

PRODUCTION AND VALUE
OF
MINERAL PRODUCTS IN MICHIGAN
FOR
1917 AND PRIOR YEARS

MICHIGAN GEOLOGICAL AND BIOLOGICAL SURVEY

Publication 27
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MINERAL RESOURCES OF MICHIGAN

WITH

STATISTICAL TABLES OF PRODUCTION
AND VALUE OF MINERAL PRODUCTS

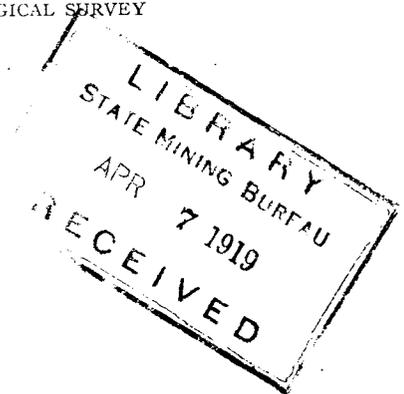
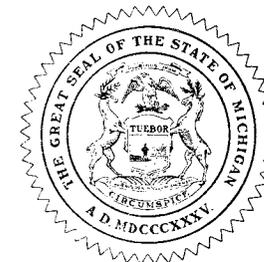
FOR

1917 AND PRIOR YEARS

PREPARED UNDER THE DIRECTION OF

R. C. ALLEN

DIRECTOR MICHIGAN GEOLOGICAL AND BIOLOGICAL SURVEY



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LETTER OF TRANSMITTAL

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

Gov. Albert E. Sleeper.
Hon. Thomas W. Nadal.
Hon. Fred L. Keeler.

Gentlemen:—Under authority of act number seven, Public Acts of Michigan, Session of 1911, I have the honor to present herewith Publication 27, Geological Series 22, the seventh of a series of annual statements of the production and value of the mineral products of Michigan.

Very respectfully,
R. C. ALLEN,
Director.

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PART I. METALLIC MINERALS

THE MICHIGAN COPPER INDUSTRY IN 1917

WALTER E. HOPPER

MICHIGAN COPPER INDUSTRY IN 1916

GENERAL REVIEW

The smelter production of primary copper in the United States during 1917 was 1,886,120,721 pounds, a decrease of 2.18 per cent from the production of 1916. Of this total 1917 production, the Michigan copper mines produced 268,508,091 pounds, which is only 1,286,440 pounds less than the record production of 269,794,531 pounds in 1916. These figures for Michigan represent the smelter output of ingot and anode copper, or the metal actually recovered from materials treated in 1917 and do not, therefore, correspond exactly with the mine production.

The average price of 2,584,000,000 pounds of copper delivered in 1917, as reported to the United States Geological Survey by selling agencies, was 27.3027 cents a pound. The price received for copper sold by the Michigan mining companies in 1917 varied from 26.238 cents to 29.39 cents per pound. The average price of copper per pound received by Michigan companies in 1916 was 24.6 cents.

The outstanding feature of the Michigan copper industry in 1917 was the constantly rising cost of production. The greatly increased cost of all material and supplies, the high scale of wages and the general scarcity of labor, with the consequent decreased product, materially added to the production costs for the year. All supplies practically doubled in price in 1917. Coal and powder advanced 100 per cent in cost. Stamp-mill costs are now more than 100 per cent higher than formerly, and at the present time the costs in all departments of operation will average about 75 per cent above normal times.

Further increase in costs was due to the reduced production because of the scarcity and inefficiency of labor. Adventure, Ahmeek, Calumet & Hecla, Cherokee, Franklin, Hancock, Isle Royale, Keweenaw, LaSalle, Michigan, New Arcadian, Quincy and South Lake were the only operating companies which produced more copper in 1917 than in 1916. The Calumet & Hecla's mine production showed a decrease in 1917, but the large increase in production by the Reclamation Plant increased the total production over that of 1916. Production by the Copper Range showed a decrease of about 18 per cent from the record production of the previous year.

In general the output of the mines was largest during the first four months of the year, but after war was declared and the selective

draft became effective, the loss of men was felt severely. During the summer months the turnover of labor was extreme. In most of the mines the shortage of labor was considerably reduced before the end of the year. At the Copper Range mines in the third quarter of the year the number of underground men fell off 20 per cent from the number employed in the first quarter, and in the fourth quarter the loss was increased to 24 per cent. At the Quincy a total of 2,525 men was hired during the year, of which 805 were secured from other sections, the largest importations of men occurring during the summer months. At the Mass in January the average number of men employed underground was 409. This number gradually decreased until August, when there were only 232, a decrease of over 43 per cent. In December, however, the average number of employees was 372. At the Mohawk the number of men employed in all departments for the entire year averaged 18 per cent under normal. Much of the imported labor was unaccustomed to underground work, required constant attention and training, and thus handicapped the mining operations and decreased the output of ore.

Notwithstanding the inefficiency of the new employees, wages were maintained at a very high average throughout the year. At the Calumet & Hecla and all its subsidiaries the ten per cent premium and 50 cent bonus for each day worked were continued throughout 1917, and notices were posted early in 1918 announcing the continuance of this premium and bonus until July 1, 1918. At practically all the operating mines increase in wages and bonuses were necessary in order to secure the men and maintain production.

On September 21, 1917, a copper price of 23½ cents per pound, f. o. b. New York, to the Government, allies and the public, was fixed by voluntary agreement between the Government and leading copper producers. The price of 23½ cents was to hold for four months, and producers agreed not to reduce wages and to maintain maximum output. On September 28 the copper producers organized a new Copper Producers' Committee to conduct the copper business of the country under the new conditions, and on October 2, the principal copper consumers formed a committee to confer with the Copper Producers' Committee.

The price received for copper sold by the Michigan mining companies in 1917 varied from 26.238 to 29.39 cents per pound. The fixed price of 23½ cents per pound, however, placed a severe handicap on all operating companies and resulted in the closing down of six or seven mines in the development stage. Operations during the latter part of the year were limited, and work was con-

finied to the more productive areas. At Mass there were practically no earnings during the last six months of the year. Such properties as Centennial, Lake, LaSalle, Mass, Victoria and Winona cannot make a profit and still carry on necessary development at the established Government price of 23½ cents.

The same companies which paid dividends in 1916 paid dividends in 1917. The total amount paid in dividends by the 15 companies in 1917 was \$28,041,026.00, compared with a total of \$28,840,348.59 in 1916. Many of the companies, including Calumet & Hecla, Ahmeek, Allouez, Centennial, Isle Royale, Mass, Osceola and White Pine, showed a net decrease in current assets for the year. Although Copper Range sold its copper at a price nearly 2½ cents per pound higher than in 1916, yet, owing to the reduced production and increased cost, the balance of \$1,022,912.47 added to the surplus from the year's operation was less by more than a million dollars than the amount added in 1916. The income and excess profits taxes and Red Cross payments for the year 1917 amounted to a large sum and helped to decrease current assets.

Adventure, Michigan, North Lake, South Lake and White Pine Extension showed a balance of liabilities at the end of the year, and several other companies showed only a very small balance of assets.

EXPLORATION AND DEVELOPMENT

Scarcity of labor, high wages and high cost of supplies placed a severe handicap on all properties in the exploration and development stage. Throughout the district there was very little exploratory work done in 1917. Some of the larger mines temporarily closed certain of their shafts.

No work of any kind was done at Algomah during 1917.

At the Contact no active work has been done since the completion of diamond drilling in hole No. 21 on June 29, 1916.

At the Cherokee, although results of operations were very encouraging, the mine was closed down about December 25th to await more propitious times.

The Adventure was closed down October 26th. Adventure resumed work in November 1916, and the lodes where opened showed on the whole a satisfactory copper content. A total of 652,977 pounds was produced during the year. Shortage of labor and high cost of production, however, necessitated the discontinuance of mining operations.

At the Houghton copper mine operations were discontinued the latter part of September.

At the Indiana all work on the property has been stopped until conditions become more favorable.

At the Phoenix mine of the Keweenaw Copper Company a total of 1,410 feet of openings was made, and 380,536 pounds of copper was produced. On December 1st all operations were discontinued and the mine closed down.

The Mayflower-Old Colony began the preliminary work of preparing the property for sinking of a shaft in April. Considerable time was spent in repairing old dwellings, constructing railroad connections and a dam, erecting the necessary buildings for the mine plant and in assembling and installing the necessary equipment. At the end of the year the shaft had reached a depth of about 261 feet.

Exploration and development work was continued throughout the year at the Michigan. Results of operations on the Butler, Ogima and Evergreen lodes were highly encouraging. During the latter part of November shipments to mill were made from the stockpile, and at present regular shipments direct from the stopes are being maintained.

No. 2 shaft Mohawk was closed down temporarily in July.

Naumkeag continued exploratory work throughout the year. The shaft was sunk 156 feet, and 3,284 feet of drifts and crosscuts was driven. Fair copper ground was found for 350 feet on the 400 foot level north. In one or two other places the mineralization was found to be local.

At the New Arcadian development work was reduced to a minimum, and the plan to place the property on at least a limited producing basis was abandoned. Total openings amounted to 1,633 feet, and results were satisfactory.

Operations at the New Baltic were continued to a limited extent. The New Arcadian lode and a parallel amygdaloid, about 30 feet above the New Arcadian lode, were explored, and both showed good mineralization.

North Lake carried on exploratory work at the 800 foot level continuously throughout the year. Total openings amounted to 2,034 feet. Several amygdaloid beds carrying copper were cut by the northwest crosscut, but no drifting will be done until the Butler lode is reached.

South Lake continued operations on the north dipping lodes. Production was continuous throughout the year but was incidental to the opening of the lodes. Results insure profitable production when openings have been made and equipment installed for operations on a larger scale.

At the Winona mining operations were carried on as usual for the first nine months of the year. For about six months there was a small margin of profit. Beginning in July, the underground openings ran into much poorer ground, the price of copper was dropping, and when the results of the month's operations were obtained, it was evident that the mine would have to shut down. At that time the fixing of a price for copper by the Government was pending, and it was thought best to await the announcement before stopping operations. Immediately upon the announcement by the Federal Government of a price of 23½ cents, the mine was shut down. Supt. R. R. Seeber recommended a continuance of operations on a somewhat smaller scale and in certain parts of the mine only. It did not seem advisable to the Board of Directors to follow his recommendation. Mr. Seeber, therefore, made application to work the property on tribute, guaranteeing a small minimum payment per pound of copper produced and an additional payment dependent on the price at which the copper was sold exceeding a minimum figure. The mine has been operated on this basis by Mr. Seeber since October 1 with satisfactory results.

All work at the Wyandot mine during 1917 was confined to the further development of No. 8 lode on the 10th level. Two mill tests were run at the Winona mill, one of selected ore and one of unselected ore direct from the openings. Results were very encouraging. The lode is lean, openings are encouraging, but whether the lode can be developed profitably remains yet to be proven. At the end of the fiscal year all operations were suspended, and the mine closed down.

Of the numerous projects undertaken in 1916 in Ontonagon county, only one, the White Pine Extension, carried on operations in 1917. Nothing was done at the Onodaga, at the Carp Lake mine or at the Algonac and Porcupine Exploration properties. Nothing further developed from the explorations at the Flint steel mine and the Tremont & Devon. The Cass Copper suspended diamond drilling and exploratory work in August.

At the White Pine Extension mining operations were carried on throughout the year. Total openings at the end of 1917 amounted to 5,420 feet, and 13,478 tons of ore had been hoisted. Results of work indicate that only the No. 2 shale can be seriously considered as a mining proposition at the present time. The property must be worked on a large daily tonnage of at least 1,000 tons. This will require sinking of two shafts simultaneously, a large amount of underground opening work and the construction of a modern flotation mill, besides railroad connections. Results show an average of 21.5

to 23 pounds of copper per ton and a width of only 4.8 feet in the lode.

Copper Range expended \$57,364.32 in diamond drilling the lands south of the Champion mine, under option from the St. Mary's Mineral Land Co. No important developments were made, and the drilling will be continued a while longer.

In the latter part of April, the Federal Syndicate Copper Co. was admitted to the State of Michigan and purchased 360 acres of land in Keweenaw County, formerly owned by the Federal Copper Co. The Federal intended to explore the Kearsarge amygdaloid and the Kearsarge conglomerate, and in the fall of 1917 a diamond drill was taken in to the property and set up ready for work. Owing to financial difficulties, however, no drilling was done.

During the year 1917, perhaps the most important and interesting exploratory work was that undertaken in the vicinity of Bear Lake, about seven miles west of Calumet. About the middle of March, copper was found in an exploratory pit in section 24. This resulted in the formation of the Bear Lake Pool, and diamond drilling was started in August. Four holes were drilled before the end of the year with encouraging results. The exploratory work will be continued.

In the latter part of 1916, the Longyear-North interests secured options on 1,240 acres in the Bear Lake district and drilled one hole in section 35.

In the fall of 1917, the Federal Syndicate Copper Co., under the name of the Bear Lake Extension, secured options on 2,000 acres adjoining the property of the Bear Lake Pool and the Longyear-North options. Diamond drilling will begin on these lands early in 1918.

It is probable, owing to the difficulty of financing three separate explorations, that in the year 1918 the holdings of the Bear Lake Pool and the Longyear options will be consolidated with the Federal Syndicate Copper Company, thus giving a combined acreage of 4,600 acres to be explored by the one organization. Results of the exploratory work in this Bear Lake district will be watched with great interest.

The New Seneca Copper Corporation, organized late in December 1916 to take over the controlling interest in the Seneca Mining Company, began preparatory work towards sinking a shaft to develop the Kearsarge lode in June. During the summer, fall and early winter, practically all the surface buildings were erected, and with the completion of railroad connections in December, the heavy equipment was ready for installation. Shaft sinking will begin early in 1918, and the progress and the results at the Seneca will be watched with interest.

CONSTRUCTION

Notwithstanding the difficulty in securing delivery of equipment, the shortage of labor, the increased cost of all material and high wages, construction work was continued on a considerable scale throughout the district in 1917. Over \$3,743,976.00 was expended for construction during the year at the various mines and mills. All this work was for improvements towards increased production in the future and for the betterment of the employees. Under the requirements of the Federal Government in regard to income tax returns, it is not permitted to charge construction against income.

Calumet & Hecla expended for construction \$2,274,901.27, including Tamarack Mining Company construction. At the stamp-mills the electric power house is being made thoroughly fire proof, and increased equipment for prevention and control of fire is being installed throughout the mills. A 2,000 ton plant for the treatment of slimes from Nos. 1 and 2 regrinding plants will also be built. The 2,000 ton addition to the leaching plant should be completed by late spring 1918. A new electrically operated coal bridge, capable of handling from vessels 10,000 tons per 24 hours, has been erected and will go into commission at the opening of lake navigation in 1918.

Ahmeek spent \$231,257.42 for construction in 1917. At No. 2 shaft the new steel rockhouse went into commission in April. All of the dwelling houses were provided with stone foundations. Fire protection lines were extended to the 28 new dwellings which were completed early in the year. At the stamp-mill several improvements were made, and an automatic sprinkler system for fire protection is being installed.

Allouez expended \$24,503.11 for construction. A two-boiler addition to No. 1 boiler-house was erected, and considerable work was done on Company dwellings.

At the No. 2 mill, Hubbell, and at the No. 1 mill, Point Mills, of the Lake Milling, Smelting and Refining Company, automatic sprinkler systems for fire protection were installed. At the No. 1 mill work was started on two new stamp units, and at the No. 2 mill a tailings pumping plant is being built.

Isle Royale spent \$316,370.62. At two of the shafts modern fireproof change-houses to accommodate 250 men were erected. These buildings contain offices for mining captains, shift bosses and timekeeper on the main floor, rooms for mine supplies, surface tools, etc., in the basement, toilets, shower-baths and steel lockers. Other items of construction were a combined smithshop, machine shop and warehouse, a new locomotive house containing stalls for six locomotives, a new medical dispensary, 20 new seven-room, two-story

dwelling houses with full sized basements and concrete floors, and a twin boarding house, capable of accommodating 39 men. This latter is steam heated, electric lighted, and contains toilets, shower-baths and a large lounging room.

Osceola expended \$96,788.55 for construction, of which amount \$47,314.82 was for new work at the stamp-mill.

White Pine spent \$78,360.76 chiefly towards improvement of living conditions at the location.

Quincy spent \$370,315.25 for construction during 1917. This amount includes the erection of 50 substantial eight-room dwelling houses with full basements, boarding houses for employees, an automatic sprinkler system for better fire protection at the stamp-mills, stokers and coal handling plant at stamp-mill boilers, new hoisting plant at No. 2 shaft and numerous other improvements at mine and mill.

Mass expended \$62,775.59 for additions to buildings and \$22,576.87 for additions to equipment.

Franklin spent \$39,510.67 for construction at mine and \$24,570.77 for construction at mill.

Keweenaw spent \$14,866.17; Mayflower-Old Colony, \$22,598.24; Victoria, \$27,090.63.

Mohawk expended \$40,056.73 at the mine for machine shop and for reconstructing hospital and \$50,847.64 at the mill for installing turbine, sprinkler system, water tank and sand conveyor.

MINING AND MILLING

Scarcity of labor was a serious matter during the greater part of the year 1917. Therefore, improvements made in mining were directed toward compensating for a decreased supply of labor. Power haulage was extended underground, and at a number of the mines storage-battery locomotives were installed for this work. At some of the mines it was found advisable to concentrate mining operations. During the latter part of the year, all operations were limited and confined to the more productive areas. The only possible offset to increasing cost of labor and supplies and decreasing copper content of ore is increased production. Hancock and White Pine carried on underground exploration by diamond drill.

At the stamp-mills fine grinding in Hardinge conical mills became standard throughout the district.

At the Calumet & Hecla mills a second steam turbine of 10,000 kilowatt capacity is being installed.

Ahmeck stamp-mill was completed; No. 8 stamp went into commission February 1. At the two oldest units round tables and jigs were replaced by Wilfley tables.

At the Lake Milling, Smelting and Refining Company's No. 1 Point Mills plant work was started on two new stamp units, one for the Isle Royale and one for Hancock. As additional power will be required, the entire plant will be electrified, thereby introducing a decided fuel economy, as the exhaust steam from the stamps will be utilized in a mixed flow pressure turbine which will operate a 2,000 kilowatt electric generator. A 30,000 gallon motor driven centrifugal pump, for furnishing water for the entire mill, will also be installed. No. 6 Chilian mill was replaced by a Hardinge conical mill.

At the No. 2 mill, Hubbell, the first unit of the two stamp addition went into commission October 1st. The second unit is completed except for installing concentrating machinery. Work has been started on a tailing pumping plant, which when completed, will be available for pumping mill tailings farther out into Torch Lake when the present area for launder discharge is exhausted.

At the Quincy mills the bins in No. 1 stamp-mill were remodeled and the capacity doubled. The foundation of No. 4 stamp head was completely rebuilt. A new assay office was erected and equipped at the mills. Taylor stokers and ash handling apparatus under the Stirling boilers were installed.

At the Victoria mill 15 new concentrating slime tables were installed. Six old concentrating tables were rebuilt with new head motions and rearranged to have ample concentrating machinery for the crushing capacity of the mill.

At the Keweenaw mill plans were made for additional concentrating equipment, consisting of tables, screens, etc., of which four Wilfley tables were installed, replacing the older tables.

At the Calumet & Hecla and White Pine mills experiments with the flotation process were carried on most of the year. Results at the Calumet & Hecla were entirely satisfactory, and two 600-ton Minerals Separation units will be installed at once, with all necessary auxiliary machinery, including Dorr thickeners and Oliver filters. One stamp unit at a time will be converted to the new system. In addition to this, it is proposed to build a 2,000 ton plant for the treatment of slimes from Nos. 1 and 2 regrinding plants, which are now wasted as they are too fine to permit of treatment by leaching.

At the White Pine mill results were sufficiently encouraging to warrant treatment of all tailings by flotation, although only low grade concentrates have been made, and smelting costs will be high. Sufficient Wilfley tables will be removed to make room for a 600-ton flotation unit of the Minerals Separation type. Additional power will be furnished by a triple expansion engine, and two of the pebble

mills will be converted into ball mills for finer grinding. An addition to the mill has been built to house two Dorr thickeners.

The two Calumet & Hecla regrinding plants crushed a total of 512,172 tons of coarse tailings during 1917 and produced 2,222,419 pounds of copper, at a cost per pound, excluding smelting and selling, of 6.48 cents. In addition, the No. 2 regrinding plant treated 730,543 tons of tailings sands from Torch Lake, producing 4,635,386 pounds of copper, at a cost of 3.5 cents per pound, excluding smelting and selling.

The Calumet & Hecla leaching plant operated continuously throughout the year. The 2,000-ton addition should be completed by late spring 1918. Total recovery was 5,250,331 pounds, of which 810,260 pounds was from current mill tailings and 4,440,071 pounds from Torch Lake. The cost per pound, excluding smelting and selling, was 6.41 cents. The total production by the Reclamation plant in 1917 was 9,075,457 pounds, the pounds saved per ton was 12.42, and the cost per pound, excluding smelting and selling, was 5.94 cents.

GENERAL

During 1917 the Calumet & Hecla acquired all of the assets of the Tamarack Mining Company for the sum of \$3,600,000, and the latter company has been dissolved.

The Baltic Mining Company has also been dissolved, and all its assets transferred to the Copper Range Company.

The remaining shares of the Laurium Mining Company stock, not owned by the Calumet & Hecla December 31, 1916, were acquired by the Calumet & Hecla, and dissolution proceedings are in process.

Frederick W. Denton retired from active duty as general manager of the Copper Range mines August 1st, and William H. Schacht was appointed general manager of mining operations. Mr. Denton will continue his connection with the Company as vice-president and managing director, with headquarters in Boston.

J. L. Harris, who had been manager of the Hancock since its organization, resigned June 1st, and C. E. Weed, formerly manager of the Lake Copper Co., was appointed to succeed him.

Early in 1917, Ralph Hayden, formerly with the Anaconda, was appointed superintendent of the Quincy stamp-mills.

Many of the employees throughout the district availed themselves of the opportunity to subscribe through their respective companies to both issues of Liberty Loan bonds, paying ten per cent of the purchase price monthly until fully paid.

DETAILS OF OPERATIONS OF THE MINING COMPANIES IN 1917*

Adventure Consolidated Copper Company

Operations at the Adventure mine in 1917 resulted in a loss. Financial statement shows a balance of assets January 1, 1917, of \$53,783.73 and a balance of liabilities over assets January 1, 1918, of \$11,892.16. Because of the constantly increasing cost of labor and supplies, the low grade of ore and the sudden decline in the price of copper, it was considered useless to continue further efforts to make the mine pay, and mining operations were discontinued October 26th.

The Adventure resumed mining operations the latter part of November 1916, and shipments of ore to the Winona mill were begun about the middle of December. Production was gradually increased up to the end of the year and by May 1, 1917, amounted to about 300 tons a day. The lodes, where opened, showed on the whole a satisfactory copper content, and results indicated that the mine can be worked profitably. Shortage of labor and high cost of production, with limited openings, however, were too much of a handicap.

