerate which establishes its position geologically. In this connection he says:

"The South Lake shaft, located 1½ miles southwest of the North Lake shaft, has recently passed through three amygdaloid lodes well charged with copper which lie about 400 feet above No. 8 conglomerate. This fact has an important bearing on North Lake because this geological horizon can be readily explored on the North Lake property by a crosscut northwest from the shaft. As soon as the shaft has attained sufficient depth, it is proposed to drive such a crosscut to the northwest and also one to the southeast to explore the lodes which diamond drilling has proved lie in this direction under No. 8 conglomerate."

OJIBWAY MINING COMPANY.

The company, late in 1911, mined ore for a mill test and is now continuing exploration at lower levels in an endeavor to develop sufficient good ground to permit continuous production. The ore treated in the test shipments proved disappointing yielding only 7.28 pounds copper per ton. At No. 1 shaft, more promising openings have been recently made at the 16th and 17th levels. The shaft is, in December, 1912, 2,051 feet deep on the incline of 33°. At the 19th level a raise is being made to intersect the lode, which appears to be flattening considerably with depth. At No. 2 shaft a diamond drill is being operated to explore south and west from the mine workings.

To continue the work, an assessment of $1 has been called and is payable December 10, 1912. The present expenses are said to be about $6,500 per month, so this assessment of $84,000 provides for a year's operations.

The ground so far opened up, has not proven satisfactory; but there are structural features which lead Dr. Hubbard to hope that more valuable deposits will be opened up at greater depth.

The President states his reasons for this belief as follows:

"A careful examination of the different openings off No. 1 shaft discloses the probable existence of mineralized basins in the ancient "Kearsarge" formation separated by barren trap ridges. These basins trend from south to north and, thus far, near the surface are not wide. The central parts of the basins appear to be the richest, and they all probably contain commercial rock, the lateral delimitation of which must, of course, depend upon the varying price of copper. If the basins above noted be the work of ancient corrosion, it is probable that the ancient stream flow was towards the northwest, and as the shafts gain in depth we should expect to find these basins or ancient valleys widened out and the contemporaneous beds in them merged into one continuous bed. If this hypotheses be true, the occurrence of copper of commercial quality should be more uniform and the deposits should be mined with greater economy. The history of other properties in this Kearsarge group leads us to hope for better conditions as we go deeper, and we believe it to be good policy to sink No. 1 shaft as far as possible with our present plant, and by aid of the diamond drill, or otherwise, to explore the new ground thus made accessible."

Concerning the mill test made in November, December and January, President Hubbard reports:

"On November first, shipments began to the Tamarack mill from all but three of the stopes and other openings, these three showing no copper. In all 7,448 tons of rock were stamped, the returns from which at the mill were estimated at 6.58 pounds of refined copper per ton of rock. After November 21st, all mass copper, as far as practicable, was retained at the mine, and by estimate amounted to 0.7 pounds per ton stamped, bringing the total product up to about 7.28 pounds per ton of rock, with tailing losses of about three pounds.

"The mill product as reported, varied from period to period. That for the first period ending November 21st, showed a much less amount of mass and barrel work than had been expected by the mine officials, and a total of 5.89 pounds per ton of rock. Between November 21st and December 1st, the mill product was estimated to be at about the rate of 13 pounds per ton, which, with the mass accumulated during the same period at the mine, brought the total up to about 15 pounds per ton. The rock, from which this total came, was not considered by the mine management to be any better than that supplied during the previous period."

OLD COLONY COPPER COMPANY.

During the past two years, the company has obtained very promising drill cores from the Mayflower lode. The drilling is being continued in order to obtain additional information regarding the extent and structural relations of the ore body.

Supt. Goodale describing recent explorations says:

"We have located the horizon of the Mayflower lode in each hole driven in the Old Colony property, and all of the holes through this information have disclosed copper, the general average of all the values indicating a formation with an unusual degree of mineralization.

"Holes Nos. 19 and 20 were designed to investigate the lode about 1,000 feet east of hole No. 14. In No. 19, we have just cut the formation, having first passed through the overlying trap, below which was the mineralized amygdaloid bed, followed by the footwall trap, the middle conglomerate and the lower ophite. The data secured from this hole is more satisfactory than that from No. 18, for, while No. 18 definitely located the Mayflower lode, which showed rather phenomenal richness, only a small portion of the core was secured, the drill having evidently cut a fault plane showing considerable disturbance at that point. Hole No. 20 is now sinking about 600 feet northeast on the assumed strike line through No. 19, and No. 21 has been located about 300 feet west of No. 15.

"After the completion of hole No. 20, further attention will be given to the southerly extension of the lode."

ONECO COPPER COMPANY.

Balance of assets January 1, 1913, $60,196.

Exploration has been continued during 1912 by crosscuts and drifts at the 11th and 12th levels.

President John D. Cuddihy in his report to the stockholders says in part:

“During the past year the shaft was sunk 236 feet, on a dip of 37 degrees, to a point 1,250 feet below the collar and plats cut at the tenth, eleventh and twelfth levels.

"Shaft was bottomed at a depth of 1,250 feet and lateral openings extended on the vein at the 11th and 12th

levels. The 11th level was driven south 355 feet and the 12th level 361 feet north and 340 feet south of shaft, respectively, mostly in fair character vein, but it does not carry in commercial quantity.

"After the shaft had attained a depth of 1,250 feet extensions were made north and south at the bottom level (12th level) and at the 11th south, at which approximate depth good quality vein was intersected by diamond drilling.

"Lateral openings on the lode are the most practical method to adopt, and although no main copper bearing course has been met the character of the vein warrants the assumption that such copper courses of commercial value may exist both north and south of the shaft and these lateral openings under existing conditions should be extended for some considerable distance before resuming the sinking of shaft.

"The surface equipment is not adequate to carry on more extensive development work to advantage and continue sinking the shaft at the same time, but will answer all purposes for development work and mining on a small scale to a depth of some 1,500 feet."

ONONDAGA COPPER COMPANY.

This company was organized in 1912 under laws of the State of Michigan, with capital stock of 150,000 shares of $25 each. To purchase property and to finance the company's operations, 105,000 shares have been issued. $4 per share is paid in. 45,000 shares remain in the treasury.

The officers of the company are:

R. C. Pryor, President and Treasurer.
J. H. Rice, Vice-president.
Wm. Duffney, Secretary.

The property is in Ontonagon County, north of Bergland and south of the White Pine mine. About 11,000 acres in sections and fractional sections of townships 49-41, 49-42, 50-42 and 50-43 have been purchased and are being explored. A geological map was made during the summer and a contract let for diamond drilling. Two drills are now in operation. Ward B. Smith is superintendent.

OSCEOLA CONSOLIDATED MINING COMPANY.

Balance of assets December 31, 1912, $1,888,458.05. The company worked both Kearsarge and Osceola amygdaloid lodes during 1912 and is equipping the North Kearsarge for larger production. One shaft was closed for a few weeks, owing to water flooding some of the workings, and recently hoisting at No. 1 shaft has been discontinued, while a new rock house is being constructed. The loss in output at North Kearsarge has been offset by resuming operations at No. 5 and No. 6 Osceola shafts. The mill has been remodeled and extraction is now higher than formerly. The Leyner-Ingersoll one-man drills have been adopted as standard. By use of these machines the company is able to pay higher wages while reducing cost in drifting and stoping.

In 1911 there was broken 1,276,790 tons of ore of which 30,194 tons were discarded. There was stamped 1,246,596 tons, yielding 18,388,193 pounds copper, an average of 14.8 pounds per ton at a cost of 9.28 cents per pound. A new low record was set in cost per ton mined, the average for 1911 being $1.14 per ton for mining, transportation, stamping and taxes. In 1911 there was paid in dividends $721,125, bringing the total up to $9,679,775. The profits were larger during 1912 and dividends amounting to $1,201,875 have been paid this year. Owing to higher wages and expenditure for construction, the cost per pound was higher; but the net profit was larger than in 1911 because of the better price received for the product.

In 1912 there was stamped 1,246,557 tons of ore yielding 18,413,387 pounds copper, an average of 14.8 pounds at a cost of 10.36 cents per pound. 17,175,066 pounds was sold at 16.63 cents per pound, the balance at about 15 cents.