During the year 1917, a total of 652,977 pounds of copper was sold for \$198,562.75.

Ahmeek Mining Company

Ahmeek, with four operating shafts, produced 27,919,812 pounds of refined copper in 1917. This is an increase of 3,777,654 pounds over the previous record production of 24,142,158 pounds in 1916. Of the total production 19,299,590 pounds was delivered and billed in 1917, leaving on hand at the end of the year 8,620,222 pounds.

The cost of production, including mining and mine taxes, smelting, refining, eastern offices and corporation taxes, was 9.05 cents per pound, and the total cost of production and delivery for the 19,299,590 pounds was 9.42 cents per pound. Gross income from 1917 operations was \$3,389,145.92.

The average yield of refined copper per ton of ore treated was 22.0 pounds, a gain of over one pound compared with the yield in 1916.

No. 1 shaft is bottomed 43 feet below the 22d level in foot-wall trap. The shaft entered the shattered zone at about the 20th level and is still in a crushed area, making close timbering necessary and probably involving high maintenance costs in the future. For this reason No. 1 shaft will not be sunk any deeper, and the ore below the 22d level will be hoisted through No. 2 shaft.

*For details of production, costs, dividends, assessments, assets and liabilities see statistical tables.

All openings and stopes showed ground of average quality, except the stopes on the 10th, 14th and 16th levels south, beyond the disturbed area. At these points the lode is below average quality, the copper occurring in small bunches.

No. 2 shaft is 46 feet below the 25th level. Drifts and stopes mined during the year were of average quality. During the year 628,000 pounds of copper was obtained from the fissure vein north of the shaft. The fissure is now opened up for a total distance of 4,528 feet on the 8th to the 18th levels inclusive, with the exception of the 12th level. Development work on this fissure was somewhat restricted during 1917, owing to shortage of labor and lack of compressor capacity. The new steel rockhouse at No. 2 shaft went into commission in April.

During 1916, a crosscut was driven through the Kearsarge conglomerate, and drifts were run a short distance north and south near the foot of the bed. During 1917, this drifting on the Kearsarge conglomerate was continued north and south of the crosscut for a total distance of 341 feet, but did not develop ground of commercial value. This exploratory work was stopped in April because of shortage of labor but will probably be resumed at some future time.

No. 3 shaft is bottomed 120 feet below the 20th level and is in the hanging-wall trap. Underlying the Fulton fissure is a shear zone, and here the Kearsarge lode has been thrown toward the foot. No work was done on the Fulton fissure on the 15th level because of shortage of labor. Several small masses were taken out in stopes on the 14th level. Although the copper occurs in bunches, all the openings during the year showed ground of average quality for the north end of the property.

The bottom of No. 4 shaft is 173 feet below the 19th level, with about two feet of average lode showing on the hanging wall side of the shaft. All openings showed ground of average quality for the north end of the property. After passing through the shattered zone on the 14th level, it was found that the lode turns toward the east to such an extent, that at a point about 2,000 feet north of the shaft, there would be only about 69 feet of stoping ground between the level and the Mohawk boundary. It was therefore decided to discontinue drifting on the 14th level, as the ground can be mined through the 15th level. On the 17th level north, the shattered zone, which was encountered on the 14th, 15th and 16th levels, has almost disappeared, being represented by a clay seam about 18 inches wide.

A storage-battery locomotive is in operation on the 18th level of No. 2 shaft. Similar locomotives will be installed on three other levels in No. 2 shaft, on one level of No. 3 shaft and on four levels

in No. 4 shaft. At all levels where motor haulage will be used, chutes have been cut to facilitate dumping into the skip.

The stamp-mill has been completed; No. 8 stamp unit went into commission February 1. The round tables and jigs of the oldest units, Nos. 3 and 4 stamps, have been replaced by Wilfley tables.

Ahmeek paid an income tax of \$112,999.28 in 1917 and an excess profits tax of \$869,760.59.

For premiums and bonuses see Calumet & Hecla Mining Co.

Algomah Mining Company

Concerning operations at the Algomah in 1917, President R. M. Edwards states as follows:

"Owing to the very adverse labor situation and high costs, no mining work was undertaken during the year, and it is deemed unwise to resume sinking of the shaft while present conditions continue."

Treasurer's statement shows a surplus on December 31, 1917, of \$16,868.54

Algonac Mineral Development Company

On account of the unsettled financial condition of the country, it was decided to suspend all work at the property.

Allouez Mining Company

Allouez's total production of refined copper in 1917 was 8,892,915 pounds, which is 1,326,375 pounds less than the record production of 1916. Although the total number of tons of ore treated in 1917 was only 286 tons less than the amount treated in 1916, the yield of refined copper per ton of ore treated dropped from 18.02 in 1916 to 15.69 pounds in 1917, hence the noticeable decrease in pounds of refined copper produced. Production cost was 13.47 cents per pound.

No. 1 shaft was sunk 99 feet. The bottom of the shaft is just below the 21st level. Sinking was delayed because of the very bad character of the ground passed through, owing to "crossings." The shaft is in the hanging-wall trap, so that the value of the adjacent lode is not known. Stopes tributary to this shaft have been of rather low grade.

Total depth of No. 2 shaft is 198 feet below the 21st level, 3,407.5 feet from surface. Stopes tributary to this shaft have yielded ore of fair grade. Five electric locomotives have been put in service and have proved very satisfactory.

For premiums and bonuses see Calumet & Hecla Mining Co.

Baltic Mining Company

On May 29, 1917, the Baltic Mining Company was dissolved, and all its assets have been transferred to the Copper Range Company. The mine will be operated as the Baltic mine of the Copper Range Company.

For details of operations in 1917 see Copper Range Company.

Bear Lake Pool

For many years Mr. George North of Quincy Hill has held the idea that some day copper in commercial quantity would be found in the neighborhood of Bear Lake, east of the Portage Lake Ship Canal and about seven miles west of Calumet. In connection with J. M. Longyear, Jr., of Marquette, Mr. North secured options on 1,240 acres of land in sections 26, 27, 34 and 35, T. 56 R. 34, and late in the year 1916, a diamond drill hole was put down in the N. E. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ of section 35. This hole was drilled to a depth of 1,000 feet and disclosed nothing but sandstone.

Although no copper was found in this hole drilled in section 35, Mr. North continued his explorations by sinking a test-pit in the S. W. $\frac{1}{4}$ of the S. W. $\frac{1}{4}$ of section 24. On March 17, 1917, Mr. North struck a fairly good showing of copper in this pit and reported the fact to Dr. P. D. MacNaughton, of Calumet, who held an option on the land.

The finding of copper in this test-pit in section 24, resulted in the formation on May 1st of the Bear Lake Pool. Options were secured on 1,360 acres, consisting of all of section 24, the S. E. $\frac{1}{4}$ of section 23, the N. W. $\frac{1}{4}$, the N. E. $\frac{1}{4}$ and the S. E. $\frac{1}{4}$ of section 26 and the W. $\frac{1}{2}$ of the N. W. $\frac{1}{4}$ of section 25, and from May 1 to November 10, efforts were made to secure sufficient money to thoroughly explore the lands. Interests were sold at \$500, and at the end of the year, 27 interests, representing 80 individual people, had been sold.

Diamond drilling was started by the Bear Lake Pool in August 1917. Four holes were drilled before the end of the year. Late in the fall, Mr. John Been was engaged as engineer to superintend the exploration work. The drilling will be continued, and probably more work will be done in the pit originally sunk by Mr. North.

Bear Lake Extension

See Federal Syndicate Copper Company.

Calumet & Hecla Mining Company

The total production of the Calumet & Hecla, from mine and

reclamation plant, was 77,495,283 pounds. The production cost or this copper was 12.60 cents per pound. The production from the mine was 68,419,826 pounds and from the reclamation plant 9,075,457 pounds, compared with 71,349,591 pounds and 5,412,649 respectively in 1916. Of the total production, 59,527,902 pounds was delivered and billed in 1917, leaving on hand at the end of the year 17,967,381 pounds. Gross income from 1917 operations was \$13,132,392.83. The 1917 income tax amounted to \$409,188.82, and the 1917 excess profits tax amounted to \$570,285.87

Conglomerate Lode

Production from the conglomerate lode showed a decrease compared with that of 1916 and 1915. The yield per ton of ore treated was also lower in 1917.

There are 10 operating shafts on the conglomerate lode. The work of removing shaft pillars and cleaning up arches and backs of old stopes was continued throughout the year. About 89 drills were used during the year in this work, and a total of 505,682 tons was secured from the operations. About 2,940 feet of drifting was done in Nos. 6 and 7 shafts, Hecla branch and in Nos. 9 and 10 shafts, South Hecla branch. Ground opened in the former shafts was fair; that opened in the latter shafts was fair to poor.

Osceola Lode

There are six shafts operating on this lode. No marked change was found in the grade of ore opened during the year; the average yield of copper per ton of ore treated was 12.79 pounds, which is a slight decrease compared with the average yield of the three previous years.

Total production from the Osceola lode was 18,003,966 pounds, of which about 27 per cent was secured from foot-wall stopes. Shaft openings are so far in advance of drifts that, with the exception of 338 feet at No. 17, no sinking was done during the year.

Kearsarge Lode

No work has been done on the Kearsarge lode since July 1913. There are three shafts on this lode, Nos. 19, 20 and 21. Nos. 19 and 20 are both bottomed at 1,350 feet and were closed down December 1907. No. 21 is 2,291 feet deep and was closed down in July 1913.

Manitou-Frontenac Branch

No work was done on these lands during 1917.

St. Louis Branch

No work has been done at this branch since July 1913. The shaft is 137 feet below the 5th level, or 693 feet from surface.

Stamp-mills

A 50-ton experimental flotation unit was in operation for six months during the year. This experimental work proved so satisfactory that two 600-ton Minerals Separation units, including Dorr thickeners and Oliver filters, will be installed at once. One stamp unit at a time will be converted to the new system, beginning with the Hecla mill, and continuing into the Calumet mill, as units can be shut down. In addition it is proposed to build a 2,000-ton plant for the treatment of slimes from Nos. 1 and 2 regrinding plants; these slimes are now wasted, as they are too fine to permit of treatment by leaching. Contracts have been let for remodeling the conglomerate slimes treating machines, and active work of remodeling will be under way in the near future.

Regrinding Plants

Owing to the non-delivery of 15 of the required 24 Hardinge mills, the remodeling of No. 1 plant is almost a year behind schedule. No changes were made in the No. 2 plant. The comparative results for 1917 for the two plants on mill tailings were as follows:

	No. 1	No. 2	Total
Tons coarse tailings crushed.....	322,811	189,361	512,172
Pounds per ton in material treated.....	12.74	12.74	12.74
Pounds copper saved per ton.....	4.11	4.73	4.34
Pounds copper produced.....	1,326,348	896,071	2,222,419
Cost per pound, excluding smelting and selling.....	7.10c	5.56c	6.48c

In addition to the above, No. 2 regrinding plant treated 730,543 tons of sands from Torch Lake, producing 4,635,386 pounds of copper, at a cost of 3.5 cents per pound, excluding smelting and selling.

Leaching Plant

The leaching plant operated continuously throughout the year with very satisfactory results. The 2,000 ton addition is well underway; the first of the new tanks will go into commission in February, and all work should be completed by late spring 1918. The results of the leaching plant for 1917 were as follows:

Tons treated.....	643,911
Assay headings.....	.571
Assay tailings.....	.148%
Pounds refined copper.....	5,250,331
Pounds copper per ton treated.....	8.15
Cost per pound copper, excluding smelting and selling.....	6.41c

Of this copper 810,260 pounds were from current mill tailings and 4,440,071 pounds from Torch Lake.

Reclamation Plant

Production from this plant was continuous and uniform throughout the year. The operations of the plant include pumping the sands from Torch Lake to a shore-plant, classifying the sands, elevating the coarse sands into the regrinding plant, regrinding and washing these coarse sands, pumping the tailings of this plant to the leaching plant where they are leached, and the disposal of the waste material after being leached. Results for 1917 were as follows:

Tons tailings treated.....	730,543
Pounds per ton in material treated.....	17.06
Pounds copper saved per ton treated.....	12.42
Pounds copper produced.....	9,075,457
Cost per pound copper, excluding smelting and selling.....	5.94c

General

A new electrically operated coal-bridge, capable of handling from vessels 10,000 tons per 24 hours, has been erected at No. 2 coal dock.

During the year 1917 the Calumet & Hecla acquired all of the assets of the Tamarack Mining Company for the sum of \$3,600,000, and the latter company has been dissolved.

The remaining shares of Laurium Mining Company stock, not owned by the Calumet & Hecla December 31, 1916, were also acquired, and dissolution proceedings are in process.

The ten per cent premium and fifty cent bonus for each day worked were continued throughout 1917 and will remain in force until July 1, 1918. This statement of premiums and bonuses also applies to the following Calumet & Hecla subsidiaries: Ahmeek, Allouez, Centennial, Isle Royale, LaSalle, Osceola, Superior and White Pine.

Carp Lake Mine

No work was done at the Carp Lake mine during 1917.

Cass Copper Company

Exploratory work at the Cass was discontinued in August 1917. Eight holes, totalling 10,000 feet, have been drilled. Management states results of exploration were satisfactory, and reason given for stopping work was "drilling completed."

Centennial Copper Mining Company

Results of operations at the Centennial during 1917 showed a marked decrease in total production and in the yield of refined copper per ton of ore treated. Production costs showed a decided increase to 18.35 cents per pound, and there was a very noticeable increase in the percentage of discard of rock hoisted.

Centennial has two shafts; No. 1 is bottomed at the 37th level, 4,000.5 feet from surface; No. 2 shaft is 300 feet below the 38th level, 4,537 feet from surface.

No active mining operations were carried on tributary to No. 1 shaft in 1917.

A No. 2 shaft sinking was continued. Openings, totalling 1,409 feet, disclosed ground poor to fair in quality.

For premiums and bonuses see Calumet & Hecla Mining Co.

Champion Copper Company

Champion again in 1917 led all the producing mines in the district in the yield of refined copper per ton of ore treated, with an average yield of 35.50 pounds. Champion's cost per pound, however, increased from 7.80 cents in 1916 to 10.40 cents in 1917.

Champion is one of the three producing Copper Range mines. The total production of the three mines in 1917 was 45,043,301 pounds, of which Champion produced 27,550,343 pounds. This is a decrease of 6,050,793 pounds from the record production of 1916. Total tonnage hoisted was 814,284 tons, of which 38,248 tons, or 4.7 per cent, was discarded as waste rock. The ground developed by the openings made during the year was of average quality.

Cherokee Copper Company

Exploratory work was continued at the Cherokee throughout the year 1917. About the middle of December, the Directors decided that, in view of the general unfavorable conditions, it would be better to suspend all operations at the mine and to await more propitious times. Results of the work to the end of the year 1917 may be summarized as follows:

The shaft is bottomed at a depth of 450 feet. Drifts were driven northeast and southwest at 110, 220, 320 and 420 feet; total footage of drifts is 653 feet.

Copper of commercial value was found in the shaft from the surface to a depth of 300 feet. The copper follows the foot-wall, and the mineralized area varies from two to five feet in width. From the shaft and the drifts on the 1st, 2nd and 3rd levels, 93 tons of selected ore was obtained, which yielded 7,472 pounds of refined copper.

Above the No. 3 station a fault plane crosses the shaft. The fault was first encountered in the west drift on the No. 2 level; it dips to the east at an angle of about 45° and again appears in the east drift on the 3rd level. The extent of the broken and disturbed ground due to this minor faulting is at present unknown.

When work is resumed, the shaft will probably be sunk to the 6th level, and a drift run to the east, with the hope of finding the mineralized part of the lode, lost at the 3rd level.

Captain John Broan, of Houghton, made a detailed examination of the mine on December 24th. Mr. Broan reported as follows:

"First level East, shows 38 feet of good commercial copper ground.

"First level West, shows 22 feet of good commercial copper ground.

"Second level East, shows 30 feet of good commercial copper ground.

"At this point the drift shows 22 feet of poor ground followed by 3 feet of good copper ground at the breast of drift.

"Second level West good copper ground shows to fault line. At this point the drift went through about 20 feet of poor ground. The face of this drift is showing good commercial copper.

"Third level East, length of drift 90 feet for 35 feet showing a little copper.

"Third level West, 41 feet in poor ground, with about 3 feet good copper ground.

"Fourth level East, 54 feet, some places showing a little copper.

"Fourth level West, 85 feet, showing some copper. East of clay slip about 52 feet from shaft.

"The showing down to where the fault line was struck in the shaft is very good. This fault line has a dip to the east of about 45 degrees and it is reasonable to expect that a continuation of that copper will be found farther east which can be tested by drifting the bottom levels through the broken ground to a front east of the fault line. The showing at the 2nd level west, I considered very important as that drift is breasted in good copper ground, west of the broken ground.

"It is rather unfortunate that the shaft should come down into such broken ground, but that ought not to discourage the stockholders, as some of the best mines of the Copper Country meet with similar conditions, and though having very often to drift hundreds of feet, are well rewarded for it. I think the showing to date warrants further development when conditions are favorable."

Contact Copper Company

Since the completion of diamond drilling in hole No. 21 on June 29, 1916, no further active work has been done at the Contact. At the time of the suspension of the exploratory work, the plans for investigation of the mineralized bed (No. 8 Wyandot amygdaloid) were but partly carried out. As mentioned in the report on the

Copper Industry in 1916, in order to protect the Company's cash resources, further work on the property was suspended, pending results at the Wyandot to the south.

During 1917 additional sales of machinery and supplies were made from the equipment long held in storage. The treasurer's report shows a balance of \$12,006.97.

Copper Range Company

The net income of Copper Range for 1917 amounted to \$4,966,824.97, \$12.60 per share. Dividends paid during the year totalled \$3,943,912.50, \$10.00 per share. Although the copper produced was sold at an average price of 28.735 cents per pound, the highest price ever received by the Company and two and one-half cents per pound higher than in 1916, yet, owing to the reduced production and increased cost, the balance of \$1,022,912.47, added to the surplus from the year's operations, was less by more than a million dollars than the amount added in 1916.

The total production of copper from the Baltic, the Trimountain and one-half of the Champion was 31,268,130 pounds, a decrease from the 1916 production of 6,678,800 pounds.

The reduced production was due to the scarcity and inefficiency of labor. The loss of men was not felt severely until after the draft went into effect. In the third quarter of the year the number of underground men fell off 20 per cent from the number employed in the first quarter, and in the fourth quarter the loss was increased to 24 per cent. Wages were high; coal and other supplies are now costing double the price of normal times. Stamp-mill costs are now more than 100 per cent higher than formerly, and at the present time the cost in all departments of the operation will average about 75 per cent above normal times.

The outstanding feature of the year's operations was the remarkable average yield of 32.97 pounds of copper per ton of ore treated.

During 1917 Copper Range expended \$57,364.32 in diamond drill exploration of lands lying south of the Champion and under option from the St. Mary's Mineral Land Company. President Paine states that no important developments have been made and that the drilling will be continued a while longer.

Copper Range has purchased from Messrs. T. F. Cole and F. W. Nichols surface and mineral rights of certain scattered lands, amounting to 5,050 acres, in Houghton and Ontonagon counties. There has also been purchased the mineral rights on an additional 2,000 acres. The price paid was approximately \$50,000.

Frederick W. Denton, who has been connected with the Copper

Range mines since 1900, most of the time as general manager, retired from active duty as manager August 1, and William H. Schacht, who had been Mr. Denton's assistant for seven years, was appointed general manager of mining operations. Mr. Denton will continue his connection with the Company as vice-president and managing director, with headquarters in Boston.

The Baltic Mine

During 1917 the Baltic Mining Company was dissolved, and all its assets transferred to the Copper Range Company. The mine will henceforth be operated as the Baltic mine of the Copper Range Company.

Results of operations at the Baltic mine during 1917 were as follows:

Net profit for the year amounted to \$1,678,323.39. The average yield of refined copper per ton of ore stamped was 34.47 pounds, the highest in the history of the mine. Of the total tonnage of material hoisted, 119,265 tons, or 27 per cent, was discarded as waste rock. Total production for the year was 11,214,861 pounds.

No. 2 shaft was the chief producer from the main lode. All shafts are now producing from the West lode, with No. 5 the chief producer. Ground opened was of fair quality.

Federal Syndicate Copper Company

The Federal Syndicate Copper Company was incorporated under the laws of South Dakota, October 12, 1916, and was admitted to the State of Michigan April 27, 1917.

The Company purchased 360 acres of land, formerly owned by the Federal Copper Company, consisting of the N. W. $\frac{1}{4}$ and all but the S. E. $\frac{1}{4}$ of the S. W. $\frac{1}{4}$ of section 33, T. 58 R. 31, and the W. $\frac{1}{2}$ of the N. W. $\frac{1}{4}$ of section 4, T. 57 R. 31, Keweenaw County. The property carries the Kearsarge amygdaloid, and the northwesterly dip of this bed at an angle of about 30 degrees gives an underlay on the Federal lands of about 292.5 acres of possible copper-bearing ground.

The Federal intended to explore the Kearsarge amygdaloid and the Kearsarge conglomerate, and in the fall of 1917 a diamond drill was taken in to the property and set up ready for work. The Company was unable to secure 160 acres of land lying to the east, and about December 1, 1917, the drill was taken out, no drilling having been done.

On November 20, 1917, the Federal, under the name of the Bear Lake Extension, secured options on 2,000 acres of land southwest of

Calumet, consisting of the S. W. $\frac{1}{4}$ of section 27, the W. $\frac{1}{2}$ of section 34, T. 56 R. 34 and all of section 3, the N. W. $\frac{1}{4}$ of section 10 and the N. $\frac{1}{2}$ and the W. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of section 2, T. 55 R. 34, Houghton County. These lands adjoin the Longyear options of 1,240 acres in sections 34, 35, 27 and 26, T. 56 R. 34 and the property of the Bear Lake Pool, consisting of 1,360 acres in sections 23, 24, 25 and 26, T. 56 R. 34. No diamond drilling was done during 1917 on these lands, known as the Bear Lake Extension, but exploration will probably be started in February by drilling a hole in section 3.

It is probable, owing to the difficulty of financing three separate explorations on adjoining lands, that the holdings of the Bear Lake Pool and the Longyear options will be consolidated with the Federal Syndicate Copper Company, thus giving a combined acreage of 4,600 acres to be explored by the one organization.

Flint Steel

In the 1916 report on the Copper Industry, it was stated that during the latter part of 1916 the old Flint Steel mine was unwatered for the purpose of examining and exploring the old workings. It was hoped that a thorough examination would result in some activity at the property.

Mr. Samuel Brady states that nothing was done at the property during 1917, and that the mine has been allowed to fill with water again.

Franklin Mining Company

Franklin produced 3,155,574 pounds of refined copper in 1917. Practically all of the ore came from the Allouez conglomerate tributary to No. 1 shaft. The working of a limited number of stopes with an increased number of machines in each, instead of working numerous places with two drills in each place, proved practical and worked to advantage. This plan of stoping was made possible by mechanical haulage, which also greatly increased the output per man and very materially reduced the cost per ton.