At the Osceola branch, mining operations were resumed in No. 6 shaft on June 1st and in No. 5 shaft on October 1st. There were produced 115,551 tons ore yielding 1,479,642 pounds copper, an average of 12.8 pounds per ton, at a cost (excluding mill construction), of 14.55 cents.

At the North Kearsarge branch, there was produced 672,231 tons of ore, yielding 8,611,720 pounds copper, an average of 12.81 pounds, at a cost of 11.44 cents.

At the South Kearsarge branch there was produced 458,651 tons ore yielding 8,322,025 pounds of copper, an average of 18.15 pounds per ton, at a cost of 6.79 cents per pound.

President R. L. Agassiz states:

"Fully two-thirds of the (South Kearsarge) tonnage was mined from the footwall. This rock consisted in part of vein matter which extended back into the footwall and in part, of foot trap which was found to contain copper. This rock can be mined cheaply and it is hoped that a large part of the old stopes can be worked over in this way."

Mr. Agassiz reports that the remodeling of No. 3 and No. 4 heads at the stamp mills was completed in July and work started on No. 5 head in September.

PACIFIC COPPER COMPANY.

Idle.

PHOENIX CONSOLIDATED COPPER COMPANY.

Was merged with Keweenaw Copper Co. this year. The property will be explored by diamond drilling.

QUINCY MINING COMPANY.

Balance of assets December 31, 1912, $1,233,278.15.

The company continues large and profitable production, while doing extensive development work and improving equipment at mine, mill and smelter. In 1911 there was stamped 1,382,524 tons of ore which with mass sent direct to the smelter, yielded 22,252,943 pounds copper. Silver in the ore netted a profit of $23,005.28. The business profits for the year totaled $507,596.71. There was paid in dividends, $440,000 and to the St. Mary's Canal Mineral Land Co. for property $158,005.10.

During 1912 scarcity of labor has kept down production somewhat, but in spite of higher wages the profits, owing to good prices for copper, have been larger. $550,000 was paid in dividends.

In September 1912, the No. 8 and No. 9 shaft workings were connected. A long drift was carried north from No. 8 at the 20th level and No. 9 has now been completed to this depth. This northern shaft will now be equipped for heavier work, a new hoist and rock house being necessary before an important output can be made.

The management has found light weight rock drilling machines to be preferable to the larger machines and is gradually equipping the mine with the former. To provide air at higher pressure for the light drills, a compressor has this year been installed to take the air at 60 pounds pressure and raise it to 100 pounds pressure.

No. 8 shaft has been electrified for power tramming and is equipped with new automatic side dump tramcars. At No. 6 shaft the rock house has been remodeled and the ore is now more economically handled there. At the stamp-mill, improved extraction has been obtained by installation of newly designed classifiers. At the smelter a new reverberatory furnace of 50,000 pounds capacity was completed in 1911 and has been in operation with good results.

In 1912 there was produced 1,309,253 tons of ore yielding 20,634,800 pounds of refined copper, or 15.7 pounds per ton. The mining profit was $1,089,673.68 and net business profit for the year was $960,778.84. The profit from sales of silver was $30,227.50.

The report of the general manager, Charles L. Lawton says in part:

"The operations of the Quincy mine, railroad stamp mills, and smelter for the year 1912, have included more development and construction than for several preceding years. This feature of the work, however, has been met to a considerable degree by the increased price of copper, which has also permitted the wider distribution of efficiency installation. Notwithstanding the shortage of labor and the more perceptible decrease in the output of No. 7 shaft, the tonnage of rock sent to the stamp mills was 1,309,253 tons. This means a consequent lessening of the total production of copper for the year, which, together with the increased cost of labor entails a higher cost.

"No material change has been noted in the copper contents of the rock in the new lower, or bottom, openings of the mine—this, of course, as compared with recent years—though the good showing of copper m the new openings of the bottom of the mine north of No. 8 shaft, is worthy of mention.

"The openings for the year have been greater by 2,625 feet than during the previous year.

"At No. 7 shaft the available stoping ground is being steadily mined out. The loss in tonnage from this shaft amounted to a million pounds of copper during the year.

"The 2,484 feet of drifting in this shaft was almost exclusively on one of the east branches, averaging about seven feet wide. It is rich stamp rock and carries much small and heavy mass copper. The shaft produced 376 tons of mass copper. There is no active work on the west branches in this shaft.

"The west branches only, of No. 2 shaft are being mined on the upper levels, where they are narrow and very irregular in width and copper contents. From the 11th to the 34th levels, they produce a low grade of stamp rock, but considerable mass copper. Below the 34th level, as the depth is gained, these branches gradually become wider, to an average of from five and one-half to six feet; and, while they continue to be irregular and bunchy, the stretches of poor ground are of less extent, some stopes being a very good grade of stamp rock. The heavy mass copper of several tons weight comes chiefly from these branches, as is also true of nearly all of the small, or barrel copper. The stopes on the lower level of the west branches are wider and produce a more uniform and better grade of stamp rock and contain more mass copper than the stopes on the upper levels. Some of the stopes are rich in copper, such as the 51st level north, the 53rd level south, the 57th level north, the 60th level north; and on the 66th level north, there are two parallel stopes that are heavy in copper. The shaft produced 996 tons of mass copper during the year. The east branches from the 64th to the 71st levels are wider and more uniform in width and copper contents than the west branches. They average about seven feet in width, and produce a fair to good grade of stamp rock, though not so much mass copper as the west branches.

"The development work ahead of stoping in this shaft is upwards of 12,000 lineal feet. The shaft was sunk 335 feet during the year, and will continue sinking. It is now down 503 feet below any stoping.

"The output of copper rock from No. 6 shaft fell below that of the previous year, and was hoisted from an average incline depth of four thousand two hundred and sixty feet. There is no special change in the copper contents of the rock developed in the bottom of the shaft.

"The lineal feet of development for the year was 10,460, about one-half of which was in the bottom. The development work ahead of the stoping in the shaft is now upwards of sixteen thousand lineal feet.

"In this shaft the west branches exclusively are being mined on the upper levels—namely, the 25th, the 27th, and the 29th—where they are a little wider than in No. 2 shaft; yet they have the same general characteristics of irregularity of width and copper contents and produce a low grade of stamp rock. Below the 29th level, they become narrower. From the 41st level to the 49th, the grade of stamp rock produced is fairly good, and there is more mass copper. Below the 49th level to the 64th level the west branches widen out to a maximum width upwards of ten feet, with an average of about seven feet. They produce a good grade of stamp rock; some stopes are very rich in barrel and heavy mass copper.

"With depth, the mineralization in the west branches is extending a greater distance to the north towards No. 8 shaft, until at the 46th level it appears as though they may merge into the south drift of that shaft. There are a number of stopes rich in copper—namely, the 43rd level south, the 46th, the 49th, the 41st, and the 57th levels north; while the levels from the 57th to the 61st south also have stopes rich in copper. These west branches yielded practically all of the small and heavy mass produced by the shaft, which was seven hundred and sixty-three tons.

"The east branches of this shaft are being worked from the 59th level down to the bottom, or 68th level. As at No. 2 shaft, they are more uniform in width and copper contents than the west branches, and average upwards of seven feet, with a maximum of ten feet. They produce a fairly good grade of stamp rock. The old main extreme east branch, which contained little or no copper in the upper levels throughout the mine is carrying good stamp rock on the 63rd level down to the bottom of the shaft. It contains more or less small mass copper. The shaft has been sinking in this foot-wall branch from the 51st level. Openings are now being made on this branch, which show good stamp rock and may develop a new source for copper. The prospects for copper in the bottom of this shaft now are better than at any time during the past ten years or more.

"The shaft was sunk 121 feet during the year; and, excepting one stope and one raise for ventilation on the 65th level, is now down six hundred and eight feet below any stoping.

"During the year, there was another heavy caving of the surface on the outcrop of the lode, north of No. 6 or Pewabic shaft, owing to mining operations in former years having been carried too close to the surface. This was remedied, as were al] the former ones, by a strong, heavy reinforced concrete wall.