Results obtained during the year were such as to encourage the belief that, with two or more shafts operating and with normal conditions as to material and labor, the Allouez conglomerate may be worked at a profit.

The 27th level north on the conglomerate was driven 540 feet to explore new territory, but results were unfavorable. On the 30th level of the Pewabic amygdaloid the north drift disclosed 700 feet of the best ore ever found in the amygdaloid workings. It is expected that the same grade of ore will be encountered in the extensions of the drifts north on the lower levels. A crosscut to test the west

lode on the 37th level had advanced 51 feet January 1, 1918, with a total distance of about 230 feet to drive in order to reach the lode.

No. 2 conglomerate shaft was opened and rebuilt from the 4th level to the bottom at the 17th level. Sinking is now underway.

Hancock Consolidated Mining Company

With two operating shafts, Hancock produced during 1917 a total of 4,005,882 pounds of refined copper, at an average yield of 13.223 pounds per ton of ore treated. Total production showed an increase of 1,180,948 pounds over the production in 1916.

A large amount of development work was done during the year. This work was confined chiefly to exploring the known lodes and opening ground for future stoping.

Electric haulage was installed on the main haulage levels during the year. Six electric locomotives, four of the battery type and two of the trolley type, are now in operation. This electric haulage offset to some extent the scarcity and inefficiency of trammers during the summer and fall. Production was not, however, increased as much as was expected.

No. 2 Shaft

During 1917 about 74 per cent of the ore from this shaft came from the No. 4 "vein." Development work on this lode showed fair mineralization. A little stoping was done on No. 3 west "vein" on the 53rd level, with fair results.

A small amount of drifting and stoping on the No. 2 west "vein" showed the bed to be very narrow and bunched, with a very poor hanging-wall. About 8.9 per cent of the ore from this shaft came from this lode.

The Pewabic "vein" and the No. 1 west "vein" furnished about 17 per cent of the ore from this shaft. Both lodes showed very good mineralization during the year.

About 1,200 feet of diamond drilling was done underground, and some very important results were obtained.

No. 7 Shaft

Stoping and development work were carried on in this shaft on the Pewabic and No. 1 West lodes. About 95 per cent of the ore stamped came from the Pewabic lode and the rest from the No. 1 West.

During the first eight months of the year, a fairly good yield of copper per ton was obtained, but during the last four months of the year, the average yield dropped considerably. Mr. C. E. Weed,

superintendent, states that "this was due to a poor bar of ground about 200 feet wide which seems to extend almost vertically all through that part of the mine." He further states that "south of this bar we are again getting into good ground so that our production from this shaft should increase again rapidly."

Mr. John L. Harris, who had been manager of the Company since its organization, resigned June 1, and Mr. C. E. Weed, formerly superintendent at the Lake mine, was appointed to succeed him.

Houghton Copper Company

During the first nine months of the year, Houghton Copper produced a small amount of ore, and at the same time preparations were being made for a somewhat larger output. It was hoped that this increased tonnage would make possible a further exploration of the property at a little greater depth.

The total production for the year was 179,012 pounds. The yield of copper per ton of ore stamped was 11.45 pounds. The bulk of the production for the year came from the 620 foot level, both north and south of the shaft. On the 820 foot level some good ore was cut south of the winze, and preparations for stoping were made. On the 1,220 foot level fair ground was cut on the Superior lode for a considerable distance north of the winze.

In the latter part of September, operations were discontinued. The fixing of the price of copper by the Government at 23½ cents made it necessary to shut down the mine.

Since it was believed by the directors that the showing in the property warranted further exploration, arrangements were made with the adjoining Superior Copper Company to extend the 19th level of the Superior mine into Houghton Copper territory. Preparations for drifting were begun October 1. The drift is on the West lode. President Paine states that "the undertaking of any further work will depend largely on what is exposed by this drift."

Indiana Mining Company

During the year 1917, all work at the Indiana was confined to the No. 2 exploratory shaft. This shaft was started in the S. W. ¼ of section 21 late in 1916. During 1917, the shaft was sunk 186 feet to a total depth of 310 feet. At the 300 foot level crosscuts were driven for a total distance across the formations of 1,496 feet, 769 feet to the southeast and 727 feet to the northwest.

President Edwards states that "this exploration is supposed to be in the horizon of the main system of Ontonagon County lodes, but,

as no conglomerate was encountered, the geological position of the crosscut has not been definitely established."

Several amygdaloid beds carrying a little copper and one narrow seam carrying heavy copper were cut by the crosscut. Although these beds cannot be considered of commercial value where opened by the crosscut, they are worthy of further exploration by drifting.

Owing to the constant increase in cost of all material and labor, it was decided to suspend all work on the property for the present or until conditions become more favorable.

Isle Royale Copper Company

Operations at the Isle Royale during 1917 resulted in an increase of over one million pounds of refined copper over the production in 1916. The yield of copper per ton of ore treated also increased from 13.4 pounds in 1916 to 14.6 pounds in 1917. Production cost per pound was 15.35 cents. Mining operations were carried on in six shafts.

At No. 1 shaft no sinking was done during the year. Drifts driven during 1917 indicate that about 38 per cent of the ground opened may be available for stoping.

On January 31st miners on the 9th level north blasted into unmapped workings of the old Grand Portage mine which were filled with water. The water rushed down No. 1 shaft, filling it to the back of the 14th level plat and filled No. 2 shaft to a point midway between the 28th and 29th levels. Two men were lost by drowning.

Drifting on the 9th and 12th levels north was stopped because of the proximity to the old Sheldon-Columbia mine which is full of water.

At the No. 2 shaft sinking was continued on a vertical curve to reach the West lode. All drifting during 1917 was in the West lode; about 60 per cent of the ground opened showed copper.

At the No. 4 shaft all work was done on the Isle Royale lode. About 90 per cent of the openings disclosed ground of commercial value. Driving of the crosscut on the 6th level, 200 feet north of the shaft, was continued. Amygdaloid beds were cut at points 334 feet and 411 feet from the Isle Royale lode. (The crosscut is in the foot.) A limited amount of drifting on each of these beds disclosed no copper, and the work was discontinued.

At the No. 5 shaft about 85 per cent of the ground opened in 1917 appears to be of commercial value.

No. 6 shaft was sunk to a point 23 feet below the 19th level. The shaft is in the lode, and the ground at the bottom is of average

quality. About 70 per cent of the ground opened during the year appears to be of commercial value.

At the No. 7 shaft sinking and drifting were continued. About 65 per cent of the ground opened seems to be of commercial value.

In shafts Nos. 4, 5 and 6 preparations were made for the installation of storage-battery locomotives for tramping, on three levels in each shaft.

For premiums and bonuses see Calumet & Hecla Mining Co.

Keweenaw Copper Company

All work during the year 1917 was conducted on the property of the Phoenix Consolidated Copper Co.

No sinking was done during 1917 at No. 1 shaft. Total openings for the year amounted to 1,410 feet. Ground opened varied from poor to good. Stopping was done on the 3rd, 4th, 5th, 6th, 8th and 10th levels east and west, also on the 7th and 12th levels east. General Manager Uren states that "as stopping was continued it was found that the gray part of vein was not of sufficient value as a whole to mine alone, and as the stopes first opened on the red part showed good values, during latter part of year more work was done on the red part of vein which showed better ground than the gray part."

A crosscut north on the 7th level on the old Phoenix fissure showed no copper, but to the south the crosscut showed some copper, and near the end of the crosscut some fair copper ground, containing small mass copper, was found.

For exploratory purposes, 53 diamond drill holes, aggregating 3,063 feet, were drilled.

Total production during 1917 was 380,536 pounds of refined copper. Although at the mill four Wilfley tables were installed to replace older tables, the mill loss was 5.586 pounds of copper per ton of ore stamped. The number of pounds of copper in ore per ton stamped was 14.834, and the recovery per ton stamped was 9.248 pounds.

Scarcity of underground labor during the year made it impossible to maintain an adequate force, and this fact, together with the increasing cost of labor and supplies, resulted in the suspension of all operations for the present on December 1.

Lake Copper Company

The production of the Lake mine during the year ending April 30, 1918, was 1,461,893 pounds of refined copper. This amount is only 27,354 pounds less than the production of the year ending

April 30, 1917. The fixed price of 23½ cents for copper, which became effective in September, 1917, however, caused a decrease of about \$70,000 in the amount received from the sale of the year's production compared with the previous year. At the same time the increased cost at the mine, due to high scale of wages and higher prices for supplies, resulted in a further loss of over \$77,000 compared with the operations of the previous year. Scarcity of mine labor was a serious handicap to operations, and taxes in Ontonagon County continued to be a heavy burden.

Work at the Lake shaft during the year consisted of stoping ground already developed. A total of 711 feet of drifting, 86 feet of crosscutting and 488 feet of raising was done at this shaft during the year. Drifting on the 9th level south and the 10th level north opened up some good stoping ground which continued up only a short distance. Drifting on the 11th level north failed to locate the lode. Crosscuts in the foot on the 6th and 7th levels north opened a small bunch of rich stoping ground which continued up to the 3rd level.

At the Knowlton shaft the work consisted of stoping on the Knowlton lode and drifting on the Butler lode. Stopping has been done from the 2d to the 6th levels inclusive on the Knowlton lode on the east side and also on the 6th level on the west side. Stopes on the 4th and 6th levels on this lode show very rich ground over a width of three or four feet. The 2d and 3rd levels show good copper ground. During the year 110 feet of raising and 84 feet of drifting were done on the Knowlton lode.

On the Butler lode the west drift was advanced 435 feet to a point near the South Lake boundary and was stopped. A stope started on this side is showing fair copper ground. The east drift on the Butler lode was advanced 899 feet during the year; some stretches of good stoping ground are exposed.

The crosscut from which the Knowlton and Butler lodes have been developed will be continued to the Evergreen lode, which should be reached early in August.

The yield of refined copper per ton of ore stamped showed an increase of about two pounds; the yield in 1917 was 23.13 pounds, and the yield in 1916 was 21.14 pounds.

Lake Milling, Smelting and Refining Company

No. 1 Mill, Point Mills

At this plant work has been started on two new stamp units, one for the Isle Royale Copper Company and one for the Hancock Consolidated Mining Company.

As additional power will be required, contracts have been let to electrify the entire plant, thereby introducing a decided fuel economy, as the exhaust steam from the stamps will be utilized in a mixed-flow pressure turbine which will operate a 2,000 kilowatt electric generator.

A 30,000 gallon motor driven centrifugal pump for furnishing water for the entire mill will also be installed. The pump intake will be located at the extreme west end of the property, making the area in front of the mill available for sand room when the present pump is out of commission.

No. 6 Chilian mill was replaced by a Hardinge conical mill, and the roof over No. 1 and No. 2 stamp units was raised to give necessary head room for compounding these stamps when desired.

No. 2 Mill, Hubbell.

At this mill the first unit of the two stamp addition went into commission October 1 and is at present stamping Allouez ore. The second unit is completed, with the exception of concentrating machinery.

Work has been started on a tailings pumping plant, located near the outer edge of the sand bank, which, when completed, will be available for pumping mill tailings further out into Torch Lake when the present area for launder discharge is exhausted. This plant is being built jointly by the Osceola Consolidated Mining Company, the Lake Milling, Smelting and Refining Company and the Calumet & Hecla Mining Company.

LaSalle Copper Company

Results of operations at LaSalle during 1917 showed a larger tonnage of ore treated than in 1916, an increase of almost a pound in the yield of refined copper per ton of ore treated, and a noticeable increase in the pounds of refined copper produced. Production and delivery cost of copper delivered was 20.14 cents per pound, so that the gain on copper delivered was only 8.31 cents per pound. The average yield of refined copper per ton of ore treated was still low, being 10.38 pounds.

At the No. 1 shaft the stopes continued lean, with occasional limited areas of fair quality. No. 1 shaft supplied 70 per cent of the total product of the mine for the year.

At the No. 2 shaft sinking was resumed late in April, after the installation of the larger hoist. The shaft was sunk 163 feet in foot-wall trap, but throughout this distance there was exposed from

two to four feet of the foot side of the lode, which showed fair mineralization.

The 17th and 19th level drifts north of the shaft showed fair stoping ground, although both became leaner as the Osceola boundary was approached. In the drifts to the south, fair copper ground continued 700 feet from the shaft on the 17th level and 800 feet on the 19th level. Beyond these points the 17th level was driven 600 feet and the 19th level 100 feet, with practically no copper being disclosed. At the end of the year the 21st level was in good ground at a distance of 140 feet on each side of the shaft. Stopping was continued throughout the year on the 15th and 17th levels in fair ground, which supplied about 72 per cent of the total product from this shaft.

Osceola Lode Exploration

The exploration of the Osceola lode in LaSalle territory was continued until the end of November, when it was stopped on account of difficulties of operation. The 42nd level south of the Osceola No. 6 shaft was extended 466 feet, to a point 1,158 feet south of the Osceola boundary, or 4,443 feet from the No. 6 Osceola shaft. The ground was found to be poorer than that previously opened, much of it being of no value. The 45th level was driven 713 feet into LaSalle territory, to a point 3,593 feet from No. 6 Osceola shaft. This work opened fair to good ground, corresponding with that in the openings directly above.

LaSalle ore was stamped at the No. 1 mill of the Lake Milling, Smelting and Refining Company, and there was no lack of stamping facilities at any time during the year.

For premiums and bonuses see Calumet & Hecla Mining Co.

Longyear-Michigan Exploration Company

This company holds options on 1,240 acres of land in sections 26, 27, 34 and 35, T. 56 R. 34, Houghton County.

In the latter part of the year 1916, a diamond drill hole was put down in the N. E. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ of section 35. The hole was drilled through sandstone to a depth of 1,000 feet and disclosed no copper.

See Federal Syndicate Copper Company.

Mass Consolidated Mining Company

Scarcity of labor throughout the year was responsible for the marked decrease in production at the Mass. In January the average number of men employed underground was 409. This number

gradually decreased until in August there were only 232 men, a decrease of over 43 per cent. During the latter part of the year the number increased slowly, and in December the average number of employees was 372. Conditions underground continued very satisfactory throughout the year, and had it been possible to obtain sufficient labor, results would have been very much better.

The main Butler lode and branches produced 163,310 tons of ore, the Evergreen lode 74,733 tons, and the Ogima lode 6,628 tons, making a total of 244,671 tons from all lodes. Total production of refined copper was 3,984,616 pounds. The cost per pound was 19.81 cents.

Considerable more development work was done in 1917 than in 1916, so that the reserves were appreciably increased. Considerable work was done on the Evergreen lode on a number of levels, and the lode has shown good values where opened on all the levels. Superintendent E. W. Walker states as follows:

"The Evergreen lode was first opened on the 5th level at 'C' shaft, in 1916. With the new openings on this lode at the 3rd, 7th and 9th levels and the character of the rock exposed by drifting and stoping, it seems reasonable to assume that a new mine has been opened at this end of the property which can be operated through our present 'C' shaft. Crosscuts to this lode will be driven on the lower levels as required."

A large quantity of mass copper was obtained from the Evergreen lode during the year, accounting in part for the large proportion of mass copper produced, which amounted to 29.7 per cent of the gross mass and "mineral."

The mineralization of the Butler lode, as shown in the drifts and the bottom of C shaft, was very good.

As soon as labor conditions permit, work will be started on a new shaft at about 1,800 feet west of C shaft.

Three dividends of \$1.00 each were paid during the year, amounting to \$291,915.

Mayflower Mining Company

See Mayflower-Old Colony Copper Company.

Mayflower-Old Colony Copper Company

The new Mayflower-Old Colony Copper Company is a consolidation of the Mayflower Mining Company and the Old Colony Copper Company. The consolidation was made for the purpose of exploring and developing, by means of a shaft, the mineralized formation

disclosed by the extensive diamond drill campaigns, previously conducted on both properties.

The preliminary work of preparing the location for a shaft was undertaken in April 1917. The site of the shaft is about 300 feet west and 250 feet south of the quarter post between sections 8 and 17, T. 56 R. 32, on the line formerly dividing the properties of the two companies.

Considerable time was spent in repairing old dwellings, constructing railroad connections and a dam, in erecting the necessary buildings for the mine plant and in assembling and installing the necessary equipment.

In sinking for the shaft, the overburden was found to be 13½ feet deep. The shaft, below the concrete collar, is 20 feet by 8 feet 10 inches. It is constructed for two skip roads and one ladderway, and is being sunk on a dip of 80 degrees. At the end of the year it had reached a depth of about 261 feet.

Michigan Copper Mining Company

Operations at the Michigan mine during 1917 were continued according to the plans undertaken in 1916.

The triple compartment E shaft was sunk to a point below the 8th level, and on several of the drifts south from the shaft at the different levels, the Butler, Ogima and Evergreen lodes were explored. These lodes seem to indicate a general mineralization of the territory commanded by the shaft and thus far have proved of commercial value. Results for the year were very satisfactory and most encouraging.

Development work was pushed on the 6th level, especially on the Ogima lode east and west and upon the Evergreen lode east of the main crosscut, where work on this level has been largely concentrated. Results were very encouraging.

Crosscuts have been completed as far as the Ogima lode upon the 5th, 7th and 8th levels, and also upon the 6th level as far as the Evergreen lode. Drifting upon the Ogima on the 5th and 7th levels has not yet exposed mineralization equal to that found on the same lode on the 6th level, but better results are expected when the work becomes more extended.

Upon the Butler, or most northerly one of the three lodes thus far opened, the rich shoot of ore opened in 1916 to the east of the shaft on the 5th level, after having been traced through from the 6th level, was enlarged in extent, and, by crosscutting a short distance to the north from the east drift on the 4th level, its presence there was proved, carrying the same high values as upon the lower levels.

These bunches or patches of rich ground, two of which have thus far been opened, seem to be associated very intimately with the strong shear lines characterizing the locality of the shaft.

About 75 feet of work on the Butler lode at the 2nd level west of E shaft has disclosed there very favorable conditions, and, at the present time, a considerable quantity of rich stamp material and mass copper is now being obtained at this point.

During the year, 188 feet of new ground was opened by drifting east on the Evergreen lode on the 6th level. This work disclosed a very wide and strong lode, carrying stamp material and mass copper in satisfactory quantities, especially in and near the characteristic cross fractures. In some places the lode was found to be from 16 to 18 feet wide, with copper still showing in the hanging. Since production was started, stoping upon this lode has presented many surprises in regard to the richness and width of the copper-bearing ground.

Shipments of ore to a custom mill from the stockpile of about 6,000 tons were begun November 22. These stockpile shipments were continued until February 12, 1918, when they were replaced by shipments of ore direct from the stopes on the Butler, Ogima and Evergreen lodes on the 5th and 6th levels. A total of 4,876 tons of stockpile ore was shipped and treated; results showed better than 25 pounds of ingot copper per ton of ore stamped. A total of 2,777 tons of ore, taken from the stopes now being opened in the mine, showed a somewhat higher yield of refined copper than the stockpile ore.

The future outlook of the Michigan continues most promising, and at nearly all points where openings have been made, the copper-bearing ground continues to prove to be of somewhat exceptional richness.

Mohawk Mining Company

Mohawk's total production for 1917 amounted to 12,313,887 pounds of refined copper. Mass copper produced totaled 574,600 pounds, and the average yield per ton of all ore stamped was 20.35 pounds. The total cost per pound of refined copper produced and marketed was 11.32 cents.

No. 1 shaft contributed 20 per cent, No. 2 shaft 3 per cent, No. 4 shaft 21 per cent, No. 5 shaft 23 per cent, and No. 6 shaft 33 per cent of the total tons of ore stamped.

New openings in No. 1 shaft, as a whole, did not show any improvement in mineralization and indicate the necessity of picking out a large amount of poor material underground. Since labor for

this work was scarce, mining operations were confined as much as possible to the better blocks of ground in the upper levels.

Operations at No. 2 shaft were carried on largely in ground which would not be accessible from No. 1 shaft. Scarcity of labor prevented the completion of the work toward eliminating entirely hoisting from No. 2 shaft, and the shaft was closed down temporarily in July.

The exploration crosscuts on the 21st level, at a point 670 feet south of No. 2 shaft, were extended but were discontinued early in the year. The crosscut west, or in the hanging, had reached a distance of 791 feet, and the crosscut east a distance of 1,112 feet. About 16 amygdaloids were intersected by the crosscuts, but none indicated mineralization worth further exploration.

The new openings in Nos. 4, 5 and 6 shafts showed the lode to be of excellent quality, and an improvement in mineralization was noted in general throughout all the new openings. The drifts in Nos. 4 and 5 shafts continued to show a slightly better average in copper than those in No. 6 shaft.

Stoping on the mass fissure vein, encountered on the 8th level south of No. 6 shaft, was carried up to the 7th level. Considerable mass copper was recovered, and the main lode was found to be greatly enriched in its vicinity. The fissure was drifted upon for a distance of 213 feet and 32 feet into the hanging on the 7th and 9th levels respectively, but the heavy mineralization did not extend to any great distance beyond the hanging wall of the main lode. There is sufficient copper in evidence in the fissure at the ends of the present drifts to warrant the extension of these drifts and possibly others on lower levels, as soon as sufficient labor is available.

Naumkeag Copper Company

Operations at the Naumkeag were continued during 1917, and a total of 3,440 feet of work was done during the year.

The bed upon which shaft "A" was sunk, and the 250 feet of drifting done on the same bed, showed only a little copper, less in amount than the mineralization indicated by the diamond drill holes which originally cut this particular bed.

On the 400 foot level 1,806 feet of drifting was done on the Pewabic lode, 830 feet of crosscutting and about 170 feet of drifting on another bed. Two crosscuts were driven at a point about 900 feet north of the shaft, one to the east and one to the west, each about 250 feet long. The west crosscut will be extended about 200 feet to cut No. 15 conglomerate. In this crosscut No. 2 to the west.

a bed was cut, carrying small masses of copper up to 200 pounds in weight, but drifting showed the mineralization to be local.

The best copper-bearing ground on the 400 foot level was disclosed from a point 750 feet north of the shaft to 1,100 feet north of the shaft, all showing fair copper ground.

New Arcadian Copper Company

Because of the unusual rise in the price of material and the high cost and great demand for labor, the plan to place the New Arcadian on at least a limited producing basis in 1917 was abandoned, and operations were reduced to a minimum.

From the stockpile, which had accumulated during development work, there was shipped, taking the run of the pile, some 4,900 tons of ore which yielded 53,278 pounds of refined copper.

The shaft was sunk 392 feet during the year and is now bottomed at 1,860 feet, stations having been cut at the 1,700 foot and 1,850 foot levels. On the 1,500 foot level, drifting, both north and south, was carried on to a limited extent (443 feet) in ground of fair mineralization. A crosscut was also extended west on the 1,500 foot level 175 feet to the Old Arcadian vein, on which 80 feet of drifting was done in badly faulted ground.

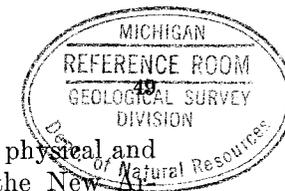
On the 1,700 foot level, a crosscut is being extended east to cut the No. 8 conglomerate, which was found to be mineralized where exposed on the 900 foot level. The crosscut has been driven 320 feet and should cut the No. 8 conglomerate within the next 100 feet.

At a distance of 47 feet east in this crosscut on the 1,700 foot level, a well mineralized bed, 10 feet in thickness, was passed through, which, from its general appearance, is believed to be the New Arcadian lode. H. W. Fesing, mining engineer at the mine, states as follows:

"As this vein was encountered much sooner than expected, a decided change in dip was the only explanation, which is apparently borne out by the fact that a vein well charged with copper in similar appearance was exposed in sinking the shaft below the 1,700 foot level, from 1,730 feet to 1,760 feet.

"In cutting the station at the 1,850 foot level, a very marked fault, running about north and south and with a hade of about 85 degrees to the east, was encountered, thus accounting in part, at least, for the decided change in dip of the vein noticed at and below the 1,700 foot level.

"Crosscutting both east and west on the 1,850 foot level was undertaken, with the result that an amygdaloid about 18 feet in thickness and very heavily charged with copper, was encountered



in the west crosscut at a distance of 47 feet. From its physical and mineral bearing characteristics, this is undoubtedly the New Arcadian vein, which heretofore has always been found from 100 feet to 150 feet east of the shaft, on all levels above the 1,700 foot."

New Baltic Copper Company

On account of the abnormal conditions, due to the war, and especially because of the great increase in cost of labor, fuel and supplies, operations at the New Baltic in 1917 were somewhat limited. Exploration and development work, however, were continued throughout the year.

At a depth of 270 feet, which corresponds with the 250 foot level of the New Arcadian mine, a station was cut, and active exploration was undertaken at this point. From the appearance and general character of the lode exposed in sinking the shaft, it was thought that the bed in which the shaft is sunk was the New Arcadian lode. Further work, however, demonstrated that this is not the New Arcadian lode but a parallel lode about 30 feet above or west of the New Arcadian lode. The New Arcadian lode where cut was found to be very heavily charged with copper of commercial grade and showed a thickness of from 6 to 12 feet, averaging about 8 feet.

Drifts were run north and south on the New Arcadian lode for a total distance of 420 feet, of which 270 feet were south and 150 feet north of the shaft. While more or less copper was in evidence all the way, the chief values seem to be concentrated in a shoot about 200 feet in length, 40 feet of which is north and 160 feet south of the shaft. The richest ground opened is in the vicinity of the shaft.

In order to further test the ground, a few small raises were put up both north and south of the shaft, with the result that a considerable quantity of "barrel work," in addition to stamp material, was obtained.

As a result of the development work, it was deemed advisable to extend the shaft; sinking was resumed about March 1, 1918.

Soon after sinking was resumed, copper again appeared in the foot of the shaft, which is carrying three or four feet of the hanging of the lode. On the next lower level, further work will be done on the hanging-wall lode, as well as on the New Arcadian lode to the east.

North Lake Mining Company

Exploratory work was carried on continuously throughout the year 1917 on the 800 foot level. On January 1, 1918, the face of the northwest crosscut was 1,695 feet from the shaft, and the face

of the southeast crosscut was 1,410 feet from the shaft, making a total distance of 3,105 feet across the formation that has been explored by the 800 foot level crosscut. The foot-wall of No. 6 conglomerate is at the shaft on the 800 foot level, consequently the total length of the northwest and southeast crosscuts represents the horizontal distance that has been explored above and below the foot-wall of No. 6 conglomerate.

The amygdaloid which showed fair copper values, where cut by the southeast crosscut at 679 to 728 feet from the shaft, was drifted on east and west for a total distance of 384 feet. Some good ore was taken out, but the average was low grade.

Several amygdaloid beds carrying copper were cut by the northwest crosscut, but no drifting was done to determine their value, as it was thought advisable not to interrupt the crosscutting until the Butler lode is reached.

The next amygdaloid to be cut by the southeast crosscut should be the one that showed very good copper values where encountered in the diamond drill holes, and the northwest crosscut should reach the Butler lode within the next 200 feet.

Old Colony Copper Company

See Mayflower-Old Colony Copper Company.

Onondaga Copper Company.

Onondaga has not done any exploratory work since August 1916, and it is not probable that diamond drilling will be resumed until conditions are more normal.

The Company has about \$30,000 on hand.

Osceola Consolidated Mining Company

The total production of Osceola for 1917 was 16,084,958 pounds, compared with 19,586,501 pounds in 1916. Besides this marked decrease in total production, the yield of refined copper per ton of ore treated also dropped from 15.2 pounds in 1916 to 13.0 pounds in 1917. Operations at all three branches, however, resulted in a substantial profit for the year.

Osceola Branch

The total production from the Osceola branch was about 25 per cent less than that of 1916. A very low grade of ore was encountered in the workings during the middle of the year, and the average yield of copper per ton of ore treated in 1917 was 12.38 pounds.

No. 3 shaft and surface plant remained idle all the year. No. 5 shaft was kept in repair as a safety outlet, and mining operations were carried on in No. 6 shaft only. The most active and the most productive part of the mine was that above the 46th level and nearest to the extreme south and west boundaries.

The 42d level was driven into LaSalle territory to a point 1,158 feet beyond the LaSalle boundary line and was stopped in May. The 45th level, also in LaSalle territory, was stopped in November, at a point 713 feet beyond the boundary line.

New openings were kept ahead of immediate requirements, with the view of getting the extreme south workings properly opened for a retreating stoping system. This aim will have been accomplished by the early part of 1918, so that during the greater portion of 1918, it will be possible to reduce development work considerably and concentrate on stoping.

North Kearsarge Branch

With the exception of the year 1916, North Kearsarge produced more copper and made a larger profit in 1917 than in any other year since 1911. The grade of ore treated was low, 12.54 pounds per ton of ore treated, which contributed to higher costs per pound of copper recovered.

All three shafts were in operation throughout the year, with only slight interruptions. No. 1 shaft was sunk below the 38th level, but on drifting has been done below the 35th level. In No. 3 shaft most of the product in 1917 was taken from the upper levels. At No. 4 shaft all levels were worked to as great an extent as the scarcity of laborers would permit.

To partly offset the scarcity of labor, power haulage will be installed. Three storage-battery locomotives with five ton tram cars will be put in operation in No. 4 shaft. If they prove successful, similar equipment will be provided for No. 1 and No. 3 shafts.

If nothing unforeseen occurs to prevent, this branch should make a further increase in tonnage during 1918, as it is expected that a considerable number of men can be transferred from the South Kearsarge branch when no longer needed there.

South Kearsarge Branch

Production at South Kearsarge in 1917 was 4,900,781 pounds, nearly one-third less than that of 1916. Operations were very seriously hindered by snow storms in the early months of the year, and trammers were very scarce during the summer and fall. Nearly half the tonnage came from foot-wall work and from the backs of

old stopes, and was nearly all low grade material. The branch, however, made a substantial profit in 1917.

Less than 100,000 tons was mined from shaft pillars, leaving about 500,000 tons available in the mine. As soon as the ground under the bottom level of No. 1 shaft along the Wolverine boundary had been mined, it will be possible to mine shaft pillars more rapidly.

For premiums and bonuses see Calumet & Hecla Mining Co.

Quincy Mining Company

The production of the Quincy mine during the year 1917 was 1,280,837 tons of ore, which yielded 17.33 pounds of copper per ton. Total production of refined copper was 22,195,577 pounds. The proportion of mass copper to stamp material continued about the same as for the year 1916. The output was largest during the first four months, before the declaration of war and before the selective draft became effective, both of which decreased the underground working force.

Openings throughout the mine in 1917 totaled 26,900 feet; the shafts were sunk a total of 499 feet. The openings on the various branches of the Pewabic lode were made at a great many different points and developed ground of average mineralization, with the usual quantity of mass copper.

No. 7 shaft was used only for the operations of the Hancock and for the bailing of a small quantity of water.

No. 2 shaft was sunk 179 feet and produced 452,290 tons of stamp material. In all the drifts and openings on the several branches developed, especially on the bottom levels, fair grade ore was found, some portions showing well in "barrel work" and mass copper. On the 65th level on the west branch considerable new ground was opened. The 73rd, 74th, 75th, 76th and 77th levels are opened on the main branches and average fair in copper.

No. 6 shaft was sunk 125 feet and produced 428,250 tons of stamp material, of a slightly better grade than in 1916, and with a little greater percentage of mass copper. The drifts on the lode averaged fair in copper. Some sections are rich in mass copper, with a general average about the same as in the previous two years. All the bottom levels show a satisfactory grade of ore, with openings on only one of the branches.

No. 8 shaft was sunk 195 feet and produced 400,296 tons of fair to low grade stamp material. The lower levels in this shaft are showing the best mineralization.

There are many very long levels in the mine that make hand tramping expensive. For this work electric locomotives, hauling

tram cars in trains of four cars each, have been in use for about 15 years. There are now 25 locomotives in operation in the mine.

In order to maintain the hoisting capacity of the shafts as they become deeper, the capacity of the skips was increased early in the year by an addition to the top, thus avoiding the necessity of changing any of the loading or dumping devices in the shafts or rock-houses. The average weight of ore loaded per skip is seven and one-quarter tons.

The No. 2 and No. 8 hoisting engines are gradually approaching the limit of their capacity in depth for hoisting. Therefore, early in 1917, a large new modern compound condensing hoist was ordered of the Nordberg Manufacturing Company for No. 2 shaft, with a hoisting capacity of ten tons load from a depth of 10,000 feet. It is expected that the hoist when completed will reduce the cost of hoisting with increasing depth below the present cost of hoisting at the lesser depth.

The Quincy & Torch Lake Railroad handled 1,390,000 tons of ore, 90,000 tons of coal and 2,200,000 feet of stull timber during the year.

The stamp-mills operated satisfactorily throughout the year. Early in 1917, Mr. Ralph Hayden, formerly with the Anaconda, was appointed superintendent of the stamp-mills.

Seneca Copper Corporation

The Seneca Copper Corporation was incorporated December 26, 1916, and was organized to take over the shares of the Seneca Mining Company owned by the Calumet & Hecla Mining Company. The Company now owns 11,960 shares of the 20,000 shares of the Seneca Mining Company.

The eastern office of the Company is in New York City. The officers are Frederick Lewisohn, president; Walter Lewisohn, vice-president and treasurer, and E. J. Macnamara, secretary. The directors are Hamilton Fish, Jr., T. F. Cole, F. de C. Sullivan, P. A. Clarke and W. F. Bartholomew.

The property of the Seneca Mining Company, the controlling interest of which is held by the Seneca Copper Corporation, consists of 1,880 acres, lying north of the Mohawk and the Ahmeek and northwest of the Gratiot. This large tract carries the Ashbed, the Allouez-Pewabic bed, the Allouez, Calumet and Kearsarge conglomerates and the Osceola and Kearsarge amygdaloids.

In June 1917 work preparatory to sinking of a shaft was begun, to develop the Kearsarge lode. The site selected for the shaft is in the southeastern corner of the property, adjoining Ahmeek and Mohawk,

in the southeast corner of the N. E. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ of section 28. The shaft, which will consist of three compartments, will be sunk vertically from surface and at depth will curve to conform to the dip of the Kearsarge lode which outcrops in the S. E. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ of section 23.

During the summer, fall and early winter preparatory work was carried on under numerous difficulties. By December 1st practically all the surface buildings had been erected, and, with the completion of the spur connecting the mine with the Keweenaw Central, machinery and other equipment was ready for installation. Shaft sinking will probably begin early in 1918.

South Lake Mining Company

Openings at the South Lake during the year 1917 totaled 2,520 feet. Since shipments began in May 1916, there had been sent to the mill up to December 31, 1917, a total of 68,388 tons of ore, which produced 754,443 pounds of refined copper, at an average yield of 11.03 pounds per ton. The average yield per ton can no doubt be increased by proper selection of ore. Recovery for December 1917 was 14.5 pounds per ton and for January 1918 it was 16 pounds of refined copper per ton. Adding the average production from mass copper of three pounds per ton, the average yield of refined copper per ton for December 1917 and January 1918 would be increased to $17\frac{1}{2}$ and 19 pounds respectively. If this average can be maintained, profitable production is assured when openings have been made and equipment installed for operations on a larger scale.

The east drift on the South No. 3 lode at the 600 foot level was extended and holed through to the Lake mine. This work proved that the No. 3 lode is the extension of the lode drifted upon by the Lake. Some good copper ground was opened along this drift, but, on account of the long tram, stoping is not advisable until some system of mechanical haulage can be installed. With the exception of this drift, all work during 1917 was on the north dipping lodes. Although production was continuous, it must be considered as incidental to the opening of the lodes. Opening work must be pushed further before sufficient selection can be made to insure profitable production.

The Butler lode was opened on the surface level by a crosscut into the bluff from the collar of the shaft, on the 300 foot level and on the 600 foot level. It shows better mineralization than any of the other lodes, the higher yield per ton mentioned above for December

and January being due to larger proportion of ore from the Butler lode.

South Lake has entered into a contract to purchase at \$90,000 the 166 acres of land to the north of the present property. To furnish funds for this purpose and to pay floating indebtedness, an issue of capital stock was offered to the stockholders at \$2.00 per share. The acquisition of this property will enable South Lake to proceed with plans for more economical operation by means of an incline shaft on the Butler lode. It also gives control of a large area, carrying the Knowlton lode, which can be developed from the Butler shaft.

Superior Copper Company

Results at the Superior in 1917 showed a total production of 2,201,672 pounds of refined copper, an average yield per ton of ore treated of 16.99 pounds, and a production cost of 16.54 cents per pound. Gross income from 1917 operations was \$214,094.62.

Owing to the many difficulties encountered, which made sinking very slow and expensive, it was decided to discontinue sinking No. 1 shaft at the 31st level instead of at the 33rd level as planned. All development work during 1917 was confined to the west lode. Extension of the 21st level south opened about 200 feet of stoping ground, and, after drifting about 50 feet into barren ground, this level was discontinued. The 23rd level was extended 1,005 feet south to a point about 1,450 feet from the shaft.

The shoot of copper, opened on the levels above in this shaft, was found on the 23rd level, and, while 200 or 300 feet of it was of stoping quality, results were somewhat disappointing. The drift is being continued in lean ground.

On the 31st level, at which point extensive explorations will be made, drifting was carried on for a distance of about 700 feet to the south, but nothing of value was disclosed.

No work was undertaken at No. 2 shaft during the year 1917.

There remains approximately 150,000 tons of ore to be stoped, but the future of the mine depends upon developments on the 23rd and 31st levels south of No. 1 shaft.

For premiums and bonuses see Calumet & Hecla Mining Co.

Tamarack Mining Company

In 1917 the Calumet & Hecla Mining Company acquired all of the assets of the Tamarack for the sum of \$3,600,000, and the Tamarack Mining Company has been dissolved.

Trimountain Mining Company

Trimountain's production for 1917 showed a decrease of 2,442,461 pounds from the record production of 1916. The yield per ton dropped to 23.72, and the cost per pound increased to 15.22 cents. Net profits for the year amounted to \$848,241.06.

All openings made during the year 1917 were in ground of average quality.

The Trimountain Mining Company was ordered dissolved by the Circuit Court for the County of Houghton, Michigan, in January 1916. The dissolution ordered was appealed by dissenting stockholders, representing three-tenths of one per cent of the capital stock. In March 1918 the Supreme Court of Michigan reversed the decision of the Circuit Court, so that henceforth the Trimountain Mining Company will continue to be operated as a separate corporation.

Victoria Copper Mining Company

The production of refined copper for the year 1917 was 1,612,640 pounds, or 49,192 pounds less than the record production of 1916. This decrease was due to limited stoping ground at the first of the year, but chiefly to the great scarcity and inefficiency of labor. The shaft and hoisting capacity is now sufficient for double the year's production. Operations for the year 1917, including expenditures of \$28,176.95 for construction and development of water power, showed a profit of \$70,224.91.

More development work was done during 1917 than in 1916, but not as much as was hoped would be done, because of the unusual labor conditions. Reserves, however, are well ahead of stoping requirements.

During the latter part of the year there was a slight improvement in the copper yield per ton of ore stamped, but this required a greater amount of underground sorting.

Both the No. 2 shaft and the second compartment of the same shaft were completed to 50 feet below the 27th level, the stations cut and the drifts started. In the fall of the year a drift was driven east approximately 100 feet from the 19th level north crosscut, presumably on the Butler lode. Some copper was found but not of commercial value.

At the stamp-mill an addition was built, and 15 new concentrating slime tables were installed. Six old concentrating tables were rebuilt with new head motions and rearranged to have ample concentrating machinery for the crushing capacity of the mill. The mill is now in a position to handle a larger tonnage.

White Pine Copper Company

Production of the White Pine for the year 1917 was 4,067,529 pounds, compared with 4,207,449 pounds in 1916. The yield of refined copper per ton of ore treated was 19.11 pounds, compared with 22.27 pounds in 1916 and 24.76 pounds in 1915. Gross income from 1917 operations was \$442,085.78.

No. 2 shaft was sunk 755 feet during 1917. The upper part of the shaft is vertical, but at a depth of 581 feet from surface, a curve was started toward the south and continued for 392 feet. The lower end of this curve is 146 feet south of the vertical part of the shaft. At this lower end, which is 973 feet from surface, a tangent to the curve was started, and the shaft bottomed at a depth of 1,078 feet from surface at the end of the year.

During the sinking of the No. 2 shaft, the gray sandstone was cut at 800 and at 900 feet from surface. Drifts were started at these two points towards the southwest. On the 800 foot level the ground opened seems to consist of large blocks broken from the lode by faulting. On the 900 foot level a more even and better mineralized lode was disclosed. This level was extended in the lode for 39 feet, disclosing ore of fair quality. The 900 foot level is now being extended to the west and east. All of the ground encountered by the No. 2 shaft is badly faulted, and it will be necessary to continue the shaft some distance further before settled ground may be found.

No. 3 shaft was not sunk during the year. Two levels, "A" and "B," were started in the lode from the shaft at 100 feet and 50 feet respectively above the first level. "A" level was driven west 255 feet and east 170 feet, and "B" level west 398 feet and east 150 feet, all in ground of average quality. Drifting on the 3d lode showed good ground on the 3d level west, faulted ground carrying only fair copper values on the 4th level west and east, and ground of poor quality on the 5th and 6th levels.

No sinking was done in No. 4 shaft during 1917. Development work was confined to the upper levels, as the two lower levels, the 5th and 6th, were stopped in close proximity to the main fault. The first level was extended east 430 feet through ground of poor quality. On the 2d level east and on the 2½ level east the third lode showed fair ground. The 4th level was extended east 678 feet in the first lode; the lode was faulted, narrow, and carried only fair copper values.

Approximately 1,000 feet of diamond drilling was done on the 4th level east to explore the 2d and 3d lodes. In general the ten holes drilled showed the 2d lode to be of fair quality and the 3d lode poor.

Experiments with the flotation process were carried on at the stamp-mill most of the year. Results were sufficiently encouraging to warrant treatment of all tailings by this process, although only low grade concentrates were obtained and smelting costs will be high. Sufficient Wilfley tables will be removed to make room for a 600 ton flotation unit of the Minerals Separation type. Additional power will be furnished by a triple expansion engine and two of the pebble mills will be converted into ball mills for finer grinding. An addition to the mill was built to house two Dorr thickeners. The adoption of the flotation process will result in greater metallurgical efficiency but increased milling costs. It is hoped that the new changes will result in making available as ore, large tonnages of slate and 2d lode material now too low in copper content to mine at a profit.

For premiums and bonuses see Calumet & Hecla Mining Co.

White Pine Extension Copper Company

Exploration and development work were continued throughout the year 1917. Results were interesting and furnish valuable information as to the future prospects of the property.

The shaft was sunk 196 feet to a total of 438 feet. Drifting was carried on to north and south on the 2d and 4th levels, for a total distance of 3,344 feet.

As the drifting on No. 2 shale, the main lode, advanced, samples were taken across the entire width at the breast of the drift at intervals of from five to ten feet, as near as possible with due regard to irregularities in width of lode, caused by slight faulting. Drifting averaged 4.8 feet in width, including an average of 0.9 feet in width of barren brown shale along the hanging which broke with the lode. All assay reports include this barren shale. The results of sampling showed an average of $21\frac{1}{2}$ pounds of copper per ton as a mean average for all drifting. There is considerable variation in mineralization, a number of returns showing 40 pounds copper per ton and a few as high as 48 to 60 pounds per ton.

Starting from about 700 feet north of the shaft on the 2d level and at 350 feet north of the shaft on the 4th level, an appreciable decrease in mineralization of the No. 2 shale, or main lode, was noted. This indicates an area averaging only $13\frac{1}{2}$ pounds per ton, in which drifts were driven 558 feet on the 2d level and 330 feet on the 4th level, with no apparent improvement in mineralization at the north end of the drifts. Eliminating this poor area, there is to the south a total of 3,121 feet of drifting, 2,131 feet on the 2d level and 990 feet on the 4th level, which averages 23.5 pounds of

copper per ton, as compared with an average of 21.5 pounds of copper for all drifting.

At intervals of 100 feet along the drift on No. 2 shale short crosscuts were driven into the hanging to test No. 1 shale, and at every 200 feet crosscuts were driven into the foot to test No. 3 sandstone. Samples were taken on both of these beds in the same manner as previously described for No. 2 shale.

A total of 23 observations on No. 1 shale on the 2d level and 11 on the 4th level gave returns varying from 6 pounds to 20 pounds per ton, an average of 12 pounds of copper per ton for an average width of 5.7 feet.

A total of 10 observations in crosscuts on No. 3 sandstone on the 2d level gave returns varying from nothing to 28 pounds per ton and a width varying from 1.6 to 3.0 feet. In the crosscut at the shaft and also in the crosscut 100 feet north and 100 feet south, the average width was found to be 1.6 feet, with 60 pounds of copper per ton. A drift of 40 feet on the 2d level showed a width of two feet but no copper. This No. 3 sandstone has shown no mineralization on the 4th level and in some crosscuts cannot be identified.

To ascertain whether both No. 1 and No. 2 shales can be stoped without breaking the intervening six foot layer of barren sandstone, stopes were made on the 2d level at 240 feet north of the shaft. The stope on No. 2 shale is 60 feet long and 45 feet high, and the stope on No. 1 shale is 60 feet long and 60 feet high. The greater part of the broken ground was withdrawn and after several months' time the walls appear to stand up well. There is, therefore, every reason to believe that both shales may be stoped simultaneously if desired.

The main crosscut on the 4th level at the shaft was extended west of the shaft 63 feet, thus cutting across the formation a distance of 158.5 feet from the foot of No. 2 shale. A conglomerate was encountered at 105 feet to 125 feet below No. 2 shale, otherwise the crosscut was in sandstone, and no mineralization was noted.