“The production of copper rock from No. 8 shaft was slightly in excess of that of the preceding year, and was hoisted from an average incline depth of three thousand eight hundred and seventy feet. The development continues to open ground of about the same grade as formerly. The north drifts at the 46th and the 49th levels, of 2,000 feet and 2,150 feet, respectively, appear to have entered the low grade territory that lies to the north. The lineal feet of development work driven during the year was 9,256; there is upwards of 17,000 lineal feet of development work in the shaft ahead of stoping.

"The operations of this shaft were mostly on the east branches. There is some extra rich ground on the 17th level south, but it is small in extent. The active levels are from the 43rd level down. From the 43rd level to the 49th, the stamp rock produced is mostly low grade, while below the 49th level to the present bottom, or 56th level, a fairly uniform grade of stamp rock is produced, together with considerable mass copper. The east branches are now widest in this shaft, the average being perhaps eight feet, and the maximum upwards of twenty feet. There are stopes on the 50th, 51st, 53rd, and 55th levels north of the shaft, which are rich in copper. The west branches contain a rather low grade copper to the south of the shaft, where worked. To the north in the upper levels, they have not been found profitable to work; while, on the 51st level eight hundred feet north, a new three hundred-foot drift on the west branch shows good stamp rock. The shaft produced 810 tons of mass copper.

"The shaft was sunk two hundred and twenty-six feet during the year; and, excepting one stope on the 54th level for ventilation, is down three hundred and forty-four feet below any stoping, and sinking will be continued.

"At No. 9 shaft, the surface has been cleared and graded, preparatory to the erection of an engine-boiler-house, and a railroad spur built. The old Franklin carpenter shop was moved to No. 9, and equipped for treating the shaft timbers with preservatives.

"This shaft was holed into the raise from the twentieth level No. 8 shaft during the month of September, with such exactness that it reflects great credit upon the chief of the engineering staff The shaft was sunk 845 feet during the year; it is now down below the twentieth level, or 2,635 feet from the surface and will be sunk further this year. The shaft is now being reinforced with timbers, which are previously treated with preservative, and should be fully timbered to the fourteenth, or 1,920 foot level, by spring.

"Drifts are being driven both north and south on this level; and, when the shaft timbering is completed to this point, the hoisting of copper rock will commence.

"The total amount of development in this shaft is now about 3,900 lineal feet, of which 1,265 feet is in the lode. The third level is 960 feet long. At a distance of 450 feet from the shaft, it cut fair stamp rock, and continued therein for a distance of about 200 feet. More or less copper was cut in the shaft during the sinking, and fair stamp rock was encountered in the lode at a depth of 1,500 feet. At this point, there was only a portion of the lode showing, varying in thickness from two to six; it continued in the shaft until the lode passed out at 1,940 feet, where a station will be cut and drifting carried forward to the north. Throughout the mine there is upward of 50,000 lineal feet of work ahead of present stoping."

"The work at the stamp mills has been about the same as in former years. The investigation to promote efficiency and greater saving in copper, mentioned in former reports, has practically reached a satisfactory conclusion. One unit of a new system consisting of hydraulic classifiers, jigs and Symons rolls, will soon be installed on a normal working basis, to reduce all the oversize from the stamp head, and consequently to deliver a classified and a finer crushed sands to all the various machines in the mills, and thus to demonstrate the progress that has been made.

SMELTER REBUILT.

"At the smelter, repairs and renewals have been somewhat numerous during the year. Number 2 furnace was entirely rebuilt. The coal dock has received extensive repairs, and similar repairs and renewals will be continued during the coming year."

ST. LOUIS COPPER COMPANY.

Balance of Assets December 31, 1912, $55,329.77.

Development work was begun in July, 1911, on the St. Louis lode, copper bearing amygdaloid discovered by diamond drilling. In January, 1912, the shaft was 165 feet deep and 128.5 feet of drifting and 76.0 feet of crosscutting had been done. Some, but no great quantity of copper was exposed by these openings.

The shaft has been equipped with a small hoist, a 12-drill compressor, two 90 h. p. boilers and a small rock house. During 1912 the exploration has been carried on rather slowly.

The results obtained up to December 31, 1911 are thus described by President Shaw:

"A cross-section of the formation was made by a line of diamond drill-holes running from the northwestern extremity of your property to the eastern sandstone at about right angles to the strike of the formation. All drilling was done at approximately right angles to the dip of the lode. Various lodes were cut, but none of them disclosed rock which gave evidence of carrying copper in commercial quantities until an amygdaloid lode, called the St. Louis amygdaloid, was located with an outcrop 7,160 feet east of the Kearsarge amygdaloid. On this line of drilling the lode was cut in three places by Nos. 8, 10 and 7 drill holes, in order to more accurately determine the dip of the lode, No. 7 drill hole striking the hanging side of the lode at a depth of 755 feet, showing the vein to be 29 feet wide with some copper values in about five feet on the foot-wall side of the vein. No. 8 drill hole reached the hanging side of the vein at a depth of 106 feet, and showed some fine copper scattered through a width of 10 feet. At an intermediate point between these two drill holes, No. 10 drill showed the vein 8 feet wide with no copper.

"About 750 feet north of No. 8 drill, along the assumed strike of this lode, No. 12 drill cut the formation, showing the vein to be 8 feet wide, carrying no copper values. About the same distance further north, No. 15 drill cut the vein, showing a width of 14 feet with no copper values. To the south of No. 8 drill hole, about 750 feet, No. 13 drill hole showed the lode to be 39 feet wide with a good showing of copper. 750 feet further south Nos. 16 and 17 drills showed the vein to be about 30 feet wide with good values of copper, and about 900 feet still further south No. 18 drill hole showed the lode to be 25 feet wide with no copper values.

"A short distance east of the outcrop of this lode the old St. Louis conglomerate lode was located by drill holes, but no encouraging values were shown.

"A shaft was started last July in the St. Louis amygdaloid at a point opposite No. 13 drill hole. Sinking had not progressed very far when the shaft entered a belt of trap averaging about 6 feet in thickness and only a small portion of either of the sections of the lode was disclosed. Small bunches of copper were found from time to time but neither the shaft nor the drifts on the 1st level have shown rock of commercial value. In January, however, the drift to the south had a fair showing of copper."

In 1912 the Calumet & Hecla Mining Company acquired all the stock of the St. Louis and the property will hereafter be known as the St. Louis branch.

During 1912 there was completed 335 ft. of shaft sinking, 1,716 ft. of drifting and 65 ft. of crosscutting. The shaft is now 500 ft. deep.

President Shaw reports:

"Drifting on the 2nd, 3rd and 4th levels while showing some good copper rock, has not as a whole developed ground of commercial value. Diamond drilling to the north of this shaft has given no information as to the location of the so called Mayflower lode. It has, however, shown a comparatively large area throughout which copper was found in both the trap rock and various amygdaloid beds."

SAINT MARY'S CANAL MINERAL LAND COMPANY.

From land sales and from ownership of 50,000 shares of Champion Copper Co. the company has made large profits in recent years. As owner of 25,000 shares of Mayflower stock, the company is taking an active interest in the exploration of the Mayflower lode and, during 1912, had representatives placed on the directorate. As owner of 20,000 shares of Hancock, a large sum has been contributed to the development of the Hancock and Pewabic lodes. As the Hancock Mine is now nearing the producing stage, it is hoped that further assessments will not be called for and that the mine will become a source of profit. The company's 37,222 shares of Houghton Copper stock have become a large asset, owing to favorable developments at the mine. As there seems to be also a reasonable chance of the Winona Mine becoming a source of profit instead of assessments, the St. Mary's Company may be

expected in the future to derive considerable revenue from several producing mines.

The company in 1911 received $250,000 dividends from the Champion Copper Co. and $150,000 on account of lands sold to the Quincy Mining Co., $480,000 was paid out in three dividends of $160,000 each and there was left on December 31, 1911, a cash balance of $81,263.15.

In 1912 $550,000 was received in dividends from the Champion Copper Co. During 1912, 160 acres of mineral land was sold to the Naumkeag Copper Co. for $21,825 and 6,340 shares stamped $10 paid in.

SECTION TWELVE EXPLORATION COMPANY.

Idle.

SENECA MINING COMPANY.

Balance of liabilities December 31, 1912, $142,318.90.

Exploration of the Kearsarge vein was discontinued in April, 1911, owing to unfavorable results and unsuitable location of the shaft which had been sunk for development purposes. The mine has since been idle. The directors state that they "believe that the only practical method in developing your property is in connection with Gratiot, which will obviate the great expense, not now justified by known conditions, of sinking .vertical shafts to explore the lode on the southern portion of your property." No development work was done during 1912. Liabilities increased $10,207.95.

SENTER-DUPEE DEVELOPMENT COMPANY.

Idle.

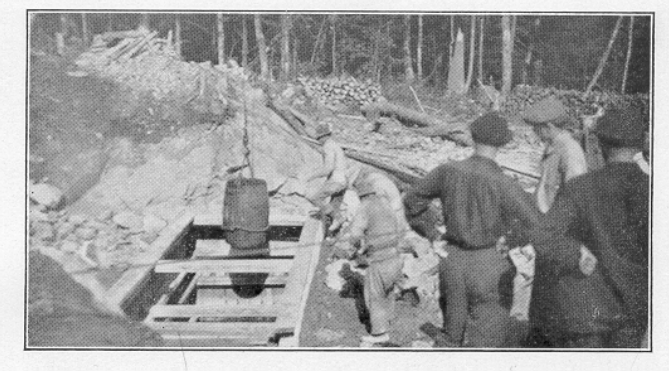

Plate V. A. North Lake shaft, 1912.

SOUTH LAKE MINING COMPANY.

Surplus assets January 1, 1913, $29,885.77.

In July, 1911 the company started to sink a shaft to open up lodes cut by drilling, but much water was encountered and the site abandoned. The property then remained idle for several months, but the necessary funds having been arranged for and a superintendent, R. M. Edwards, appointed, work was resumed this summer. A vertical shaft was started at a point 1,500 feet south and 1,500 feet east of the N. W. corner of sec. 31 and 200 feet from the main line of the Copper Range Ry. The shaft starts in rock at the base of Evergreen Bluff.

Mr. Edwards states:

"The location of the shaft is such that the lower lodes of the Evergreen Bluff series should be encountered at shallow depth and the Butler and Knowlton lodes can be reached, if desired, by short crosscuts to the northwest. It is proposed to sink the shaft to a depth of 600 feet as a three compartment working shaft. From the 600 foot level, a crosscut will be run southeast to cut the new lodes, the first one of which should be approximately 1,000 feet from the shaft at this level, the exact distance depending on the dip and strike of the lodes. In addition to opening the new lodes, the shaft and crosscut will thoroughly explore the ground cut by No. 1 drill hole, which showed as many as eight different beds carrying copper."

The shaft is now well started and a steel head frame similar to that at Indiana Mine is in place. A hoist for deeper sinking has been purchased and is now being erected. It is stated that three copper bearing amygdaloids have been cut at a depth of between 110 and 210 feet.

Mr. Edwards states:

"The first of these lodes was 18 ft. the second 10 ft. and the third 40 ft. thick. They dip to the north-west and are probably the same as those cut by No. 1 drill between 160 ft, and 254 ft. where they all showed copper."

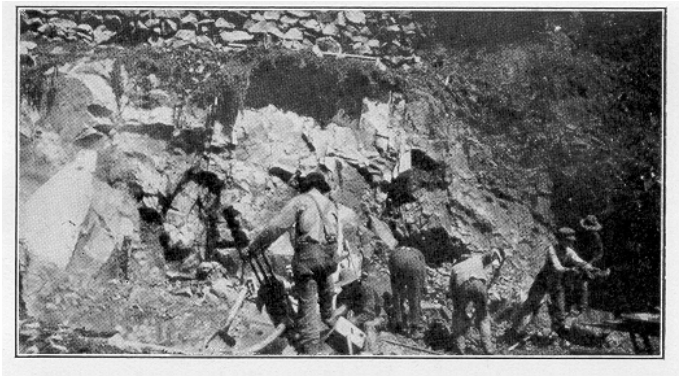

Plate V. B. Starting excavation at South Lake Mine.

SOUTH RANGE MINING COMPANY.

Idle.

SOUTH SIDE MINING COMPANY.

The property was, in 1912, merged with neighboring ones in organization of Naumkeag Copper Co.

SUPERIOR COPPER COMPANY.

Balance of assets December 31, 1912, $99,784.

The company has continued exploration and development work and is not yet making a very large production. Extensive openings have been made on two lodes—the Superior, which is probably a continuation of the Baltic lode, and the so-called West lode. The latter has proven to be remarkably rich in places and is a very important addition to the reserves. The discovery and exploration of this lode in 1911 is described by the management.

"Explorations by diamond drilling and crosscuts in the hanging wall of the Superior lode have developed what now appears to be a new copper-bearing amygdaloid lode, lying parallel with the Superior lode and separated from it by a bed of trap varying in thickness from one foot to 45 feet. This new lode differs in appearance and character from the Superior lode and contains secondary minerals that are absent in the latter. These explorations have been conducted at two points on the 12th level, 300 feet apart; at four points on the 13th level covering a distance of about 800 feet; and at two points on the 14th level, about 200 feet apart. In all but one of these places the lode has been found to be well charged with copper and to vary in thickness from 14 to 30 feet."

During 1912 arrangements were made to treat the ore at the Allouez-Centennial plant at Point Mills. A railroad spur connecting the Isle Royale Railway with the Mineral Range has been constructed and it is expected that shipments over this line will begin in January, 1913. The ore thus far produced has been treated at the Atlantic mill. The company should save money and get a better recovery in the Allouez mill, which was designed for the ore. Larger shipments will be made in 1913. Recent production has been chiefly from the West lode.

During 1911 both shafts were deepened, No. 1 to 1,763 feet and No. 2 to 1,210 feet. At No. 1 there was done 5, 956 feet of drifting and 548 feet of crosscutting, and at No. 2, 881 feet of drifting and 135 feet of crosscutting. Similar work has been done in 1912 and No 1 shaft is now at the 20th level and No. 2 at the 14th level. The sinking at No. 2 level was discontinued for some time while connection was being made at the 13th level with No. 1 shaft.

There was stamped in 1911, 162,599 tons of ore yielding 3,236,233 pounds copper, an average of 19.90 pounds per ton, at a cost of 15.31 cents per pound. Low production and extensive development have kept the cost high in 1912 also, but large and profitable output can be made when the preliminary work has been satisfactorily done.

In 1912 there was stamped 172,322 tons ore yielding 3,921,974 pounds refined copper, or 22.76 pounds per ton, at a cost of 12.75 cents per pound. Net profit for the year was $99,784.

The management reports that shafts No. 1 and 2 have reached depths of 2,014 and 1,341 ft. respectively from the surface. Operations at the shafts are described as follows:

No. 1 Shaft.

"WEST LODE.—The lode discovered late last year proved to be independent of the Superior lode, and has been named the "West lode." Cross cutting on the levels above the 12th showed the lode to be badly split, with practically no copper. On the 12th, 13th? 14th, 15th, 16th, 17th, and 18th levels the openings have developed rock of good quality. No extensive development work has yet been done beyond a fault located 500 feet north of the shaft on the 13th level.

Good continuous copper rock has been opened on the 15th and 17th levels for a distance of about 1,000 feet each.

"SUPERIOR LODE—Stoping was practically discontinued early in the summer because of the proximity of the West lode, which lies parallel to and just above this lode. It will be necessary to mine the West lode before stoping can be carried on directly underneath on the Superior lode.

"Development was confined to the 13th and 15th levels. Nothing was discovered on the 13th, but the 15th passed through a chute of very good ground about 300 feet long and at the present time the breast of the drift is again in good rock 1,300 feet north of the shaft.

"The shaft passed into the trap between the Superior lode and the West lode at the 19th level.

No. 2 Shaft.

"The 13th level, driven through the St. Mary's land, has connected the two shafts, giving better ventilation and making safer conditions for the men. No commercial rock was developed either on the West or the Superior lodes, the formation being badly broken. The shaft is now being sunk to 17th level, where it will be connected with No. 1 shaft below St. Mary's property."