Reviewing the results of operations to date, February 23, 1918, General Manager Theo. Dengler states as follows:

"The information obtained so far from openings made are such as will warrant the statement that only No. 2 shale can be seriously considered as a mining proposition at least during the present time, with the scarcity of labor, high wages and cost of materials prevailing; that the property must be worked on a large daily tonnage of at least 1,000 tons to afford commensurate returns. To attain this will require sinking of two shafts simultaneously, a large amount of underground opening work and the construction of a modern flotation

mill, but before this work is undertaken, arrangements should be made for the construction of many houses with modern conveniences to induce an influx of steady employees and competent officials.

"There being an extreme shortage in the district of mechanics and labor of all kinds, coupled with the uncertainty of delivery of construction materials, even at the prevailing high prices, no definite estimate can be arrived at for new equipment or cost per pound running expense. Under the prevailing conditions with an average of 21.5 to 23 pounds copper per ton and a width of only 4.8 feet in the lode, I cannot advise entering into extensive constructive work of any kind or starting a new shaft. Nor does it seem proper to recommend a continuation of exploring operations as the value of the lode has been fairly determined, nor to continue sinking and drifting for future enlarged operations before a standard railroad connection has been effected."

Winona Copper Company

The stopes opened at Winona during 1917 showed about the same grade of ground; the yield of copper per ton of ore stamped was 13.33 pounds. Total production of refined copper was 1,494,472 pounds.

Concerning the operations of Winona during the year 1917, President Chas. J. Paine reports as follows:

"For about nine months of the 1917 year mining operations were carried on by your Company. Throughout that period there was a marked tendency for costs of all kinds to increase, coupled with lack of adequate labor, though for six months of that time we were able to show a small margin of profit. Beginning in July the underground openings ran into much poorer ground, the price of copper was sagging, and when the results of the month's operations were obtained it became evident that the mine would have to shut down. At that time the fixing of a price for copper by the Government was pending and it was thought best to await the announcement before giving orders to stop. Immediately upon the announcement by the National Government of a price of twenty-three and one-half cents, orders were given to shut down the mine. Your Superintendent, Mr. R. R. Seeber, recommended a continuance of operations on a somewhat smaller scale and in certain parts of the mine only. It did not seem advisable to the Board of Directors to follow his recommendation. Whereupon he made application to work the property on tribute, guaranteeing a small minimum payment per pound of copper produced and an additional payment dependent on the price at which the copper was sold exceeding a minimum figure. Your

property has been operated by Mr. Seeber on this basis since October 1, 1917, and with satisfactory results to date."

Wolverine Copper Mining Company

Results of operations at the Wolverine for the year ending June 30, 1917, showed a net profit of \$1,026,404.68. Due principally to the shortage of unskilled labor, the production was not as large as that of the previous year. Receipts from sales of copper, however, exceeded those of the year 1915-1916. The total production of refined copper was 5,856,889 pounds, produced at a total cost per pound of 11.54 cents. Only \$4,740.49 was expended for construction.

Openings tributary to No. 3 shaft in general showed fair mineralization.

No. 4 shaft was sunk to 185 feet below the 41st level. On account of the flattening of the dip of the lode, the lower part of the shaft is in the foot-wall. The lode where exposed in sinking is well mineralized. Sinking, of which about 34 feet is still necessary, is in progress for the purpose of establishing the 43d level which will form the bottom of the mine. New openings made during the year showed excellent mineralization, and ground equally rich is expected on the 41st, 42d and 43d levels, each of which may be extended to a length of 800 feet from north to south boundaries.

In addition to the regular mining, considerable work was done in cutting out the lode along the foot in old and recent stopes throughout the mine. These operations supplied 38 per cent of the total ore hoisted.

The ore mined during the year carried much more epidote than usual, and in order to prevent copper losses, it was not entirely eliminated in the milling, thus reducing the percentage of copper in the resulting concentrates sent to the smelter.

Wyandot Copper Company

Owing to the scarcity of experienced labor, high wages and excessive cost of materials and supplies, and also by reason of the fact that so many of the stockholders neglected to pay the last assessment, it was deemed inadvisable to continue the development work at this time, and accordingly all operations were suspended, and the mine has been closed until more favorable conditions shall prevail.

All work during the year ending March 31, 1918, was confined to the further development of No. 8 lode on the 10th level. Drift

were extended northeast and southwest of the winze approximately 300 feet in either direction. Drift-stoping was done west of the winze for a distance of about 250 feet. A stope was finally started 30 feet west of the winze and 200 feet in length.

A stamp-mill test was made on 654 tons from the stope, the ore being selected. The milling was done at the Winona mill under the direct supervision of James W. Shields, former superintendent of the Quincy mills. The results showed a yield of 21.6 pounds of refined copper per ton of ore stamped. The results were so surprisingly good that another shipment was made direct from the openings and unselected. The results on 667.95 tons gave a refined copper yield of 8.25 pounds. This was very encouraging, considering that no selection was made, and it indicated that with proper selection and a large tonnage the lode has commercial possibilities.

Superintendent F. L. VanOrden, concerning the future development of the property, states as follows:

"We have an encouraging condition, but as to whether a commercial vein can be developed on this lode remains yet to be proven. Long laterals should be extended both northeast and southwest of the winze with the idea of proving the lateral extent of the mineralization of this lode. It is unfortunate indeed that our property is for the most part covered with a heavy overburden, which makes it very costly to attempt to make another opening on the strike or course of the lode. In other words, the lateral extension of this vein must be proven by one of three methods: first, by lateral development by means of drifts; second, by employing a diamond drill and drilling holes at intervals along the course of the vein (this method, however, cannot prove very much as to the mineralization of the vein itself, but will give valuable information as to the continuity of the lode); thirdly, by opening along the course of the lode by means of shafts where the overburden will permit. The last method would be very costly, as in places we know the overburden to be 100 feet deep.

"* * * * I again wish to call your attention to the unexplored area lying between Winona lode shaft and the northern boundary of our property. This area has long been unexplored, not only on our property, but from Portage Lake to Ontonagon County. I have always been a firm believer in the west third of the South Range, perhaps on account of the fact that no commercial mines have been opened in Houghton County southwest of the Champion Mine, although the east third of the Range has been very thoroughly explored. The Winona Copper Company, so far as I know, is the only company that has done any systematic drilling west of the

Winona lode. As I recall, they had quite encouraging results but have never had an opportunity to follow up the several encouraging lodes disclosed as the result of their thorough drilling operations."

LIST OF ACTIVE COPPER M

Name of Company.	Location of Mine or Property.
Adventure Consolidated Cop. Co.	Greenland, Ontonagon Co.
Ahmeek Mining Co.	Ahmeek, Keweenaw Co.
Algolah Mining Co.	Lake Mine, Ontonagon Co.
Algonac Mineral Development Co.	Porcupine Mt. District, Ontonagon Co.
Allouez Mining Co.	Allouez, Keweenaw Co.
Bear Lake Pool.	Bear Lake, Houghton Co.
Calumet & Hecla Mining Co.	Calumet, Houghton Co.
Carp Lake Mining Co.	Porcupine Mt. District, Ontonagon Co.
Cass Copper Co.	West of Victoria, Ontonagon Co.
Centennial Copper Mining Co.	Calumet, Houghton Co.
Champion Copper Co.	Painesdale, Houghton Co.
Cherokee Copper Co.	Between Indiana & Winona, Ontonagon Co.
Contact Copper Co.	Elm River, Houghton Co.
Copper Range Co.	Painesdale, Houghton Co.
Federal Syndicate Copper Co.	Keweenaw Co.
Flint Steel.	Between Michigan & Mass Mines, Ontonagon Co.
Franklin Mining Co.	Demmon, Houghton Co.
Hancock Consolidated Mining Co.	Hancock, Houghton Co.
Houghton Copper Co.	North of Superior Mine, Houghton Co.
Indiana Mining Co.	Indiana, Ontonagon Co.
Isle Royale Copper Co.	Houghton, Houghton Co.
Keweenaw Copper Co.	Phoenix, Keweenaw Co.
Lake Copper Co.	Lake Mine, Ontonagon Co.
La Salle Copper Co.	South of Osceola Mine, Houghton Co.
Mass Consolidated Mining Co.	Mass, Ontonagon Co.
Mayflower—Old Colony Cop. Co.	East of Wolverine Mine, Houghton Co.
Michigan Copper Mining Co.	Rockland, Ontonagon Co.
Mohawk Mining Co.	Mohawk, Keweenaw Co.
Naumkeag Copper Co.	Houghton, Houghton Co.
New Arcadian Copper Co.	East of Quincy Mine, Houghton Co.
New Baltic Copper Co.	East of Franklin Mine, Houghton Co.
North Lake Mining Co.	Lake Mine, Ontonagon Co.
Onondaga Copper Co.	Porcupine Mt. District, Ontonagon Co.
Osceola Consolidated Mining Co.	Osceola, Kearsarge, Tamarack, Houghton Co.
Porcupine Exploration Co.	Porcupine Mt. District, Ontonagon Co.
Quincy Mining Co.	Hancock, Houghton Co.
Seneca Copper Corporation.	Near Mohawk, Houghton Co.
South Lake Mining Co.	Greenland Jc., Ontonagon Co.
Superior Copper Co.	North of Baltic Mine, Houghton Co.
Tremont & Devon Mining Co.	West of Victoria, Ontonagon Co.
Trimountain Mining Co.	Trimountain, Houghton Co.
Victoria Copper Mining Co.	Victoria, Ontonagon Co.
White Pine Copper Co.	Porcupine Mt. District, Ontonagon Co.
White Pine Extension Copper Co.	Porcupine Mt. District, Ontonagon Co.
Winona Copper Co.	Winona Houghton Co.
Wolverine Copper Mining Co.	Kearsarge, Houghton Co.
Wyandott Copper Co.	East of Winona, Houghton Co.

COMPANIES OF MICHIGAN, 1917

General Office.	General Manager.	Superintendent.
32 Broadway, New York.		E. W. Walker.
12 Ashburton Place, Boston.	James MacNaughton.	S. Russell Smith.
60 Congress St., Boston.	R. M. Edwards.	Thomas Bennett.
1905 Dime Bank Bldg., Detroit.		Fred B. Close.
12 Ashburton Place, Boston.	James MacNaughton.	F. W. Ridley.
12 Ashburton Place, Boston.	James MacNaughton.	John Knox.
Houghton, Mich.		Jerry Rourke.
Houghton, Mich.		A. H. Meuche.
12 Ashburton Place, Boston.	James MacNaughton.	F. W. Ridley.
82 Devonshire St., Boston.	F. W. Denton.	
Houghton, Mich.	W. A. Hodgson.	J. A. Thomas.
70 State St., Boston.		G. S. Goodale.
82 Devonshire St., Boston.	Wm. H. Schacht.	
Hoskin Bldg., Calumet.		Samuel Brady.
60 Congress St., Boston.	R. M. Edwards.	Enoch Henderson.
Hancock, Mich.	C. E. Weed.	
705 Sears Bldg., Boston.		R. R. Seeber.
60 Congress St., Boston.	R. M. Edwards.	Thomas Bennett.
12 Ashburton Place, Boston.	James MacNaughton.	James E. Richards.
Calumet, Mich.	W. J. Uren.	
82 Devonshire St., Boston.		E. W. Walker.
12 Ashburton Place, Boston.	James MacNaughton.	Ole Hallingby.
79 Milk St., Boston.		E. W. Walker.
705 Sears Bldg., Boston.		G. S. Goodale.
15 William St., New York.		Samuel Brady.
15 William St., New York.	Theo. Dengler.	W. F. Hartman.
61 Broadway, New York.		S. S. Lang.
Houghton, Mich.	R. H. Shields.	Otto Lieber.
Houghton, Mich.	R. H. Shields.	
60 Congress St., Boston.	R. M. Edwards.	Thomas Bennett.
Houghton, Mich.	R. C. Pryor.	H. W. Fesing.
12 Ashburton Place, Boston.	James MacNaughton.	F. H. Haller.
1517 Conway Bldg., Chicago.		A. G. Ballenberg.
32 Broadway, New York.	Chas. L. Lawton.	Ralph Hayden.
11 Broadway, New York.	W. J. Uren.	
60 Congress St., Boston.	R. M. Edwards.	Thomas Bennett.
12 Ashburton Place, Boston.	James MacNaughton.	Ocha Potter.
Calumet, Mich.	W. H. Gibson.	
82 Devonshire St., Boston.	F. W. Denton.	Roy Reynolds.
60 Congress St., Boston.		George Hooper.
12 Ashburton Place, Boston.	James MacNaughton.	Thos. H. Wilcox.
15 William St., New York.	Theo. Dengler.	W. R. Bolley.
705 Sears Bldg., Boston.		R. R. Seeber.
15 William St., New York.	Theo. Dengler.	W. R. Boiley.
68 Devonshire St., Boston.		F. L. Van Orden.

SUMMARY OF RESULTS OBTAINED BY MICHIGAN COPPER MINING COMPANIES IN 1917

	Tons of ore treated.	Cost of mining, transportation, and stamping per ton.	Pounds of concentrate obtained.	Pounds of refined copper produced.	Per cent of refined copper in concentrate.	Pounds of refined copper per ton of ore treated.	Cost per pound at mine, excluding construction.	Cost per pound smelting, refining, transportation taxes and eastern offices.	Cost per pound freight, insurance, commissions, etc., on copper delivered.	Total cost per pound.	Price received for copper sold.
Adventure.....	1,271,275	\$1.74		652,977		22.0	7.91c	1.14c	.37c	9.42c	26.84c
Ahmeek.....	566,674	1.869		27,919,812		15.69	11.91	1.56	.37c	13.84c	27.95
Allouez.....	3,159,570	2.52		8,892,915		21.65	11.66			13.01	28.39
C. & H. (all ore).....	1,751,621	3.26		68,419,826 ¹		28.78					
C. & H. (conglomerate).....	1,407,949	1.60		50,415,860		12.79					
C. & H. (Osceola lode).....				18,003,966							
Centennial.....	148,332	2.331		2,002,857		13.50	17.26	1.09	.32	18.67	26.96
Champion.....	776,036			27,550,343		35.50				10.40	28.735
Cherokee.....	93			7,472		80.34					27.0
Copper Range.....	978,015			31,268,130		31.97				12.58	28.735
Copper Range (Baltic).....	325,342			11,214,861		34.47				13.77	28.735
Franklin.....	303,625			3,155,574							26.74
Hancock.....	302,725			4,047,053		13.233					28.229
Houghton.....	15,628.40		291,500	179,012		11.45					28.14
Isle Royale.....	922,160	2.02		13,480,921		14.6	13.80	1.55	.39	15.74	26.87
Keweenaw.....	41,148		619,413	380,536		9.248					
LaSalle.....	63,191		2,246,145	1,461,893	65.074	23.13					25.57
LaSalle (Osceola Branch).....	185,014	1.87		1,919,775		10.38	18.03	1.76	.35	20.14	28.45
Mass.....	244,671		6,082,820	3,984,616	65.51	16.29				19.81	26.238
Michigan.....	2,091			35,400							
Mohawk.....	605,202	1.88	17,775,200	12,313,887	69.28	20.35	9.25	2.07 ²		11.32	27.94
New Arcadian.....	4,900			53,278							
Osceola.....	1,237,805	1.63	35,785,490	16,084,958		13.00	12.53	.96	.37	13.86	27.89
Osceola (Osceola Branch).....	203,288	2.14		2,516,736		12.38					
Osceola (N. Kearsarge Br.).....	691,263	1.55		8,667,441		12.54					
Osceola (S. Kearsarge Br.).....	343,254	1.48		4,900,781		14.28					
Quincy.....	1,280,837			22,195,577		17.33					28.65
South Lake.....	48,331			533,091 ¹		11.03 ²					
Superior.....	129,587	2.50		2,201,672		16.99	14.74	1.80	.34	16.88	29.39
Trimountain.....	264,655			6,278,097		23.72				15.22	28.735
Victoria.....	137,286		2,631,693	1,612,640							
White Pine.....	212,889	2.365		4,067,529		19.11	12.38	2.25	.36	14.99	28.30
Wimona.....	112,082.55		2,640,780	1,494,472		13.33					29.05
Wolverine (1916-17).....	352,845	1.63	8,753,945	5,856,889	66.95	16.80	9.28	2.26 ³		11.54	29.15
Wyandot.....	*654					21.6					
	†667.95					8.25					

Quincy.....	1,280,837		35,785,490	22,195,577		17.33					28.65
South Lake.....	48,331			533,091 ¹		11.03 ²					
Superior.....	129,587	2.50		2,201,672		16.99	14.74	1.80	.34	16.88	29.39
Trimountain.....	264,655			6,278,097		23.72				15.22	28.735
Victoria.....	137,286		2,631,693	1,612,640							
White Pine.....	212,889	2.365		4,067,529		19.11	12.38	2.25	.36	14.99	28.30
Wimona.....	112,082.55		2,640,780	1,494,472		13.33					29.05
Wolverine (1916-17).....	352,845	1.63	8,753,945	5,856,889	66.95	16.80	9.28	2.26 ³		11.54	29.15
Wyandot.....	*654					21.6					
	†667.95					8.25					

*Selected.

†Unselected.

¹Estimated total production May, 1916 to Dec. 31, 1917 from 68,388 tons, 754,433 lbs.²Average yield from total of 68,388 tons.³Cost of smelting, freight and marketing product, including New York office expenses and taxes.⁴Besides this mine production 9,075,457 pounds were produced by the Reclamation Plant.

Note—Construction cannot be charged against income, therefore, no construction costs are stated. Total costs of construction are given in table of financial statements.

SUMMARY OF FINANCIAL STATEMENTS OF MICHIGAN COPPER MINING COMPANIES FOR 1917

	Balance of Assets (+), Liabilities (-), December 31, 1916.	Operation Expenditures.	Receipts.			Expended for Construction.
			Sale of Copper.	Sale of Silver.	Assessments.	
Adventure.....	+ \$53,783.73	\$271,508.28	\$198,562.75			
Ahmeek.....	+2,233,363.65	1,818,310.92	5,180,901.48	\$16,171.37		\$231,257.42
Algoma.....	+26,470.14	10,289.70				
Allouez.....	+1,545,813.56	1,015,666.57	2,051,297.17	22,589.24		24,503.11
Atlantic.....	+259,657.34	10,777.91			\$130.00	
Bohemia.....	+131,087.86	3,343.70	16,900,575.66	181,460.36		2,274,901.27
Catnet & Hecla.....	+10,758,601.75	7,746,125.62	454,123.11			11,961.96
Centennial.....	+448,368.48	314,526.59	7,916,569.27			
Champion.....	+1,671,933.76	2,877,118.99	1,705.57		20,070.00	
Cherokee.....	+17,326.01	27,067.10				
Cliff.....	+21,335.14	3,114.37				
Contact.....	+5,922.50					
Copper Range.....	+5,558,460.25	5,188,850.33	12,943,156.92			
Copper Range (Baltic).....		1,544,258.05	3,222,581.44			
Franklin.....	+192,094.02	758,505.20	792,526.95			64,081.44
Hancock.....		1,110,931.55	1,142,453.54			
Houghton.....	+24,419.50	72,773.90	44,871.88		15.00	
Indiana.....	-30,236.62	45,402.84			80,000.00	212.34
Isle Royale.....	+923,552.18	1,610,881.87	2,750,627.47	84,962.44		316,370.62
Keweenaw.....		172,814.42				14,866.17
Lake.....	+362,359.02	420,195.74	373,813.76			
La Salle.....	+173,491.58	311,558.31	440,150.63	12,408.87		
Mass.....	+449,255.02	796,905.89	1,045,501.77	1,290.95		85,352.46
Mayflower—Old Colony.....	+102,114.66	48,695.42				22,598.24
Michigan.....	-158,497.22	165,817.23	8,878.00		96,986.00	9,180.72
Mohawk.....	+2,333,839.04	1,139,898.71	3,440,252.58			90,904.37
New Arcadian.....	+21,315.53	107,516.35	15,184.23		108,306.75	5,252.77
New Baltic.....	+21,648.34	37,162.82			23,195.00	
North Lake.....	+28,567.47	55,264.92				
Onondaga.....						
Osceola.....	+2,677,546.88	1,716,842.64	3,453,757.92			96,788.55
Quincy.....	+2,663,615.35	3,517,880.39	6,348,604.50	1,895.80		375,688.93
South Lake.....	+2,212.17	218,113.42	94,049.56			1,918.58
St. Mary's.....	+56,104.26					
Superior.....	+434,312.98	269,782.34	469,720.75	8,141.48		
Trimountain.....	+2,492,088.59	1,004,417.35	1,804,006.21			
Union Copper.....	+15,389.97					
Victoria.....	+197,611.32	361,734.70	441,437.73			28,176.95
White Pine.....	+613,907.75	455,549.93	860,523.44	28,937.46		78,360.76
White Pine Extension.....	+48,233.19	90,988.55				
Winona.....	+330,045.30	474,488.08	555,623.86		95.00	1,181.04
Wolverine.....	+862,528.72	676,206.20	1,707,441.37			5,678.06
Wyandot.....	+16,643.63	34,028.72	3,059.35		29,375.00	4,740.49

SUMMARY OF FINANCIAL STATEMENTS OF MICHIGAN COPPER MINING COMPANIES FOR 1917.—Continued

	Profits from Operations.	Dividends.	Depreciation of Plant.	Depletion of Mineral Deposits.	1917 Income Tax.	1917 Excess Profits Tax.	Balance of Assets (+), Liabilities (-), December 31, 1917.
Adventure.....			\$210,713.34	\$422,787.93	\$112,999.28	\$869,760.59	-\$11,892.16
Ahmeek.....	\$3,389,145.92*	\$2,800,000.00					+1,505,443.88
Algomah.....	1,085,636.45*	1,050,000.00	60,750.93	150,451.95	40,070.39	204,722.28	+16,868.54
Allouez.....	11,631.84						+1,157,703.01
Atlantic.....							+286,887.57
Bohemia.....							+132,058.57†
Calumet & Hecla.....	13,132,392.83*	8,500,000.00‡	2,022,765.10	1,579,785.00	409,188.82	570,285.87	+10,626,485.07
Centennial.....	145,398.92*	90,000.00	56,197.52	15,813.67	4,384.38		+436,107.60
Champion.....	5,050,171.57	4,480,000.00					+2,242,105.33
Cherokee.....							+12,486.43
Cliff.....							+18,618.37
Contact.....							+12,006.97
Copper Range.....	4,966,824.97	3,943,912.50					+6,218,091.89
Copper Range (Baltic).....	1,678,323.39				3,600.52		+286,197.74
Franklin.....							
Hancock.....	31,491.99			77,096.36			+3,894.43
Houghton.....							+4,411.44
Indiana.....							+890,740.46
Isle Royale.....	1,224,708.04*	600,000.00	123,513.75	79,831.39	53,241.80	133,376.87	
Keweenaw.....							
Lake.....							+331,525.04
La Salle.....	142,927.39*				7,200.77		+308,842.32
Mass.....	265,412.73*	291,951.00	22,858.95				+321,371.73
Mayflower—Old Colony.....							+32,302.65
Michigan.....							-227,631.17
Mohawk.....							
New Arcadian.....	1,971,600.87	2,050,000.00					+2,255,439.91
New Baltic.....							+41,660.97
North Lake.....							+8,193.47
Onondaga.....							-26,310.05
							+30,000.00†

Osceola.....	1,777,625.26*	1,346,100.00	121,696.75†	230,664.96†	55,469.47	496,934.71	+2,410,189.86
Quincy.....	1,786,396.22	1,980,000.00	498,634.23	399,280.58			+3,192,882.45
South Lake.....							-97,076.31
St. Mary's.....							+55,255.72
Superior.....	214,094.62*	2,240,000.00	54,617.62	51,835.20	6,172.59	4,462.29	+489,292.64
Trimountain.....	848,241.06						+3,344,775.68
Union Copper.....							+23,501.19
Victoria.....	70,224.91						+267,836.23
White Pine.....	442,085.78*	29,062.50	65,119.24	76,640.04	16,961.46	17,307.03	+509,732.57
White Pine Extension.....							
Winona.....							-36,197.26
Wolverine.....	1,026,404.68	780,000.00					+301,109.65
Wyandot.....							+1,108,933.40‡
							+15,282.92‡

*Gross Income from 1917 operations. All other figures represent net profits.