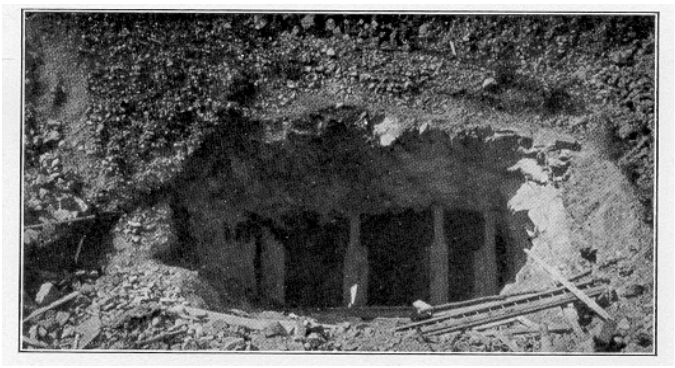

Plate V. C. No. 2 shaft in Lake Lode. Shows three compartments.

TAMARACK MINING COMPANY.

Balance of assets December 31, 1912, $1,120,861.

After some years of unprofitable operation, the company decided in November 1911, to discontinue all development work and confine attention to the ore

already blocked out. President R. L. Agassiz, in March, 1912, stated regarding this policy:

"The results for November and December show a cost of about 12 cents per pound and it is hoped that, with the same copper contents, these results can be continued; but whether or not the margin of profit will warrant again making openings must be determined by future conditions."

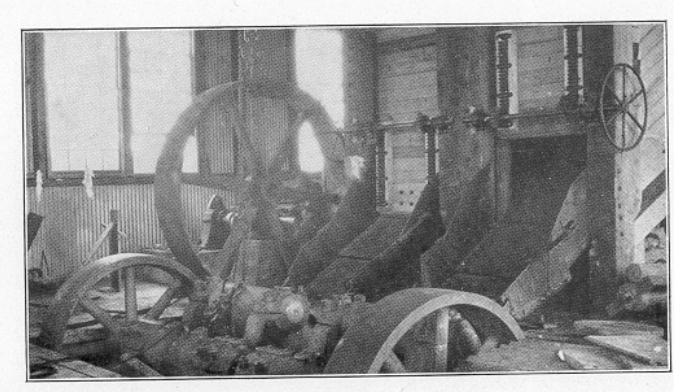

Plate VI. A. Ore bins and crushers, No. 2 shaft, Lake Mine.

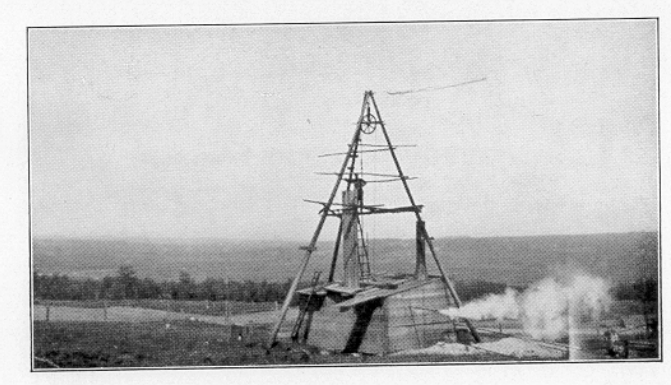

Plate VI. B. Diamond drilling on Mayflower property.

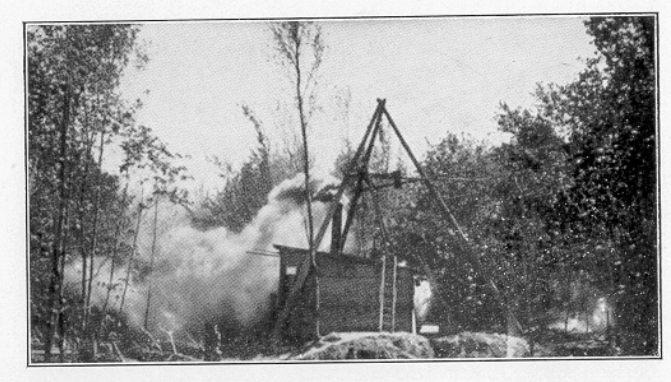

Plate VI. C. Diamond drilling on Old Colony property.

During 1911 there was broken 478,674 tons of ore of which 86,336 tons was discarded. There was stamped 392,338 tons of ore which yielded 7,494,077 pounds copper, an average of 19.1 pounds per ton, at a cost of 15.56 cents per pound. During 1912 a somewhat larger output has been obtained at lower cost. This year therefore, the company has once more become a profitable producer.

As the stamping capacity is greatly in excess of the probable production of the mine, it is planned to dispose of part of the plant. Arrangements have been made to sell two heads, 1,500 shares of the stock of the Mutual Water, Light and Power Co. and the small boiler house with three boilers, necessary for the operation of these heads, to the Lake Milling, Smelting and Refining Company, for the sum of $230,000. This sale will provide funds for building a recrushing plant for the retreatment of Tamarack conglomerate sands. It is claimed that this can be done at a substantial profit. Experiments at the Calumet & Hecla mill on similar sands give assurance of this.

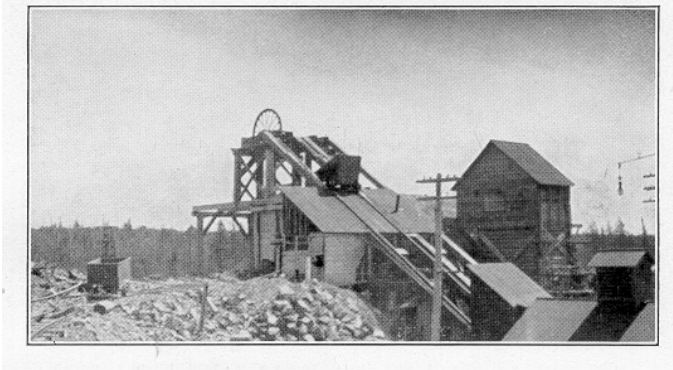

Plate VII. A. No. 1 shaft, Ojibway Mine.

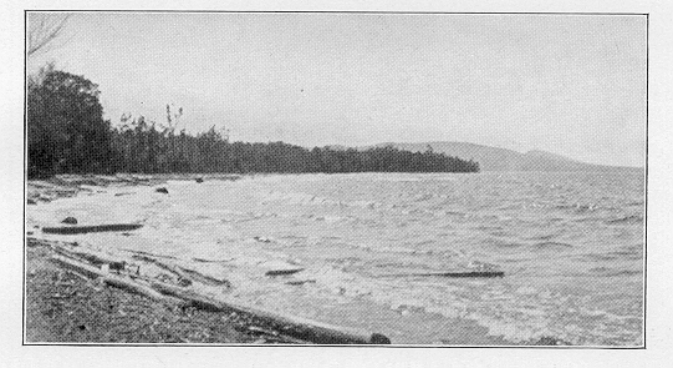

Plate VII. B. A view of Porcupine Mts., Ontonagon county, from shore of Lake Superior.

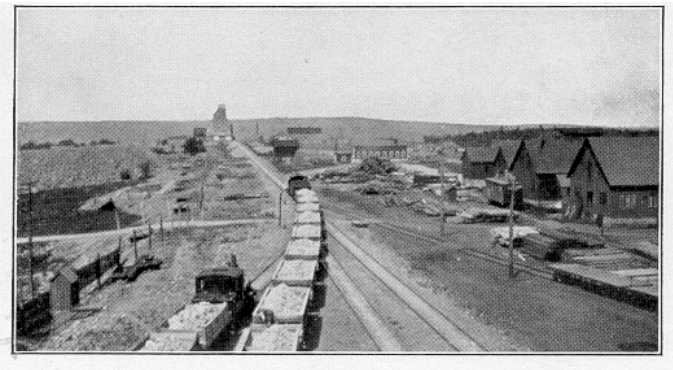

Plate VII. C. View north from No. 2 shaft, Isle Royale Mine.

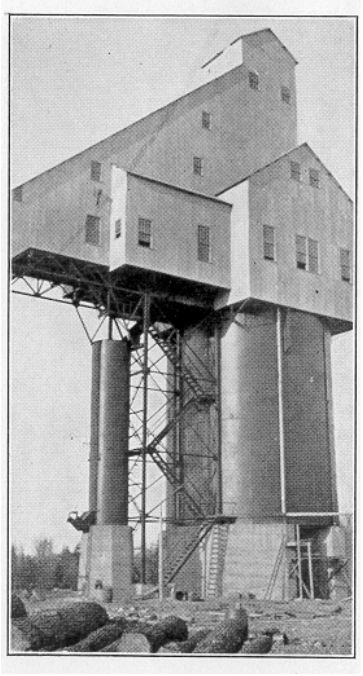

Plate VIII. A. Rock house at No. 2 shaft, Lake Mine, Ontonagon co.

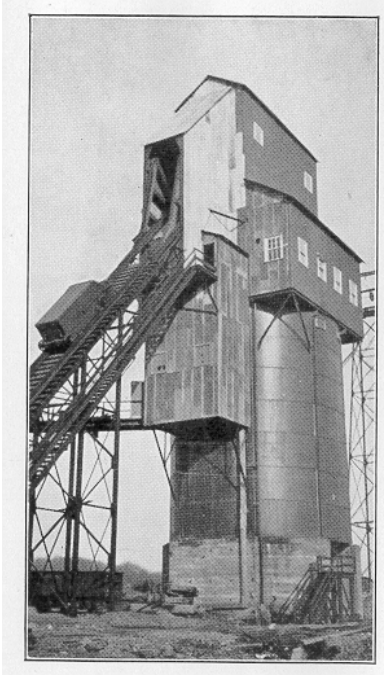

Plate VIII. B. New rock house and ten ton skip at Franklin Jr. Mine.

To improve recovery of copper from the ore, the mill is now being remodeled. The concentration will be accomplished by use of Woodbury jigs and Wilfley tables and the sands reground in Hardinge conical pebble mills.

In 1912 there was stamped 421,385 tons of ore yielding 7,908,174 pounds of copper, or 18.8 pounds per ton, at a cost of 13.15 cents per pound. A profit of $269,612 was made.

At No. 2 shaft ore was taken from a portion of the conglomerate lode previously abandoned on account of crushing and some ore was taken from the Osceola amygdaloid. Fairly good openings were made at No. 3 and No. 5 shafts and it is stated that "the 40th level north at No. 5 shows better copper values than any of the higher levels on this side of the shaft."

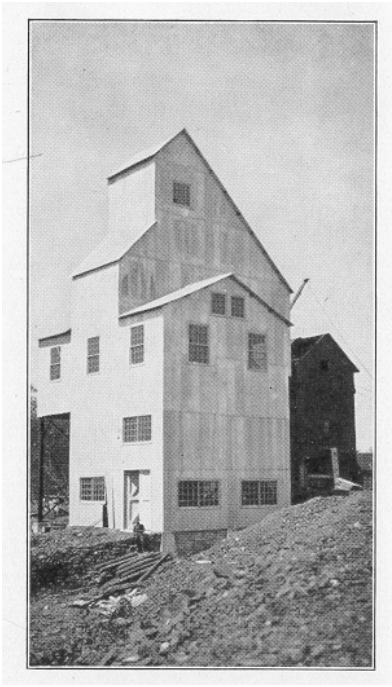

Plate VIII. C. New and old rock houses at C-shaft, Mass Mine.

TOLTEC MINE.

Idle.

TORCH LAKE MINING COMPANY.

Idle.

TREMONT AND DEVON MINING COMPANY.

Idle.

TRIMOUNTAIN MINING COMPANY.

Balance of assets December 31, 1912, $531,394.34.

The company has recently been very successful, owing to the development of good ore in the lower levels of the mine. The openings made in 1911 and 1912 give assurance of a large tonnage that can be mined profitably and the prospects are bright.

In 1911 there was hoisted 392,832 tons of which 44,947 tons were discarded. There was stamped 347,885 tons of ore, which yielded 6,120,417 pounds copper, an average of 17.59 pounds per ton at a cost of 11.55 cents per pound.

Speaking of the results obtained in 1911, General Manager F. W. Denton reports:

"Underground, the improvement noted in my last report continued steadily throughout the year. No. 2 shaft from

the 21st level to the bottom has shown very good ground, and some unusually large masses have been taken out. At Nos. 3 and 4 the openings have also been very satisfactory, and we are assured a steady improvement in output and costs."

At the mill, changes have been made in concentrating apparatus and Hardinge conical pebble mills installed to regrind sands. To insure a supply of water, a new intake has been constructed by driving a tunnel out under the lake for a distance of 1,970 feet.

The company reports that the openings made during 1912 were satisfactory and added materially to the reserves. The lower openings all show good ground.

There was stamped in 1912, 366,663 tons of ore, yielding 6,980,713 pounds of copper or 19.04 pounds per ton. This cost 11.73 cents per pound and was sold for 16.16 cents. Net profit for the year was $308,472 and $300,000 was distributed in dividends.

UNION COPPER LAND AND MINING COMPANY.

The company finished the year 1912 with $3,853 cash and with total land holdings unchanged, viz.: 6,366.7 acres. Options were granted on several parts of the property but no sales made during the year.

VICTORIA COPPER MINING COMPANY.

Balance of assets December 31, 1912, $27,623.58.

The company made a good showing in 1911 and would probably have made substantial profit in 1912, if a large production had been handled. Crippled by shortage of men, the mine has not been able to take advantage of the good price for copper.

There was stoped in 1911, 5,437.41 cubic fathoms. 145,764 tons were hoisted and 18,870 tons discarded. There was stamped 126,894 tons of ore which yielded 1,303,331 pounds of copper. From the mining operations a profit of $2,200.32 was made, but there was expended for interest, construction, development of water power, legal expense and sinking No. 6 shaft, the sum of $39,850.75.

During 1912 the workings at the producing shaft have been extended chiefly to the east. The shaft has been deepened to below the 22d level. At the new or No. 6 shaft the 12th level drift is being carried west to connect with the main shaft.

The underground force has been recently reorganized and it is hoped that increased efficiency will be obtained. A present great drawback is lack of men. Several dwelling houses have been constructed during the summer with the object of attracting a more steady class of laborers.

During 1912 there was stoped 6,448.12 cubic fathoms. 152,666 tons was hoisted, 20,711 tons discarded and 131,955 tons stamped. There was produced 1,224,911 pounds of copper at a profit of $428.35. Expenditures for several purposes reduced he surplus $36,421.

WHITE PINE COPPER COMPANY.

Balance of liabilities December 31, 1912, $16,701.36.

Promising results have been obtained from recent development work and considerable good ore is now blocked out. It has been found that the lodes are frequently displaced by faults and extensive exploration will be necessary in order that the structure may be properly interpreted and a safe approximation of the size and contents of individual blocks of the lode obtained.

During 1911 at No. 1 shaft, the winze was sunk 266 feet and 1,096 feet of drifting and 250 feet of crosscutting was done. A second vertical shaft was started 1,650 feet west of No. 1. During 1912 sinking, drifting and crosscutting have been continued with good results. At a depth of 131 feet a drift is being carried east to connect with No. 1 shaft workings.

There has been, as yet, no attempt made to produce a large quantity of ore. A large stock pile—said to contain about 5,000 tons of good ore—has accumulated at No. 1 shaft, but this is from development work only. The operating shafts are both small ones, unsuited for production on a large scale and not likely to be used for other than exploratory work. A larger and more advantageously located shaft will likely be sunk before much stoping is done.

During 1912 at No. 1 shaft openings were: drifting, 354 ft.; winzes, 144 ft. and raises 612 ft. The No. 2 shaft was sunk to 135 ft. and openings were: drifting, 197 ft. and crosscutting, 228 ft.

President Shaw says in his report:

"At No. 1 temporary shaft, the 3rd level was extended 354 ft. mostly in good copper ground. The lode is not as badly faulted here as it is further east. The No. 1 winze has been straightened between the 1st and 3rd levels and is being extended to the 4th level. No. 1 raise, 110 ft. west of No. 1 shaft, was carried 247 ft. above the 1st level in the Second Lode, and the First Lode was cut into at two points, but very little copper was found. No. 2 raise, about 700 ft. west of No. 1 shaft, was carried up 257 ft. in the First Lode and for 200 ft. above the 1st level is very rich. This raise will be carried to surface and used as an inclined shaft.