†Estimated

‡For year ending February 28, 1918.

§Dividends received from other mining companies amounted to \$3,011,205.00.

¶For year ending April 30, 1918.

**For year ending June 30, 1917.

††For year ending March 31, 1918.

Note—According to Federal law concerning income tax, construction cannot be charged against income.

SUMMARY OF RESULTS OBTAINED BY MICHIGAN COPPER MINING COMPANIES IN 1913-1917.

	Tons of ore treated.	Cost of mining, transporting, and stamping per ton.	Pounds of concentrate obtained.	Pounds of refined copper produced.	Per cent of refined copper in concentrate.	Pounds of refined copper treated.	Cost per pound at mine, excluding construction.	Other costs per pound.*	Total cost per pound.	Price received for copper sold.
Ahmeek:										
1917.....	1,271,275	\$1.74	.....	27,919,812	.....	22.0	7.91c	1.51c	9.42c	26.84c
1916.....	1,164,010	1.46	.....	24,142,158	.....	20.7	7.04c	4.50c	11.54c	25.72c
1915.....	948,874	1.26	32,292,325	21,800,492	67.50	23.0	5.48	2.48	7.96c	18.28
1914.....	590,519	1.55	20,333,000	13,634,605	67.08	23.1	6.73	2.98	9.71	13.68
1913.....	383,749	1.77	13,742,140	9,220,874	67.10	24.0	7.38	3.92	13.30	15.42
Allouez:										
1917.....	566,674	1.869	.....	8,892,915	.....	15.69	11.91	1.93c	13.84	27.95
1916.....	566,960	1.589	.....	10,219,290	.....	18.02	8.82	2.03	10.85	25.305
1915.....	534,705	1.365	14,506,440	10,043,459	69.23	18.78	7.27	2.04	9.31	18.166
1914.....	354,457	1.583	9,408,470	6,056,548	64.37	17.09	9.26	1.92	11.18	12.853
1913.....	236,663	1.687	6,640,000	4,091,129	61.61	17.29	9.76	2.33	12.09	15.672
C. & H. (all ore):										
1917.....	3,159,570	2.52	.....	68,419,826	.....	21.65	11.66	.....	13.01	28.39
1916.....	3,166,274	2.03	.....	71,349,591	.....	22.53	.....	.....	11.63	25.48
1915.....	3,188,583	1.71	.....	71,030,518	.....	22.28	.....	.....	9.33	18.41
1914.....	2,592,462	1.85	.....	53,691,562	.....	20.70	.....	.....	11.35	14.01
1913.....	2,035,625	2.38	.....	45,016,890	.....	22.11	.....	.....	14.25	15.77
C. & H. (Conglomerate):										
1917.....	1,751,621	3.26	.....	50,415,860	.....	28.76	.....	.....	10.75	.....
1916.....	1,727,794	2.63	.....	51,785,016	.....	29.97	.....	.....	8.69	.....
1915.....	1,739,984	2.13	.....	51,738,888	.....	29.74	.....	.....	10.43	.....
1914.....	1,439,986	2.37	.....	37,996,045	.....	26.38	.....	.....	10.43	.....
1913.....	1,175,259	2.99	.....	32,731,768	.....	27.85	.....	.....	12.67	.....
C. & H.:										
1917 (Osceola lode).....	1,407,949	1.60	.....	18,003,966	.....	12.97	.....	.....	11.84	.....
1916 (Amygdaloid).....	1,438,480	1.32	.....	19,564,575	.....	13.60	.....	.....	9.71	.....
1915.....	1,448,599	1.07	.....	19,291,930	.....	13.32	.....	.....	10.20	.....
1914.....	1,152,476	1.19	.....	15,695,517	.....	13.62	.....	.....	12.62	.....
1913.....	842,162	1.53	.....	12,051,238	.....	14.31	.....	.....	.....	.....
Centennial:										
1917.....	148,332	2.331	.....	2,062,857	.....	13.50	17.26	1.41	18.67	26.96
1916.....	150,617	1.916	.....	2,367,400	.....	15.72	12.18	1.26	13.44	25.02
1915.....	150,191	1.753	3,029,880	2,347,500	77.48	15.63	11.21	1.24	12.45	18.145
1914.....	138,136	1.838	3,311,780	2,287,130	69.06	16.56	11.10	1.46	12.56	12.111
1913.....	85,443	2.179	2,324,040	1,612,262	69.37	18.87	11.55	1.83	13.38	15.358
Champion:										
1917.....	776,036	2.42	.....	27,550,343	.....	35.50	.....	.....	10.40	28.735
1916.....	936,656	2.42	.....	33,601,136	.....	35.87	.....	.....	7.80	25.28
1915.....	923,743	1.95	.....	33,417,599	.....	36.17	6.08	.72	6.30	17.40
1914.....	614,854	2.11	.....	15,807,205	.....	25.71	7.92	1.29	9.21	13.38
1913.....	421,849	2.788	19,251,470	12,080,594	.....	28.64	.....	.....	10.71	14.89
Franklin:										
1917.....	303,625	.....	.....	3,155,574	.....	.....	.....	.....	.....	26.74
1916.....	267,286	.....	.....	3,116,566	.....	.....	.....	.....	.....	25.432
1915.....	122,018	.....	.....	1,314,969	.....	.....	.....	.....	.....	19.83
1914.....	7,324	.....	175,944	93,283	.....	.....	.....	.....	.....	18.57
1913.....	123,179	.....	.....	1,021,440	.....	12.73	.....	.....	.....	13.99
Hancock:										
1917.....	302,725	.....	.....	4,047,053	.....	13.223	.....	.....	.....	28.229
1916.....	203,112	.....	.....	2,824,934	.....	13.908	.....	.....	.....	28.093
1915.....	.....	.....	.....	871,124	.....	.....	.....	.....	.....	18.57
1914.....	.....	.....	.....	488,678	.....	.....	.....	.....	.....	13.389
1913.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Houghton:										
1917.....	15,628,40	.....	291,500	179,012	.....	11.45	.....	.....	.....	28.14
1916.....	19,444,35	.....	365,880	204,274	.....	10.55	.....	.....	.....	29.21
1915.....	14,656,92	.....	285,900	156,766	.....	10.69	.....	.....	.....	22.2
1914.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1913.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Isle Royale:										
1917.....	922,162	2.02	.....	13,480,921	.....	14.6	13.80	1.94	15.74	26.87
1916.....	925,419	1.53	.....	12,412,111	.....	13.4	11.38	4.37	15.75	25.86
1915.....	680,270	1.45	13,727,832	9,342,106	68.05	13.7	10.56	4.38	14.94	18.36
1914.....	474,349	1.49	9,451,115	6,601,235	69.85	13.9	10.67	2.68	13.05	13.16
1913.....	314,679	2.12	5,887,000	4,158,548	70.64	13.2	16.07	2.74	18.81	15.29

*Includes smelting, refining, corporation taxes, eastern of 1913, freight, insurance, commissions, etc., on copper delivered.

MINERAL RESOURCES OF MICHIGAN

SUMMARY OF RESULTS OBTAINED BY MICHIGAN COPPER MINING COMPANIES IN 1913-1917—Concluded

	Tons of ore treated.	Cost of mining, transportation, and stamping per ton.	Pounds of concentrate obtained.	Pounds of refined copper produced.	Per cent of refined copper in concentrate.	Pounds of refined copper per ton of ore treated.	Cost per pound at mine, excluding construction.	Other costs per pound.*	Total cost per pound.	Price received for copper sold.
White Pine:										
1917.....	212,889	\$2,265		4,087,529		19.11	12.38	2.61	14.99	28.30 ^c
1916.....	188,890	2,082		4,207,449		22.27	9.35	3.35	12.70	25.26
1915.....	114,039	2,182		2,824,145		24.76	8.80	7.84	16.64	18.353
1914.....										
1913.....										
Winona:										
1917.....	112,082.55		2,640,780	1,494,472		13.33				29.05
1916.....	161,828.55		3,700,180	2,157,255		13.39				28.03
1915.....	102,504.05		3,032,045	1,722,638		16.79				17.4
1914.....	123,330		2,239,170	1,352,985		10.96				14.2
1913.....	120,806		2,467,460	1,448,737		11.99				15.4
Wolverine:										
1916-1917.....	352,845	1.63	8,752,945	5,856,889	66.95	16.60	9.28	2.26	11.54	29.15
1915-16.....	382,898	1.39	9,127,790	6,641,492	72.74	17.07	8.11	1.43	9.54	12.81
1914-15.....	397,614	1.30	4,734,850	3,259,866	74.48	18.23	7.13		8.43	14.09
1913-14.....	182,127	1.02	4,606,015	3,435,459	74.59	18.86	9.85		11.30	14.09
1912-13.....	388,502	1.62	10,782,405	8,350,312		21.49	7.55		8.656	15.89

*Includes smelting, refining, corporation taxes, eastern offices, freight, insurance, commissions, etc., on copper delivered.

IRON INDUSTRY
STATISTICAL TABLES

IRON ORE SHIPMENTS FROM THE MARQUETTE RANGE⁷

Name of Mine.	1908 and prior years.	1909	1910	1911
Adams (D. S. S. & A. Rt. of Way)				
American (Sterling)	150,335	90,001	163,290	195,197
Ames	6,298			
Barnum (Cliff Shaft) ¹	801,851			
Bay State	16,637			
Bessemer (See Lillie)				
Bessie	59,097			
Beaufort (Ohio)	493,718	72,987	23,427	2,683
Blue (See Queen Group)				
Boston (with American)	62,542			
Braastad (Mitchell)	136,636			
Braastad (Winthrop)	831,445			
Breitung No. 1				63,497
Breitung Hematite No. 2	216,910	129,673	114,202	72,688
Buffalo ²	217,730			
Cambria	1,900,902	136,815	150,422	85,954
Champion	4,383,186	11,199	18,746	
Chase				
Chester (See Rolling Mill)				
Chicago	9,012			
Cleveland ³	2,806,298			
Cleveland Hematite (Included under Cleveland)				
Cleveland Cliffs Group ⁴	14,362,473	877,433	955,374	514,305
Columbia (Kloman)	94,813			
Curry	16,671			
Dalliba (Phoenix)	59,114			
Detroit	140,841			
Dexter	118,512			
Dey	2,709			
East Champion	76,002			
East New York	327,604			
Edison	893			
Edwards (See Sampson)				
Empire	94,102	108,993	53,687	16,954
Erie	8,136			
Etna	1,091			
Fitch	31,817			
Foster ⁵	171,893			
Foxdale	31,447			
Gibson	16,357			
Goodrich	49,754			
Grand Rapids (Davis)	110,736			
Green Bay (See Bay State)				
Hartford	1,516,271	250,680	183,471	
Himrod				
Holmes				
Hortense (North Champion)	30,574			
Home (P. and L. S.) (Now Volunteer)	26,022			
Humboldt (Washington)	713,961			
Imperial	261,213	115,478	83,404	86,95
Indiana (See Bay State)				
Iron Cliffs ⁶	1,700,537			
Iron Mountain	393			
Isabella				
Jackson	3,868,453	11,060	40,320	22,303
Keystone (See East Champion)				
Lake ¹⁰				
Lake Angeline	8,005,161	280,298	244,923	167,258
Lake Superior	14,582,128	349,435	271,445	167,352
Lillie	1,686,782	61,708	10,121	25,597
Lloyd (See Morris-Lloyd) ⁴				
Lucy (McComber)	517,359	1,672	11,257	16,676
Maas	61,414	159,197	208,103	24,926
Magnetic (Stock Pile)	292			
Manganese (Negaunee)	6,359			

See foot notes 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 on page 82.

IRON ORE SHIPMENTS FROM THE MARQUETTE RANGE

	1912	1913	1914	1915	1916	1917	Total.
						22,560	22,560
	122,211	162,253	84,845	87,514	246,163	142,488	1,444,297
							6,298
							801,851
							16,637
							59,097
				21,139	40,007	108,901	762,862
							62,542
							136,636
							831,445
							63,497
	57,085	30,994	49,590	174,107	70,328	109,962	455,563
	63,995	83,280	27,705	76,620	80,655	80,073	945,801
							217,730
	69,904	169,153	132,834	159,443	195,612	114,283	3,115,322
							4,413,131
		52,930	19,708	39,059	72,344		184,041
							9,012
							2,806,298
	1,032,836	922,005	672,428	631,358	1,022,461	933,803	21,924,476
							94,813
							16,671
							59,114
							140,841
							118,512
							2,709
							76,002
							327,604
							893
							430,711
	33,124	38,348			47,110	38,393	8,136
							1,091
							31,817
							171,893
							31,447
							16,357
							49,754
							110,736
							1,950,422
			14,466	444,669	65,029	80,092	204,256
				17,373	3,379	53,726	74,478
							30,574
							26,022
							713,961
	53,943	37,543					638,540
							1,700,537
							17,093
				10,807	5,893	63,276	196,899
				36,255	97,368	47,836	4,121,317
	53,559	1,519	20,241	56,026			
	151,910	102,762	128,073	19,513		54,673	9,154,571
	169,326	164,834	133,519	199,920	422,473	312,500	16,772,932
	26,119						1,810,327
	72,724						619,688
	46,664	171,475	55,903	267,190	259,897	313,399	1,568,168
							292
							6,359

See foot notes 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 on page 83.

¹Under Iron Cliffs 1890-1895; under Cleveland-Cliffs group after 1895.

²Under Queen group after 1890.

³Under Cleveland-Cliffs group after 1883.

⁴Includes Cleveland after 1883; includes Barnum, Foster, Iron Cliffs, Michigamme and Salisbury after 1895.

⁵Under Iron Cliffs 1891-1895; under Cleveland-Cliffs group after 1895.

⁶Under Cleveland-Cliffs group after 1895.

⁷Under Winthrop after 1892.

⁸Includes Buffalo, Prince of Wales, Queen and South Buffalo after 1890.

⁹Prior to 1890, see Braastad; includes Marquette after 1892.

¹⁰included in Cleveland-Cliffs Group.

¹Iron Trade Review reports 152,063 tons shipped in 1915 by Breitung Hematite No. 1 and No. 2 combined.

²See foot note No. 1.

³Iron Trade Review reports 634,837 tons shipped in 1915.

⁴Iron Trade Review reports 203,922 tons shipped in 1915 by Mary Charlotte. Figure includes Himrod shipment.

⁵See foot note No. 4.

⁶Isabella shipment not reported by Iron Trade Review.

⁷Does not include Gwinn district. Does not include west end of range in Baraga County.

⁸Iron Trade Review figure.

⁹Iron Trade Review reports 177,000 tons shipped in 1915.

¹⁰Iron Trade Review reports 130,902 tons shipped in 1915.

¹¹Iron Trade Review reports 18,850 tons shipped in 1915.

Total for Marquette range 1915, Iron Trade Review, 3,746,591 tons. See foot note No. 7.

IRON ORE SHIPMENTS FROM THE GWINN DISTRICT. (GROSS TONS)

	1908 and prior years.	1909	1910	1911
(Austin).....	307,179	125,858	188,588	110,839
Gwinn.....				230
(Princeton) Swanzy or Chesire.....	1,288,237	42,934	89,441	54,442
Stegmiller.....		39,869	48,842	45,122
(Stephenson).....	58,893	64,075	225,726	135,474
Total.....	1,594,309	272,736	552,597	346,107

IRON ORE SHIPMENTS FROM THE GOGEBIC RANGE, MICHIGAN

	1908 and prior years.	1909	1910	1911
Ada (included in Ironton).....				310
Anvil and North Anvil.....	698,345	22,927	7,235	151,478
Ashland.....	5,127,544	259,612	231,506	20,569
Asteroid.....				
Aurora (Norrie-Aurora Group • after 1904).....	3,961,684			
Bessemer.....	20,889			
Blue Jacket.....	1,799			
Brotherton.....	1,649,408	103,090	102,626	65,015
Castile.....	8,265	26,982	20,197	23,597
Chicago.....	68,727			
Colby.....	2,280,253	170,095	194,754	41,673
Davis (Wisconsin).....	103,961			
Eureka.....	346,472	115,662	41,611	98,609
Federal.....	36,443			
First National.....	1,997			
Geneva.....	7,108			
Imperial (See Federal).....				
Iron Chief.....	12,199			
Iron Chief No. 2.....	551			
Iron King (See Newport).....				
Ironton.....	572,291	277,594	109,025	63,359
Jack Pot.....	99,090			
Meteor (Comet).....	216,367			
Mikado.....	897,890	99,195	52,715	
New Davis (See Davis).....				
Newport and Bonnie.....	4,836,685	1,008,354	1,182,324	555,853
Norrie-Aurora Group (after 1904).....	16,767,604	977,054	1,333,006	883,910
Pabst (Norrie-Aurora Group).....	2,366,583			
Palms.....	1,284,489			
Pike.....	76,558	22,174	3,324	
Plymouth.....				
Puritan (Ruby).....	109,572		50,019	
Royal.....				
Section 13.....				
South Chicago.....				
Sparta.....	4,862			
Sunday Lake.....	1,213,263	93,712	115,486	56,096
Tilden.....	4,934,129	154,506	99,937	138,387
Townsite (formerly Norrie).....				
Vaughan (See Aurora) (Norrie- Aurora Group after 1904).....				
Wakefield.....				
Wisconsin (See Davis).....				
Yale (West Colby).....	301,715	71,458	108,253	154,944
Total.....	48,006,743	3,402,415	3,652,018	2,253,800

¹Iron Trade Review.

²Iron Trade Review reports 112,932 tons shipped 1915. This figure includes 17,692 tons shipped from the Minnewawa (Wisconsin).

³Iron Trade Review reports 1,408,516 tons shipped 1915.

⁴Iron Trade Review reports 838,875 tons shipped 1915.

⁵Iron Trade Review reports 442,422 tons shipped 1915.

IRON ORE SHIPMENTS FROM THE GWINN DISTRICT. (GROSS TONS)

1912	1913	1914	1915	1916	1917	Total.
102,530	107,365	30,493		64,521	44,420	1,081,793
143,519	53,479	20,159	57,910	143,708	138,070	410,077
50,963	45,431	13,607	17,171		150,375	1,793,205
214,386	96,298	40,972	40,272	65,420	41,526	418,417
		93,796	243,458	368,739	496,712	1,997,557
511,398	302,573	199,027	358,811	642,388	921,103	5,701,149

IRON ORE SHIPMENTS FROM THE GOGEBIC RANGE, MICHIGAN

1912	1913	1914	1915	1916	1917	Total.
55,610	238	5,771	744,749	120,355	183,525	1,139,065
211,927	2,635	123,702	94,622	70,466	27,636	6,301,128
70,239	42,419	135,120	13,468	88,867	93,265	463,947
						3,961,684
						20,889
						1,799
148,930	70,138	47,662	107,244	107,814	84,524	2,486,451
136,703	57,595	36,569	675,596	131,422	82,248	599,174
			30,977			99,704
245,195	305,744	291,947	315,913	423,553	353,880	4,613,007
65,723	14,562	23,430	128,414	206,319	191,631	103,961
						1,284,433
						36,443
						1,997
	31,303		34,416	86,922	113,804	273,553
						12,199
						551
173,135	166,123	51,138		148,200	244,517	1,805,382
						99,090
						216,367
	33,111	2,094	1,044	23,741	30,833	1,140,623
			5,434	4,997	28,234	38,665
966,435	1,139,666	702,861	4835,058	1,310,595	998,193	13,536,024
1,500,758	1,503,451	985,199	1,407,770	1,855,863	1,646,606	28,861,221
39,152	88,644	173,792	444,673	528,746	475,352	2,366,583
				330,496	658,284	3,034,848
90,683	64,463	58,410	80,367	308,534	224,082	102,056
	10,659	11,686	8,004	11,527	30,302	988,780
	3,844		32,356	48,070	13,737	98,007
			1,274			1,274
155,485	110,374	54,327	136,211	188,771	198,144	4,862
158,191	97,686	114,777	99,516	110,733	108,641	2,321,869
					25,965	6,016,503
						25,965
	15,261	313,050	651,302	1,061,753	1,116,802	3,158,168
76,772	89,482	19,074	42,632	149,155	73,633	1,087,118
4,094,938	3,847,398	3,150,609	4,591,040	7,316,899	7,003,838	87,319,690

⁶Iron Trade Review reports 76,702 tons shipped 1915.

⁷Iron Trade Review reports 45,171 tons shipped 1915.

⁸Iron Trade Review reports 40,248 tons shipped 1915.

Total for Gogebic range 1915 Iron Trade Review 4,595,498 tons.

Total for Gwinn district 1915 Iron Trade Review 358,787 tons.