"No. 2 temporary shaft reached the ledge at a depth of 45 ft., cutting into the lode with good copper values on each side of a nearly vertical fault. The shaft passed through the lode and at the elevation of the first level a crosscut was driven south about 100 ft. to the lode which was found to be badly faulted."

WILMOT MINING COMPANY.

Idle.

WASHINGTON COPPER MINING COMPANY.

This company's property will be explored by the reorganized Keweenaw Copper Co.

WEST MINNESOTA MINING COMPANY.

Idle.

WHEALKATE MINING COMPANY.

Idle.

WINONA COPPER COMPANY.

Balance of assets December 31, 1912, $62,034.

After a period of development and construction work, the property is now in shape to make larger and more economical production. Profit from operations should be made in the near future, if the price of copper remains good and sufficient laborers can be secured.

The company's mill was completed early in 1911 and production begun in March. Owing to a considerable percentage of the copper in the ore being in a finely divided state, much experimentation has been necessary that a good recovery may be made. It has been found advisable to install regrinding apparatus—Hardinge conical pebble mills—and additional concentrating tables. At present one head is working continuously, but the second head is only occasionally in operation as labor shortage at the mine prevents desired production being obtained.

In 1911 there was stamped 97,445 tons of ore yielding 1,275,675 pounds copper, an average of 13.09 pounds per ton. The recovery made during the first four months of operation of the mill was about 12 pounds per ton, but improvements made brought the average up.

The production at present is from No. 3 and No. 4 shafts, chiefly from the latter. Much work has been done underground in preparation for production. Shafts and drifts have been retimbered. In places dry walls have been used, but suitable building rock is not commonly broken and the present practice is to build drift sets lagged with cedar. Chutes are placed about 50 feet apart and mills are walled with rock or with hardwood. The ore is sorted in the stopes and about one-half is discarded and used for fill.

In 1912 there was stamped 181,148 tons ore yielding 2,307,237 pounds of refined copper, or 1,274 pounds per ton. Excess of expenditures over receipts was $84,781. A better showing would have been made if trammers could have been obtained. Pres. Hubbard reports that openings in some of the lower levels, especially in the 15th, off No. 4 shaft have shown a marked improvement in the copper content of the rock over that of the levels immediately above.

WOLVERINE COPPER MINING COMPANY.

Balance of assets June 30, 1912, $746,520.15.

The company continues to make large profits from the Kearsarge lode and is expected to do so for 10 or 12 years more. Some exploratory work has been done on other lodes but so far without notable success.

In the year ended June 30, 1912, there was hoisted 414,544 tons of which 13,236 tons were discarded. There was stamped 401,308 tons of ore, yielding 9,408,960 pounds copper, an average of 23.45 pounds per ton, at a cost of 7.586 cents per pound. The net profit for the year was $613,180.53 and $540,000 was distributed in dividends. Concerning development and exploration done during the fiscal year, Agent Fred Smith reports:

"Openings on the Kearsarge lode were in about the same grade of ground as in previous years, with the exception of the 35th and 36th levels between Nos. 3 and 4 shafts, where the vein was not so continuously mineralized as in the levels above.

"The work on the Osceola lode was disappointing, as nothing of value has thus far been encountered. In detail, this work consisted of 516 feet of shaft sinking, 669 feet of drifting on the 2d, 3rd and 4th levels and 795 feet of diamond drilling on the 2nd and 3rd levels. The vein is wide and well defined, but is mineralized in spots too widely scattered to give it commercial value. The cost of this work was $15,950.28 and was charged to operating expense.

"The crosscut east at the 28th level was advanced 514 feet to a total distance of about 1,600 feet from the Kearsarge lode. Several promising lodes were passed through and a drift driven 82 feet north of the Old Colony Amygdaloid which lies a distance of 1,489 feet from the Kearsarge lode. Nothing of value was disclosed by this work, but more drifting will be done at this point and several other lodes which were disclosed during the progress of the crosscut should be examined before any definite conclusion as to commercial value can be reached. The general condition of the mine and the reserves of stoping ground created during the past year give promise of satisfactory returns for the year to come."

During the year Mr. Fred Smith resigned his position at the Wolverine and Mohawk mines and was succeeded by Mr. Theo. Dengler, formerly superintendent at Atlantic mine.

WYANDOT COPPER COMPANY.

Balance of assets March 31, 1913, $53,704.48.

Exploration during the past few years has shown that copper occurs in several amygdaloids on the company's property. No considerable body of good ore has yet been developed however.

An assessment of $1.00 per share was called in 1911 and exploration has been continued with fair results. The No. 8 lode, considered by the management to be the most promising of those discovered has been reached by a crosscut from No. 11 shaft. A winze is now being sunk to explore this lode at greater depth.

Agent F. L. Van Orden on April 1, 1912 stated in regard to No. 8 lode.

"Some drifting was done on this lode two years ago with encouraging results, but it was deemed best to conserve our funds with which to prosecute the work in the cross-cut, the chief aim of our exploration being to expose by means of a cross-cut the lodes lying on the Eastern side of the mineral range, and to be in a position to drift upon any lode that is sufficiently promising.

"Drifting was again taken up on Lode No. 8 on February 1, and, since that time, we have made a very creditable showing. We are at present drifting both northeast and southwest on this lode, either side of the crosscut, and the showing in the breast of both drifts is sufficiently encouraging to warrant us doing considerably more drifting. This lode was encountered in our crosscut about November 1, 1909, at a point 1,100 feet southeast of the shaft or 2,300 feet southeast of the Winona lode horizon. The lode is 28 feet in width. The greatest mineralization occurs on the footwall side of the vein. However, sufficient drifting has not been done to date to give us a very thorough knowledge of the character of this lode. It is most encouraging and by far the best-looking lode we have encountered to date."

A winze, 7 ft. by 9 ft., has been sunk in the lode and drifts run north and south at the 815 ft. level. Mr. Van Orden states that the winze is in commercial copper ground most of the way, that the north drifts, have opened good ground and the south drift shows encouraging values. At the time of Mr. Van Orden's report the drifts were each 25 ft. in from the winze.

POTASH.

For the past two or three years, the U. S. Geological Survey has been prosecuting a most diligent search after commercial supplies of potash salts, the United States at present being wholly dependent upon foreign countries. The salt producing districts of Michigan were visited and an examination of the brines, both natural and artificial, was made. The results were not at all encouraging. The percentage of potash in the brines was so small as to indicate that as far as the present salt producing regions are concerned, evaporation had never been carried far enough to cause a deposition of any of the more soluble salts. Many years ago, the Canadian Survey carried on a similar investigation with like barren results, finding little or no evidence warranting a supposition that potassium salts might even be found in the brines and salt deposits in Ontario.

It must be admitted, however, that the evidence while not favorable is certainly altogether too meager for concluding that there is no possibility of potash salts being found within the limits of the state. The investigation covered only a limited and marginal portion of the probable salt bearing areas and there is good reason to believe that the central portion of the state may also be salt bearing, and in this area, we know nothing concerning the Salina or possible salt beds.

The many drillings in southeastern Michigan and in Ontario, penetrating the Salina, have more or less perfectly outlined the southeastern limits of the rock salt beds. In a rough way, the margin extends slightly north of east from Trenton, Wayne county, where the Church wells show the exact southern edge of the salt beds, into Ontario apparently lapping around the margin of the old Cincinnati anticline which runs northeastward through Essex and Kent counties. To the northwest, in Michigan, the last well which penetrates the Salina is the Royal Oak which shows the surprising thickness of 609 ft. of salt, much thicker than to the southeast. From Detroit to Port Huron, there appears to be from 300 to 400 ft. of salt as shown by the wells. From these facts, it is but natural to infer that there is at least a very considerable extension of the salt beds to the northwest and down the dip of the strata toward the central basin. It is also to be noted that toward the north the salt comes in at higher horizons.

At Grand Lake, Alpena county, there is over 300 ft. of salt and the well was not through the formation. At Manistee and Ludington, the salt beds do not total more than 20 to 30 ft. To the south at Muskegon and to the north at Frankfort, the salt was absent. Dr. C. W. Cook in his studies upon the salt deposits of Michigan appears to think that there is good grounds for believing that the Manistee-Ludington, the Alpena, and the much larger southeastern district are simply but parts of one and the same deposit. If this is the case, presumably much of the central basin is underlain by salt beds.

Obviously, since the soluble potash salts are the last to be deposited, the chances for finding bitterns or deposits of potash would be greater toward the central basin, rather than toward the marginal areas such as the Port Huron-Detroit, Manistee and Alpena districts.

In order that one may form a better idea of the possibilities for the occurrence of potash salts in Michigan, the following excerpt from Dr. W. H. Sherzer's report on Wayne County is given below. It is to be noted that, while several plausible theories have been advanced in explanation of the deposition of salt, and especially the more soluble compounds of potash, bromine, etc., there is probably more to the history of the real processes than given in the various theories.

"The frequent association of calcium and magnesium carbonate, calcium sulphate and the strong bitter brines with rock salt, as in the region just described, gave rise more than a century ago to the theory that they must all have originated from the evaporation, under and conditions, of detached arms of the sea. To account, however, for such extensive beds of salt, gypsum and

dolomite demanded depths for these inland seas which overtaxed one's belief. Furthermore, the deposits alternated in succession and were often interstratified with shale and sandstone, so that the simple evaporation of such a sea could furnish no adequate explanation.

"Laboratory experiments have shown that, when sea water is evaporated, there are first thrown down the calcium carbonate ($Ca\ CO_3$) (and hydrous oxide of iron); ($2\ Fe_2\ O_3$ - $3\ H_2O$); next about 84% of the calcium sulphate ($Ca\ SO_4$) in solution. There is next precipitated upon further concentration about 54% of the salt (NaCl) along with the balance of the calcium sulphate, followed by 8.5% of salt free from this sulphate. The remaining salt with the more soluble compounds of magnesium, potassium, bromine and iodine, finally crystallized in various combinations, or constitute the bittern in case evaporation was not complete. As pointed out by Hubbard when such simple concentration of an inland sea takes place the bottom and sides would be coated with calcium carbonate, more or less stained with iron, upon which would be deposited a layer of gypsum or anhydrite. The concentrated brine would shrink to the deeper portions of the basin and there be precipitated along with more gypsum, the final salt layers being practically pure. If the evaporation were not completed, the bittern, or "mother liquor" would remain as a concentrated mineral water, to be incorporated into subsequent deposits. To account for a succession of the above series, for irregularities and for shale and sandstone, it has been supposed that influxes of the sea took place as during storm, or exceptionally high tides, bringing in fresh supplies of sea water and incidentally mud and sand. The enormous thickness of any single deposit, however, can not be so explained.

"In 1877 Ochsenius proposed a modification of this theory by assuming a basin of sufficient depth which continuously maintained its connection with the adjacent ocean, the water of the basin evaporating and allowing a constant inflow of sea water. The concentrated surface layers will sink, encountering layers differently charged and giving rise to the deposition of various compounds, chiefly salt and gypsum. Given sufficient time, a basin of sufficient original depth or in process of slow subsidence, the continuance of uniform conditions and an extensive bed of any of the above substances might take place. This is the theory accepted by Hubbard as explaining most satisfactorily the Salina series of Michigan.

"Grabau has recently pointed out that according to this theory there should be found abundant remains of marine organisms in the strata enclosing the salt, and it would seem, even in the salt itself. The constant influx of sea water would sweep in countless forms whose remains would settle to the bottom, whether or not they had been able to maintain themselves alive for any considerable time in the water undergoing concentration. It has already been pointed out that the Salina strata are practically barren of fossils. Grabau further calls attention to the absence of marine strata, outside of the Salina area of Michigan, Ontario and New York, which might be regarded as contemporary with the salt and gypsum strata. The complete absence of such strata, this author convincingly argues, indicates a land-locked basin or series of such in which the Salina beds are to be laid down. Widespread desert conditions with intermittent streams; long continued erosion of pre-Salina strata containing imprisoned sea-salts; the solution, transportation and final concentration of these salts in the various basins, he believes most satisfactorily explains all the phenomena of the Salina. From computations, this author concludes that the erosion of 400 ft. of Niagara limestone from Minnesota, Wisconsin, the upper Great Lake region and western Ontario would be sufficient to yield 100 ft, of pure rock salt distributed over an area of 25,000 square miles."

From the foregoing discussion of theories and facts relating to salt deposits, it is evident that, in any case, the final "mother liquor" or bitterns containing potash, would be largely collected in pools in local depressions, more or less close to the center of the Basin, that these pools would form only a very small part of the total area of the salt and that a single deep drilling might not necessarily prove the absence of potash salts, as there would be relatively large barren areas in between the pools. If the potash was not deposited in the solid form, but remained to be included in later deposits, the occurrence of the potash brines would naturally be much more wide-spread than the potash salts and a single drilling would have a greater chance of being successful.

During the present year, serious consideration has been given to the project of putting down from one to three deep wells to the Salina to test the possibilities for the occurrence of potash salts or brines in Saginaw Valley. Upon request, a report summarizing and describing the available evidence was submitted by the Survey and the parties interested decided that, as yet, the evidence was too vague and indefinite to warrant so costly an exploration so fraught with risk without having state aid, and protection, in case success was obtained.

At the present time, a drilling to the Niagara, Clinton and Medina formations is being considered with a view of testing the oil possibilities of these formations as well as the potash of the Salina. It would probably require a hole at least 4,400 ft. deep to reach the Niagara and one 4,850 ft. to reach the Clinton, if the formations below the Dundee are at all regular in character and thickness.

SAND AND GRAVEL.

Since 1903 the statistics concerning the production and value of sand and gravel in Michigan have been collected in co-operation with the U. S. Geological Survey. A study of these tables as given in the present report shows a steady and rapid increase in the total production and value up to 1911 when there was a great decline, from 2,862,738 short tons valued at $816,377 in 1910 to 1,831,601 tons valued at $523,829. For this there was no apparent reason, when it is considered that a great era of road building has just been inaugurated. This branch of the industry should have shown a very marked increase instead of a decline from 1,197,791 short tons in 1910 valued at $364,841 to 560,069 tons valued at only $158,876 in 1911.

A careful examination of the lists of the producers disclosed the fact that a large proportion of the producers reporting were located in or near cities or towns. There were very few indeed of the reports from rural communities, even where state reward road building was in progress. It is evident that the reports up to this year inclusive, represent chiefly the industry as developed in the vicinity of cities.

In the spring of 1912, in co-operation with the State Highway Department and the U. S. Geological Survey, form letters were sent to all of the township highway commissioners in the state, some 1,300 or more, asking the location and character of the sand and gravel pits and the names and addresses of the various owners. The results were somewhat startling as the number of new producers sent in by the commissioners swelled the sand and grave directory from about 125 to more than 3,000.

From the nature of the replies, it is clearly indicated that an enormous amount of road sand and gravel has been handled in the rural communities, of which hitherto there has been no record. It is to be hoped that the reports from 1913 on will more nearly represent the status of the industry in the state as a whole.

Plans are already under way to make an examination of the sand and gravel pits in the state in order to determine their fitness and value for concrete-cement work. Much complaint has been made against cement in such concrete work and, nearly always, when a careful examination has been made, the fault is not in the cement but with the sand or gravel used.

PRELIMINARY STATEMENT ON LIMESTONE.

The last detailed report upon the limestones of Michigan appeared in Annual Report for 1901 by Dr. A C. Lane. Short notes were published in several of the later reports, but nothing in a comprehensive way.

At present most of the known reserves of good limestone; easily accessible, are in the hands of a few large companies. Michigan has a number of heavy limestone formations, but unfortunately the amount of high grade limestone in each is relatively very small. In such case, it is no little problem to discover just where this much sought for stone occurs in commercially important quantities and under favorable conditions for quarrying. Were it not for the drift, which hopelessly covers most of the state, it would be comparatively easy to locate inexhaustible supplies of limestone. The Dundee alone in Monroe and Wayne counties would supply an almost unlimited amount of limestone, suitable for nearly every purpose for which limestone is adapted.

During the present summer (1913), R. A. Smith, Assistant State Geologist of the Survey is devoting a large part of his time in making a detailed study of the various limestone outcrops in the state with a view of determining their character and the uses to which they may be best suited, and the regions which offer the more favorable chances for the development of limestone deposits of commercial size and grade.