MINERAL RESOURCES OF MICHIGAN

IRON ORE SHIPMENTS FROM THE MENOMINEE DISTRICT, MICHIGAN

	1908 and prior years.	1909	1910	1911
Antoine	1,353,792			
Aragon	5,589,295	246,984	241,046	201,269
Breen	75,425			
Briar Hill	14,981			
Chapin	15,594,769	587,647	465,543	357,598
Clifford & Traders		103,626	91,081	90,940
Cornell	49,302			
Cuff	58,419			
Cundy	809,377	5,512		
Curry	416,928			
Cyclops	286,093			
Eleanor (Appleton)	18,719			
Emmett	66,655			
Forest	11,988			
Half and Half	7,524			
Hamilton	96,072			
Hersel	955			
Indiana	17,871			
Keel Ridge	93,101			
Loretto	1,098,407	96,613	116,048	18,579
Ludington	1,001,518			
Millie (Hewitt)	357,378	10,887		18,556
Munro	255,315	23,241	20,022	9,303
Norway	1,291,352			
Penn Iron Mining Co	4,409,344	428,004	344,760	377,026
Perry	3,138			
Pewabic	6,452,287	465,453	380,376	352,598
Quinnesec	499,756	3,147	744	
Saginaw (Perkins)	481,991	19,994		
Stephenson	39,350			
Sturgeon River	19,404			
Verona	130,975			
Vivian	405,412		14,827	5,971
Vulcan (with Penn Mines)	1,668,654			
Walpole	19,089			
Total	42,694,636	1,991,108	1,674,447	1,431,840
METROPOLITAN TROUGH.				
Groveland	49,159	24,933	26,462	33,758
Metropolitan	107,027			
Northwestern	35,810			
Total	189,996	24,933	26,462	33,758
CALUMET TROUGH.				
Calumet	121,354			

IRON ORE SHIPMENTS FROM THE MENOMINEE DISTRICT, MICHIGAN

1912	1913	1914	1915	1916	1917	Total.
244,812	230,958	188,765	302,275	244,478	276,434	1,353,792
						7,766,316
						75,425
						14,981
327,999	369,822	341,493	385,174	557,485	682,349	19,669,879
74,144	95,311	66,329		113,362	115,823	750,616
						49,302
						58,419
						814,889
						416,928
						286,093
						18,719
						66,655
						11,988
						7,524
						96,072
						955
			52,570	44,162	46,479	161,082
135,177	158,257	45,449	68,806	174,173	193,951	93,101
						2,105,460
						1,001,518
			361			387,182
20,100	18,509			17,622	46,960	411,072
426,743	416,410	214,827	368,451	419,340	459,844	1,291,352
						7,864,749
279,771	364,176	299,228	178,013	301,125	153,256	3,138
						9,226,283
						503,647
						501,985
						39,350
						19,404
28,800	27,177					130,975
						482,187
						1,668,654
						19,089
1,537,546	1,680,620	1,156,452	1,355,289	1,871,747	1,975,096	57,368,781
12,468	9,251					156,031
						107,027
						35,810
12,468	9,251					298,868
35,587	18,976					175,917

Iron Trade Review reports 384,654 tons shipped 1915.
 Iron Trade Review reports 411,393 tons shipped 1915.
 Total for Menominee range 1915 Iron Trade Review 1,397,711 tons.

IRON ORE SHIPMENTS FROM THE CRYSTAL FALLS DISTRICT, MICHIGAN

	1908 and prior years.	1909	1910	1911
Alpha.....	1,370			
Amasa Porter.....				
Armenia.....	311,608		65,473	51,862
Balkan.....				
Bristol (Clair).....	1,788,542	396,825	270,742	322,729
Carpenter.....				
Columbia.....	942,703			
Crystal Falls.....	1,734,265	986		
Delphic.....	33,770			
Dunn.....	1,328,475	193,396	136,144	232,092
Fairbanks.....	8,500			
Genesee (Ethel).....	405,854	65,585	66,185	25,342
Gibson.....	20,905	36,246	45,202	56,528
Great Western.....	1,759,482	112,747	80,709	84,338
Hemlock.....	1,477,337	112,481	115,407	107,753
Hilltop.....	20,229			
Hollister.....	21,140	25,842	49,434	5,022
Hope.....	28,530			
Judson.....				
Kimball.....	16,224			
Lamont (Monitor).....	555,341		3,183	
Lee Peck.....	2,844			
Lincoln.....	239,970	1,657		
Magnate.....	6,844			
Mansfield.....	984,285	118,713	114,357	54,646
Mastodon.....	425,708			
McDonald.....		1,114	6,022	5,240
Michigan.....	153,787		17,922	
Monongahela.....	9,310			
Odgers.....				
Paint River (Fairbanks).....	371,289			
Ravenna.....				127
Richards.....				
Sheldon & Shafer (Union) (See Columbia).....				
South Mastodon.....	8,203			
Tobin.....	1,035,069	359,668	235,812	308,456
Victoria.....				
Warner.....				
Youngstown.....	151,425			
Total.....	13,843,009	1,425,260	1,206,592	1,254,135

IRON ORE SHIPMENTS FROM THE CRYSTAL FALLS DISTRICT, MICHIGAN

	1912	1913	1914	1915	1916	1917	Total.
							1,370
					80,492	116,762	197,254
	150,808	83,202	50,501				713,454
				144,284	229,195	261,014	634,493
	438,900	379,169	172,006	378,831	462,801	188,688	4,799,233
			51,147	284,187	240,114	269,178	844,626
							942,703
							1,735,251
							33,770
	242,304	61,080	52,883	8,304			2,254,678
							8,500
	4,248			1,184			568,398
							158,881
	3,342	50,464		35,759		7,692	2,134,533
	126,132	113,201	46,449	28,172			2,126,932
			8,223			19,341	47,793
		25,251	16,430				143,119
			6,619		162,519	60,236	28,530
				19,533			229,374
							35,757
							558,524
							2,844
							241,627
							6,844
							1,462,504
		190,503					425,708
	1,384	16,499					30,259
		27,917	9,471	112,721	28,483		350,301
					21,920		31,230
					53,176	169,668	222,844
							371,289
	18,303	70,766	49,308	116,735	3,476	37,848	296,563
			7,069	92,807	29,381	43,890	173,147
							8,203
	319,318	154,896	65,351	18,624	146,113	188,590	2,831,897
						16,946	16,946
				46	33,751	74,814	108,611
							151,425
Total.....	1,304,739	1,172,948	535,457	1,241,187	1,491,421	1,454,667	24,929,415

¹Iron Trade Review reports 378,786 tons shipped 1915.
²Iron Trade Review reports 284,088 tons shipped 1915.
³Iron Trade Review reports 116,724 tons shipped 1915.
⁴Not reported by Iron Trade Review.
⁵Not reported by Iron Trade Review.
⁶Iron Trade Review reports Hemlock 28,172 tons, Michigan 112,680 tons shipped 1915.
⁷Total for Crystal Falls district 1915 Iron Trade Review 1,240,946 tons.

IRON ORE SHIPMENTS FROM THE IRON RIVER DISTRICT, MICHIGAN

	1908 and prior years.	1909	1910	1911
Baker.....		45,003	39,417	3,290
Baltic.....	994,237	174,426	171,930	66,502
Bates.....				
Bengal.....				
Berkshire.....	3,440	34,295	97,999	22,272
Beta.....	4,211			
Caspian.....	338,948	189,023	171,334	165,660
Cortland.....				
Cottrell.....				
Chatham-Riverton.....	60,709	68,730	51,988	58,054
Davidson No. 1.....				215
Davidson No. 2.....				45,219
Chicagon.....				108,947
Fogarty.....	40,509	77,356	51,071	67,616
Forbes.....				
Hiawatha.....	348,873	136,739	128,884	116,633
Homer.....				
Iron River.....	904,587			
James (Osana).....	62,120	90,851	78,388	50,439
*Dober-Isabella.....	65,192			
Nanaimo.....	373,765			
Riverton (Dober and Isabella).....	969,898	171,200	84,269	200,142
Rogers.....				
Selden.....	2,092			
Sheridan.....	116,299			
Spies.....				
Tully.....			2,726	8,323
Virgil.....				
Wapama.....				
Wauseca.....				749
Wickwire.....				1,919
Youngs.....	221,235	154,150	98,399	89,450
Zimmerman.....	1,832	10,303	25,555	110,084
Total.....	4,507,947	1,152,076	1,001,960	1,115,514

*Riverton.

IRON ORE SHIPMENTS FROM THE IRON RIVER DISTRICT, MICHIGAN

1912	1913	1914	1915	1916	1917	Total.
	24,286	113,733	41,378			267,107
100,736	130,631	29,206	10,078	110,965	89,679	1,878,390
			45,171	72,275	155,703	273,149
	23,259	5,539	39,615	140,961	261,350	470,724
33,422		23,826	15,413	38,470	57,791	326,928
						4,211
306,914	295,841	279,379	479,083	448,631	412,313	3,087,126
17,499	26,823	15,316				59,638
			45	75,089		75,134
135,298	107,604	19,455	132,664	188,807	245,744	1,069,053
27,614	115,499	70,881	86,103	96,518	115,132	511,962
98,760	79,948	51,686	66,327	67,731	108,858	518,529
149,619	137,002	114,849	155,411	100,640	90,785	857,253
84,074	124,568	15,329	27,718	89,506	37,291	615,038
	69,435	77,960	99,219	121,010		367,624
220,106	160,511	91,370	93,453	187,070	62,847	1,546,486
			102,511	156,528	202,592	461,631
75,702	176,634	73,832	102,294	136,645	171,001	904,587
						65,192
171,493	160,818	176,274	262,382	174,992		373,765
		27,081	53,155	81,842	117,324	2,371,468
						279,402
						2,092
						116,299
						6,310
	16,650	63,411	242,049	236,302	121,426	690,887
3,750	48,395	5,972		35,948		94,065
						16,033
	12,377		19,361	30,470		62,957
40,417	40,322	25,584		12,890	242	121,374
83,528	43,649			53,691	23,197	767,299
187,584	149,309	172,720	108,218	138,881	230,123	1,134,609
1,736,516	1,943,561	1,453,403	2,181,648	2,795,862	2,525,741	20,414,228

¹Iron Trade Review reports 132,779 tons shipped 1915.²Iron Trade Review reports 155,711 tons shipped 1915.³Iron Trade Review reports 99,050 tons shipped 1915.

Total for Iron River district 1915, Iron Trade Review 2,182,934 tons.

SUMMARY OF IRON ORE SHIPMENTS FROM MICHIGAN RANGES
(GROSS TONS.)

	1904 and prior years.	1905	1906	1907	1908
Marquette.....	71,842,088	4,086,943	3,935,293	3,907,955	2,214,782
Gwinn.....	719,368	129,079	166,894	380,118	199,850
Menominee.....	33,276,202	2,741,169	2,953,131	2,498,784	1,254,110
Crystal Falls.....	9,011,655	1,174,366	1,395,910	1,631,484	629,602
Iron River.....	2,380,364	337,973	568,469	589,946	630,745
Gogebic.....	36,598,206	3,215,352	3,113,981	3,093,083	2,348,626
Metropolitan.....	169,060			13,913	9,123
Calumet.....	38,913		15,773	51,646	15,222
Total.....	154,035,856	11,684,882	12,149,451	12,166,929	7,302,060
	1909	1910	1911	1912	1913
Marquette.....	3,983,436	3,840,129	2,666,121	3,415,650	3,487,993
Gwinn.....	272,736	552,597	346,107	511,398	302,573
Menominee.....	1,991,108	1,674,447	1,431,840	1,537,546	1,680,620
Crystal Falls.....	1,425,260	1,206,592	1,254,135	1,304,739	1,172,948
Iron River.....	1,152,076	1,001,960	1,115,514	1,736,516	1,943,561
Gogebic.....	3,402,415	3,652,018	2,253,800	4,094,938	3,847,398
Metropolitan.....	24,933	26,462	33,758	12,468	9,251
Calumet.....				35,587	18,976
Total.....	12,251,964	11,954,205	9,101,275	12,648,842	12,463,320
	1914	1915	1916	1917	Total.
Marquette.....	2,340,326	3,778,098	4,698,048	3,959,103	118,155,965
Gwinn.....	199,027	358,811	642,388	921,103	5,702,049
Menominee.....	1,156,452	1,355,289	1,871,747	1,975,096	57,397,541
Crystal Falls.....	535,457	1,241,187	1,491,421	1,454,667	24,929,423
Iron River.....	1,453,403	2,181,648	2,795,862	2,525,741	20,413,778
Gogebic.....	3,150,609	4,591,040	7,316,899	7,003,838	87,682,203
Metropolitan.....					298,968
Calumet.....					176,117
Total.....	8,835,274	13,506,073	18,816,365	17,839,548	314,756,044

SHIPMENTS OF IRON ORE FROM MICHIGAN RANGES BY COUNTIES
(GROSS TONS)

County.	1904 and prior years.	1905	1906	1907	1908
Gogebic.....	36,598,206	3,215,352	3,113,981	3,093,083	2,348,626
Iron.....	11,392,019	1,512,339	1,964,379	2,221,430	1,260,347
Dickinson.....	33,484,175	2,741,169	2,968,904	2,564,343	1,278,455
Marquette.....	71,789,955	4,176,055	4,097,111	4,154,288	2,305,366
Baraga.....	771,501	39,967	5,076	133,785	109,266
Total.....	154,035,856	11,684,882	12,149,451	12,166,929	7,302,060
County.	1909	1910	1911	1912	1913
Gogebic.....	3,402,415	3,652,018	2,253,800	4,094,938	3,847,398
Iron.....	2,577,336	2,208,552	2,369,649	3,041,255	3,116,509
Dickinson.....	2,016,041	1,700,909	1,465,598	1,585,601	1,708,847
Marquette.....	3,888,055	4,236,311	2,922,586	3,873,105	3,753,023
Baraga.....	368,117	156,415	89,642	53,943	37,543
Total.....	12,251,964	11,954,205	9,101,275	12,648,842	12,463,320
County.	1914	1915	1916	1917	Total.
Gogebic.....	3,150,609	4,591,040	7,316,899	7,003,838	87,682,203
Iron.....	1,988,860	3,422,835	4,287,283	3,980,408	45,443,201
Dickinson.....	1,156,452	1,355,289	1,871,747	1,975,096	57,872,626
Marquette.....	2,494,029	4,018,294	5,300,429	4,771,305	121,779,912
Baraga.....	45,324	118,615	40,007	108,901	2,078,102
Total.....	8,835,274	13,506,073	18,816,365	17,839,548	314,756,044

AVERAGE NUMBER OF MEN EMPLOYED IN THE IRON MINES OF MICHIGAN IN 1917 BY COUNTIES

	Gogebic.	Iron.	Dickinson.	Baraga.	Marquette.
Total employed in producing mines = 81,000.....	7,158	3,864	2,576	88	4,314
Total in idle mines and explorations = 351.....	11	104	none	1	235
Total = 18,351*.....	7,169	3,968*	2,576	89	4,549*

*Youngs Mine in Iron County not reported. Jackson, Regent Group, Stegmiller and Volunteer Mines in Marquette County not reported.

LIST OF THE ACTIVE IRON MINES OF MICHIGAN.

Name of Mine.	Location.				First shipment.	No. of men employed 1917.	Depth 1917 feet.
	County.	Section.	Twp.	Rge.			
MARQUETTE RANGE:							
American and Boston . . .	Marquette.	32	48	28	1880	260	1,620
Breitung Hematite No. 1 . .	Marquette.	6	47	26	1903	252	960
Breitung Hematite No. 2 . .	Marquette.	8	47	26	1875	82	640
Cambria	Marquette.	35, 36,	48	27	1875	129	1,303
Champion	Marquette.	31, 32	48	29	1867	129	1,984
Cliff Shaft	Marquette.	9, 10	47	27	1887	344	987
Empire	Marquette.	19	47	26	1907	60	200
Hartford (Cambria No. 2) . .	Marquette.	36	48	27	1889	1	1
Himrod (see Mary Charlotte)	Marquette.	7	47	26	1914	87	640
Holmes	Marquette.	9	47	27	1915	96	1,055
Imperial	Baraga.	25	48	31	1890	1	185
Isabella	Marquette.	29, 32	47	26	1915	137	900
Jackson	Marquette.	1	47	27	1846	*	*
Lake and Moro	Marquette.	10	47	27	1892	328	591
Lake Sally	Marquette.	14	47	27	1915	2	2
Lake Superior (Hard Ore) . .	Marquette.	9, 10	47	27	1858	395	1,250
Lake Superior (Soft Ore) . .	Marquette.	10	47	27	1858	45	820
Lake Angeline (Angeline) . .	Marquette.	15	47	27	1864	16	615
Lucy (with Jackson)	Marquette.	6, 7	47	26	1878	1	1
Maas	Marquette.	31	48	26	1907	272	1,250
Maitland (Volunteer)	Marquette.	30	47	26	1903	203	640
Mary Charlotte	Marquette.	8	47	26	1903	203	640
Morris and Lloyd	Marquette.	1	47	28	1911	242	1,260
Moro with Lake	Marquette.	10	47	27	1881	1	1
Negaunee	Marquette.	5, 6	47	26	1887	359	1,186
Ohio	Baraga.	22	48	31	1882	88	250
Portland	Baraga.	26	48	31	1896	*	†
Queen Group	Marquette.	5	47	26	1888	*	1,010
Republic	Marquette.	7	46	29	1872	239	2,150
Richmond	Marquette.	28	47	26	1896	80	†
Rolling Mill	Marquette.	7	47	26	1872	147	786
Salisbury	Marquette.	15	47	27	1872	124	941
Volunteer	Marquette.	30	47	26	1871	*	506
Washington (Barron)	Marquette.	11	47	29	1865	16	875
SWANZY DISTRICT:							
Austin	Marquette.	20	45	25	1907	69	364
Gwinn	Marquette.	28	45	25	1914	151	1,109
Princeton	Marquette.	18, 20	45	25	1872	8	782
Stegmiller	Marquette.	17	45	25	1909	*	300
Stephenson	Marquette.	20	45	25	1907	214	562
MENOMINEE RANGE:							
Aragon	Dickinson.	8, 9	39	29	1889	419	1,355
Chapin	Dickinson.	25, 30	40	31, 30	1880	811	1,501
Cyclops & Norway (Penn Group)	Dickinson.	5	39	29	1878	1	355
East Vulcan (Penn Group) . .	Dickinson.	10, 11	39	29	1877	761	1,400
Indiana	Dickinson.	27	40	30	1915	51	85
Loretto	Dickinson.	7	39	28	1893	190	800
Millie (Hewitt)	Dickinson.	31	40	34	1881	1	312
Munro	Dickinson.	6	39	29	1903	44	170
Pewabic	Dickinson.	32	40	30	1890	220	941
West Vulcan, Curry & Brier Hill	Dickinson.	9, 10	39	29	1879	1	1,770
Clifford and Traders	Dickinson.	20	40	30	1879	80	143

*Not reported.

†Undeveloped

1917, WITH LOCATION, OWNERSHIP, ETC.

Number or name of level.	Operators.	Address of Home Office.
20th	American Boston Mining Co.	1300 Leader-News Building, Cleveland, Ohio.
10th	Breitung Hematite Mng. Co.	Marquette, Mich.
6th	Breitung Hematite Mng. Co.	Marquette, Mich.
6th	Republic Iron & Steel Co.	Youngstown, Ohio.
33rd	Champion Iron Co.	Wolvin Building, Duluth, Minnesota.
10th	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
2nd	Empire Iron Co.	Rector Building, Chicago, Illinois.
	Republic Iron & Steel Co.	Youngstown, Ohio.
106th	Mary Charlotte Mng. Co.	Marquette, Mich.
2d	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
4th	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
New Main	Cascade Mining Co.	Hibbing, Minn.
	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
5th	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
	Jones & Laughlin Ore Co.	Pittsburg, Penn.
17th	Oliver Iron Mining Co.	Wolvin Building, Duluth, Minn.
820 L	Oliver Iron Mining Co.	Wolvin Building, Duluth, Minn.
9th	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
4th	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
5th	Volunteer Ore Co.	1400 Alworth Bld., Duluth, Minn.
6th	Mary Charlotte Mining Co.	Marquette, Mich.
6th	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
10th	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
6th	Niagara Iron Mining Co.	North Tonawanda, N. Y.
	Niagara Iron Mining Co.	North Tonawanda, N. Y.
1010 L	Oliver Iron Mining Co.	Wolvin Bldg., Duluth, Minn.
	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
2150 L	Richmond Iron Co.	1300 Leader News Bldg., Cleveland, Ohio.
	Jones & Laughlin Ore Co.	3d Ave. & Try St., Pittsburg, Pa.
8th	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
19th	Volunteer Ore Co.	1400 Alworth Bldg., Duluth, Minn.
5th	Washington Iron Co.	Marquette, Mich.
10th	Washington Iron Co.	Marquette, Mich.
6th	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
10th	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
6th	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
2nd	American Mining Co.	Western Reserve Building, Cleveland, Ohio.
5th	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
14th	National Tube Works Co.	Frick Bldg., Pittsburg, Pa.
17th	Chapin Mining Co.	Wolvin Bldg., Duluth, Minn.
	Penn Iron Mining Co.	1703 Morris Bldg., Philadelphia, Pa.
	Penn Iron Mining Co.	1703 Morris Bldg., Philadelphia, Pa.
1st	Thomas Furnace Co.	Milwaukee, Wis.
	Loretto Iron Co.	1400 Fulton St., Chicago, Ill.
8th	Dessau Mining Co.	Care B. J. Clergue, Montreal, Que.
3rd	Munro Iron Mining Co.	55 Erie Co. Bank Bldg., Buffalo, N. Y.
2nd	Munro Iron Mining Co.	55 Erie Co. Bank Bldg., Buffalo, N. Y.
8th	Pewabic Co.	910 Wells Bldg., Milwaukee, Wisconsin.
18th	Penn Iron Mining Co.	1703 Morris Bldg., Philadelphia, Pa.
1st	Antoine Ore Company	Republic Building, Youngstown, Ohio.

LIST OF THE ACTIVE MINES OF MICHIGAN.

Name of Mine.	Location.				First shipment.	No. of men employed 1917.	Depth 1917 feet.
	County.	Section.	Twp.	Rge.			
CRYSTAL FALLS DISTRICT:							
Amasa Porter	Iron	22, 33	44	33	1916	153	550
Balkan	Iron	13	42	33	1915	145	236
Bristol	Iron	19	43	32	1892	70	1,160
Carpenter	Iron	31	43	32	1914	373	480
Dunn-Richards	Iron	1	42	33	1887	102	1,723
Genesee (with Tobin)	Iron	29, 30, 31	43	32	1902		
Great Western	Iron	21	43	32	1882	1	1,257
Hilltop and Victoria	Iron	22	43	32		51	
Judson	Iron	13	42	33	1914	133	300
Odgers	Iron	30	43	32	1916	125	250
Ravenna	Iron	19	43	32	1911		350
Tobin	Iron	30	43	32	1901	180	1,335
Warner	Iron	9	44	33	1915	108	740
IRON RIVER DISTRICT:							
Baker-Tully	Iron	31	43	34	1909	240	548
Baltic	Iron	7	42	34	1901	211	553
Bates	Iron	19	43	34	1915	104	850
Bengal	Iron	36	43	35	1913	228	280
Berkshire	Iron	6	42	34	1908	86	365
Casplan	Iron	1	42	35	1903	371	392
Chatham-Riverton	Iron	35	43	35	1907	175	1,050
Chicagon	Iron	26	43	34	1911	66	910
Cottrell (with Berkshire)	Iron	1	42	35	1915		265
Davidson No. 1	Iron	14	43	35	1912	50	550
Davidson No. 2	Iron	23	43	35	1912	76	240
Fogarty (see Baltic)	Iron	1	42	35	1907		365
Forbes	Iron	14	43	35	1913	94	275
Hiawatha	Iron	35	43	35	1893	98	1,029
Homer	Iron	22, 23	43	35	1915	151	458
Osana (James)	Iron	23	43	35	1907	115	428
Dober Isabella (Riverton)	Iron	1, 35, 36	42, 43	35	1898	61	1,000
Rogers	Iron	29	43	34	1914	116	330
Spies	Iron	24	43	35	1917	88	410
Tully (see Baker)	Iron	36	43	35	1910		700
Virgil	Iron	24	43	35	1912	32	273
Wapama	Iron	14	43	35	1917	3	220
Wauseca	Iron	23	43	35	1910	10	398
Youngs	Iron	12	42	35	1905	*	575
Zimmerman	Iron	7	42	34	1908	152	350
GOGEBIC RANGE:							
Anvil	Gogebic	14	47	46	1887	521	1,663
Asteroid	Gogebic	13	47	46	1906	129	1,130
Ashland	Gogebic	22	47	47	1885	105	1,900
Brotherton	Gogebic	9	47	45	1886	93	1,347
Castile	Gogebic	10	47	45	1906	115	1,810
Colby and Ironton	Gogebic	16	47	46	1884	780	1,314
Davis, Geneva, Royal,		17, 18					
Puritan	Gogebic	19, 20	47	46	1886	400	1,754
Eureka	Gogebic	13	47	46	1890	239	2,041
Ironton (see Colby)	Gogebic	17	47	46	1886		
Keweenaw	Gogebic	11	47	46	1914	104	1,663
Mikado	Gogebic	18	47	45	1895	59	1,131
Newport and Bonnie	Gogebic	24	47	47	1886	896	2,292
Norrie-Aurora Group	Gogebic	22, 23	47	47	1884	1,871	1,676
Palms	Gogebic	14	47	46	1912	444	1,663
Plymouth	Gogebic	18	47	45	1916	250	*
Puritan (see Davis)	Gogebic	17	47	46	1886		
Sunday Lake	Gogebic	10	47	45	1885	232	1,391
Tilden	Gogebic	15	47	46	1891	245	1,526
Townsite	Gogebic	23	47	47	1917	75	304
Wakefield	Gogebic	16, 17	47	45	1913	423	*
Yale	Gogebic	16	47	46	1901	177	1,757

*Open pit.

1917, WITH LOCATION, OWNERSHIP, ETC.—Concluded

Number or name of level.	Operators.	Address of Home Office.
1160 L	Bristol Mining Co.	Wade Building, Cleveland, Ohio.
2d	Balkan Mining Co.	Cleveland, Ohio, Western Reserve Bldg.
550 L	Nevada Mining Co.	Duluth, Minnesota.
1st	Hollister Mining Co.	1300 Leader-News Bldg., Cleveland, Ohio.
14th	Corrigan, McKinney Co.	Wickliffe, Ohio.
	Corrigan, McKinney Co.	Wickliffe, Ohio.
16th	Corrigan, McKinney Co.	Wickliffe, Ohio.
4th	Jos. E. Thropp	Everett, Pa.
3rd	Judson Mining Co.	First National Bank Bldg., Chicago, Illinois.
2nd	Hudson Iron Mining Co.	Wickliffe, Ohio.
2nd	Hollister Mining Co.	1300 Leader-News Bldg., Cleveland, Ohio.
13th	Corrigan, McKinney Co.	Wickliffe, Ohio.
7th	Hemlock River Mining Co.	Cleveland, Ohio, Western Reserve Bldg.
4th	Corrigan, McKinney Co.	Wickliffe, Ohio.
7th	Verona Mining Co.	Cleveland, Ohio, Western Reserve Bldg.
850 L	Bates Iron Co.	New York City, 25 Broad St.
2nd	Verona Mining Co.	Cleveland, Ohio, Western Reserve Bldg.
4th	Brule Mining Co.	76 Wade Building, Cleveland, Ohio.
4th	Verona Mining Co.	Cleveland, Ohio, Western Reserve Bldg.
10th	Brule Mining Co.	76 Wade Bldg., Cleveland, Ohio.
9th	Munro Mining Co.	55 Erie Co. Bank Bldg., Buffalo, N. Y.
3rd	Oliver Iron Mining Co.	Duluth, Minn., Wolvin Bldg.
550 L	Davidson Ore Mining Co.	403 White Bldg., Buffalo, N. Y.
2nd	Davidson Ore Mining Co.	403 White Bldg., Buffalo, N. Y.
4th	Verona Mining Co.	Western Reserve Bldg., Cleveland, Ohio.
2nd	Jones & Laughlin Ore Co.	3d Ave. & Try St., Pittsburg, Pa.
9th	Munro Mining Co.	55 Erie Co. Bank Bldg., Buffalo, N. Y.
3d	Buffalo Iron Mining Co.	Buffalo, N. Y., Station B.
4th	Mineral Mining Co.	910 Wells Bldg., Milwaukee, Wis.
10th	Oliver Iron Mining Co.	Wolvin Bldg., Duluth, Minn.
1st	Munro Iron Mining Co.	55 Erie Co. Bank Bldg., Buffalo, N. Y.
3d	Cleveland Cliffs Iron Co.	Ishpeming, Mich.
4th	Corrigan, McKinney Co.	Wickliffe, Ohio.
2nd	Wickwire Mining Co.	Buffalo, N. Y.
220 L	Wapama Iron Co.	Iron River, Mich.
4th	Mineral Mining Co.	910 Wells Bldg., Milwaukee, Wis.
5th	Huron Iron Co.	Iron River, Mich.
4th	Miami Metals Co.	Tower Building, Chicago, Ill.
11th	Newport Mining Co.	First National Bank Bldg., Milwaukee, Wis.
12th	Castile Mining Co.	76 Wade Bldg., Cleveland, Ohio.
25th	Hayes Mining Co.	1st National Bank Bldg., San Jose, Cal.
23rd	Brotherton Iron Mining Co.	808 Western Reserve Bldg., Cleveland, Ohio.
19th	Castile Mining Co.	76 Wade Bldg., Cleveland, Ohio.
19th	Corrigan, McKinney Co.	Wickliffe, Ohio.
18th	Oliver Iron Mining Co.	Wolvin Bldg., Duluth, Minn.
20th	Castile Mining Co.	76 Wade Bldg., Cleveland, Ohio.
	Corrigan, McKinney Co.	Wickliffe, Ohio.
11th	Newport Mining Co.	First National Bank Bldg., Milwaukee, Wis.
16th	Verona Mining Co.	Western Reserve Bldg., Cleveland, Ohio.
20th	Newport Mining Co.	First National Bank Bldg., Milwaukee, Wis.
23rd	Oliver Iron Mining Co.	Wolvin Bldg., Duluth, Minn.
11th	Dunn Iron Mining Co.	First National Bank Bldg., Milwaukee, Wis.
	Verona Mining Co.	Western Reserve Bldg., Cleveland, Ohio.
	Oliver Iron Mining Co.	Wolvin Bldg., Duluth, Minn.
23rd	Sunday Lake Iron Co.	Western Reserve Bldg., Cleveland, Ohio.
23rd	Oliver Iron Mining Co.	Wolvin Bldg., Duluth, Minn.
5th	Townsite Mining Co.	Care of Coates and Tweed, Duluth, Minn.
	Wakefield Iron Co.	1300 Leader-News Bldg., Cleveland, Ohio.
1757 L	Charcoal Iron Co. of America	312 Union Trust Bldg., Detroit, Mich.

IRON ORE RESERVES OF MICHIGAN

Range.	1911:		1913:		1914:	
	Developed. Tons.	Prospective. Tons.	Developed. Tons.	Prospective. Tons.	Developed. Tons.	Prospective. Tons.
Gogebic County.....	18,296,721	13,308,279	23,813,191	7,754,388	23,765,158	21,113,192
Iron County: (Iron River District) (Crystal Falls District).....	7,934,687	25,689,155	13,249,683	47,536,233	13,337,913	45,045,227
Menominee: (Dickinson County).....	9,082,750	2,567,700	9,682,994	3,100,458	11,062,700	2,129,950
Marquette: (Marquette County) (Baraga County).....	36,228,742	56,473,068	34,692,034	51,529,275	33,095,467	47,919,718
State.....	71,542,900	98,038,202	81,437,902	109,920,354	81,261,238	116,208,087
Total.....	169,581,102		191,358,256†		197,469,325*	

*Of date January 1, 1914 in addition to which there was in stock 4,954,830 tons of ore, making a grand total of 202,424,155 tons.
†Of date January 1, 1913 in addition to which there was in stock 4,366,349 tons of ore, making a grand total of 195,724,605 tons.
‡Estimated by C. K. Leith for Board of State Tax Commissioners.
§Estimated by C. K. Leith and R. C. Allen for Board of State Tax Commissioners.
¶Estimated by R. C. Allen and O. R. Hamilton for Board of State Tax Commissioners.

IRON ORE RESERVES OF MICHIGAN.—Continued

Range.	1915:		1916:		1917:	
	Developed. Tons.	Prospective. Tons.	Developed. Tons.	Prospective. Tons.	Developed. Tons.	Prospective. Tons.
Gogebic County.....	33,764,457	12,838,990	31,150,667	13,496,137	29,458,730	16,896,310
Iron County: (Iron River District) (Crystal Falls District).....	19,258,369	42,961,778	17,051,882	42,096,186	15,274,255	42,217,450
Menominee: (Dickinson County).....	10,134,241	1,701,540	8,035,306	1,671,055	7,506,771	2,710,080
Marquette: (Baraga County) (Marquette County).....	28,629,708	50,235,280	30,671,677	49,239,115	31,481,814	46,130,241
State.....	91,786,775	107,737,568	86,909,542	106,502,493	83,721,570	107,954,081
Total.....	199,524,343‡		193,412,035**		191,675,651***	

*Of date January 1, 1914 in addition to which there was in stock 4,954,830 tons of ore, making a grand total of 202,424,155 tons.
†Of date January 1, 1915 in addition to which there was in stock 6,596,195 tons of ore, making a grand total of 206,120,538 tons.
**Of date January 1, 1916 in addition to which there was in stock 5,608,465 tons of ore, making a grand total of 199,029,503 tons.
***Of date January 1, 1917 in addition to which there was in stock 5,132,343 tons of ore, making a grand total of 196,750,302 tons.
§Estimated by R. C. Allen and O. R. Hamilton for Board of State Tax Commissioners.

IRON ORE RESERVES OF MICHIGAN—Concluded

Range.	1918 ⁴	
	Developed. Tons.	Prospective. Tons.
Gogebic County.....	42,115,292	12,970,233
Iron County.....	15,129,721	39,931,634
(Iron River District) (Crystal Falls District)	5,634,660	3,048,671
Menominee: (Dickinson County).....	30,900,191	45,363,518
Marquette: (Baraga County) (Marquette County).....	93,779,864	101,314,056
State.....		
Total.....	195,093,920****	

***Of date January 1, 1918 in addition to which there was in stock 5,049,589 tons of ore, making a grand total of 200,143,509 tons.

⁴Estimated by R. C. Allen and O. W. Wheelwright for Board of State Tax Commissioners.

APPRAISED VALUE OF MICHIGAN IRON MINES¹

Range.	Previous appraisals.						
	1911	1912	1913	1914	1915	1916	1917
Gogebic.....	\$28,338,100	\$27,226,300	\$25,849,873	\$34,667,028	\$34,377,792	\$34,210,394	\$34,288,150
Iron County: (Iron River District) (Crystal Falls District).....	15,018,475	15,359,664	20,978,709	21,275,945	20,856,919	20,977,257	21,992,908
Menominee: (Dickinson County).....	7,427,500	7,240,625	6,641,925	6,413,003	5,906,443	5,758,461	5,816,867
Marquette: (Baraga County) (Marquette County).....	34,745,000	*31,270,500	29,063,714	29,216,139	28,616,453	29,791,496	30,092,923
State.....	\$85,529,075	\$81,097,089	\$82,534,221	\$91,572,115	\$89,757,607	\$90,737,608	\$92,190,908

¹Ten per cent cut from 1911 assessment (approximate figure).

²By Board of State Tax Commissioners.

APPRAISED VALUE OF MICHIGAN IRON MINES.¹—Concluded

Range.	1918 appraisal.		Combined value of mine and ore in stock.	Total tonnage in mine and in stock Jan. 1, 1918.	Assessed value per ton.
	Mine.	Ore in stock.			
Gogebic.....	\$37,183,759	\$6,812,252	\$43,996,011	55,813,661	\$ 78826
Iron County: (Iron River District) (Crystal Falls District).....	19,004,470	6,649,687	25,654,157	57,070,102	.44952
Menominee: (Dickinson County).....	4,323,596	1,475,506	5,799,102	9,084,445	.63835
Marquette: (Baraga County) (Marquette County).....	25,270,667	7,297,502	32,568,169	78,175,301	.41660
State.....	\$85,782,492	\$22,234,947	\$108,017,439	\$200,143,509	\$ 53969

¹By Board of State Tax Commissioners.

VALUE OF MICHIGAN IRON ORE SHIPMENTS 1917 FROM REPORT OF APPRAISER OF MINES TO BOARD OF STATE TAX COMMISSIONERS 1918*

Range.	Gross receipts.	† "Beyond the Mine" charges.	Net receipts f. o. b. at the mine.	Shipment, Tons, 1917.	Value per ton f. o. b. mine 1917.	Value per ton f. o. b. mine 1916.
Gogebic—Gogebic County.....	\$35,620,597.96	\$10,329,780.76	\$25,290,817.20	7,003,838	\$3,61090	\$2,70215
Iron River.....	17,528,203.24	4,925,317.36	12,602,885.88	13,956,989	3,18498	2,04989
Crystal Falls.....	9,381,259.13	2,400,715.03	6,980,544.10	11,967,962	3,54709	2,61542
Menominee—Dickinson County.....	19,663,527.87	4,577,283.74	15,086,244.13	34,727,942	3,19083	2,41339
Marquette.....						
Marquette County.....						
Baraga County.....						
State of Michigan.....	\$82,193,588.20	\$22,233,096.89	\$59,960,491.31	17,656,731	\$3,39590	\$2,46344

†Includes: 1. Rail freight.
2. Boat freight.
3. Cargo insurance.
4. Lower lake analyses.
5. Selling commissions.

*From report of Appraiser of Mines to Board of State Tax Commissioners 1918.

1917 U. S. Production = 75,324,000 gross tons, ² valued at \$236,178,000 or average price of \$3.12 per ton. Shipments 75,649,000 gross tons.

†Of which the Lake Superior District produced 63,964,000 tons, or 85 per cent of the total. Tonnage mined during 1917 is given by U. S. G. S. as 75,324,000 gross tons of which Michigan mined..... 45,053,000 tons
Alabama mined..... 17,709,000 tons
Wisconsin mined..... 6,707,000 tons
New York mined..... 1,202,000 tons
All other states mined..... 1,365,000 tons
Total..... 75,324,000 tons.

¹Does not include 242 tons from Wickwire Mine and 23,177 tons from Youngs Mine for which no receipts were reported. ²Does not include 7,134 tons from Penn Group for which no receipts were reported. ³Does not include 88,178 tons from Queen Group, 22,560 tons from Adams Mine and 41,526 tons from Stegmiller Mine for which no receipts were reported.

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE MARQUETTE RANGE, MARQUETTE AND BARAGA COUNTIES, MICH.

Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports by the operators

	1906. Per ton.	1907. Per ton.	1908. Per ton.	1909. Per ton.	1910. Per ton.	1911. Per ton.
Cost of Mining.						
1. General office expenses.....	\$0.08148	\$0.11454	\$0.06125	\$0.05057	\$0.05898	\$0.08927
2. Fire insurance.....	0.7846	1.1416	.06121	.04739	.05768	.08603
3. Employers liability insurance.....	0.0075	.00044	.00564	.00397	.00328	.00351
4. Taxes.....	0.0037	.00042	.00544	.00378	.00321	.00338
5. Depreciation.....			.00441	.00339	.00510	.01152
6. Mining.....	.05630	.06870	.00439	.00339	.00509	.01119
7. Exploration and development.....	.05567	.06863	.08039	.08026	.07564	.15193
8. Construction.....			.07922	.07867	.07471	.14834
9. Total cost at mine.....			.09942	.09080	.05299	.04964
	1.33839	1.40609	1.52434	1.50437	1.38899	1.50322
	1.33226	1.40609	1.51431	1.50317	1.37501	1.48929
	.06841	.09228	.09939	.07166	.06095	.08208
	.05708	.08664	.09939	.06360	.05389	.07039
	.08579	1.0932	.02212	.06506	.08351	.07106
	.06954	1.0932	.02212	.05813	.06447	.07061
	1.63112	1.79137	1.89756	1.87008	1.72944	2.01223
	1.58438	1.78526	1.88550	1.84893	1.68613	1.96943
Beyond the Mine Cost.						
10. Rail freight.....	.26842	.27659	.29435	.29444	.29841	.23228
11. Boat freight.....	.26842	.27659	.29425	.29427	.29841	.22936
12. Cargo insurance.....	.49696	.48986	.44747	.46945	.48127	.35463
13. Analysis at lower lake ports.....	.00140	.00192	.00021	.00085	.00088	.00113
14. Selling commissions.....	.00047	.00031	.00022	.00069	.00099	.00180
15. Total "Beyond the Mine" cost.....	.00915	.01198	.00629	.01873	.01852	.02815
	.77640	.78066	.75864	.78419	.80007	.61797
	7.7640	7.8066	7.5854	7.8402	8.0007	6.1466

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE MARQUETTE RANGE,
MARQUETTE AND BARAGA COUNTIES, MICH.—Continued

Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports by the operators.

	1906. Per ton.	1907. Per ton.	1908. Per ton.	1909. Per ton.	1910. Per ton.	1911. Per ton.
Beyond the mine cost.—Con.						
16. Total cost of delivery.....		\$2.57203	\$2.65620	\$2.65497	\$2.52951	\$2.63020
17. Royalties.....	a	2.36078	2.64404	2.62305	2.62305	2.48620
	b	12239	21741	18283	18283	21752
18. Total cost of delivery to operator.....	a	12239	13238	13238	13238	24763
	b	2.52991	20704	20704	20704	24036
	a	2.48317	2.70441	2.87361	2.87361	2.87783
	b		2.69830	2.85108	2.81089	2.82445
19. Receipts from sale of ore.....						
20. Profit or loss to operator.....	a	3.37320	3.77856	3.80000	3.51487	3.70991
	b	84329	1.07415	92369	67675	96288
21. Total profit (operator's profit or loss plus royalty and de- preciation).....	a	89003	1.08027	94892	70448	1.01780
	b	96568	1.20653	1.24052	95140	1.23339
22. Assessed valuation per ton by Board of State Tax Commis- sioners.....	a	1.01242	1.21265	1.25538	.97272	1.06035
	b					1.09602
						37480

a. Total of all operations

b. Total of all operations excluding non-producers.

Note.—All items in 1906 and 1907 figured on basis of tons shipped, tons mined not available.
In all other years items 1 to 9 inclusive figured on tons mined, items 10 to 17 inclusive and item 19 on tons shipped.

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE MARQUETTE RANGE,
MARQUETTE AND BARAGA COUNTIES, MICH.—Continued

Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports by the operators

	1912. Per ton.	1913. Per ton.	1914. Per ton.	1915. Per ton.	1916. Per ton.	1917. Per ton.
Cost of Mining.						
1. General office expenses.....	\$0.09194	\$0.06932	\$0.07754	\$0.05827	\$0.06977	\$0.09545
2. Fire insurance.....	.08885	.06680	.07091	.05686	.08857	.09375
3. Employer's liability insurance.....	.00388	.00357	.00435	.00378	.00292	.00271
4. Taxes.....	.00370	.00341	.00389	.00343	.00272	.00267
5. Depreciation.....	.01135	.01850	.01869	.02069	.01841	.01747
	.01135	.01840	.01854	.02069	.01827	.01735
6. Mining.....	.14140	.12160	.12630	.13616	.11330	.12925
	.13837	.11820	.11917	.13074	.10877	.12297
7. Exploration and development.....	.08597	.08817	.14911	.11265	.10585	.09152
	.08570	.08803	.13785	.11074	.10473	.09109
8. Construction.....	1.46207	1.45000	1.31975	1.34464	1.26168	1.60130
	1.45260	1.44664	1.30840	1.33367	1.26014	1.60130
9. Total cost at mine.....	.07939	.06080	.07550	.06522	.08474	.08474
	.06985	.05170	.03729	.06522	.08223	.02856
	.07912	.08205	.15827	.05274	.17699	.25337
	.06096	.04476	.12717	.05266	.15086	.16681
	1.95512	1.87401	1.92951	1.61115	1.68130	2.22581
	1.91138	1.81794	1.82292	1.57401	1.64756	2.12630
Beyond the Mine Cost.						
10. Rail freight.....	26284	30700	28232	29318	30783	30957
11. Boat freight.....	25878	30367	27765	29318	30783	30957
12. Cargo insurance.....	29943	38732	31371	32504	43619	68491
	29838	38265	30677	32504	43619	68491
13. Analysis at lower lake ports.....	.00191	.00117	.00091	.00127	.00176	.00399
	.00191	.00116	.00091	.00127	.00176	.00399
14. Selling commissions.....	.00094	.00465	.00411	.00375	.00432	.00493
	.00094	.00411	.00411	.00375	.00432	.00493
15. Total "Beyond the Mine" cost.....	01477	02128	01749	01375	01923	01631
	57987	62040	61597	63699	76933	1.01971
	57478	72142	60854	63697	76920	1.01971

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE MARQUETTE RANGE,
MARQUETTE AND BARAGA COUNTIES, MICH.—*Concluded*

Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports by the operators

	1912. Per ton.	1913. Per ton.	1914. Per ton.	1915. Per ton.	1916. Per ton.	1917. Per ton.	1918. Per ton.
Beyond the Mine Cost.— <i>Con.</i>							
16. Total cost of delivery	\$2. 53501	\$2. 59543	\$2. 54805	\$2. 24814	\$2. 45063	\$3. 24552	
17. Royalties	2. 48616	2. 53045	2. 42833	2. 21098	2. 41676	3. 14601	
18. Total cost of delivery to operator	4. 9117	4. 9221	4. 87638	4. 42112	4. 83309	6. 38653	
Profit and Loss.							
19. Receipts from sale of ore	2. 90551	3. 15906	2. 82446	2. 52302	3. 17105	4. 19400	
20. Profit or loss to operator	1. 7935	. 37142	-. 05868	. 09368	. 52963	. 68354	
21. Total profit (operator's profit or loss plus royalty and depreciation) . . . . .	. 45647	. 63180	. 42552	. 38753	. 82627	1. 04000	
22. Assessed valuation per ton by Board of State Tax Commissioners . . . . .	. 50505	. 69664	. 53398	. 42278	. 85902	1. 13908	\$0. 41660

a. Total of all operations.
b. Total of all operations excluding non-producers.
Note.—All items in 1906 and 1907 figured on basis of tons shipped, tons mined not available.
In all other years items 1 to 9 inclusive figured on tons mined, items 10 to 17 inclusive and item 19 on tons shipped.

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE GOGEBIC RANGE, GOGEBIC COUNTY, MICH.

Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports by the operators.

	1906. Per ton.	1907. Per ton.	1908. Per ton.	1909. Per ton.	1910. Per ton.	1911. Per ton.
Cost of Mining.						
1. General office expense	\$0. 07006	\$0. 06827	\$0. 07218	\$0. 06973	\$0. 05213	\$0. 08225
2. Fire insurance . . . . .	. 06908	. 06734	. 07092	. 06901	. 05119	. 08225
3. Employers' liability insurance . . . . .	. 00226	. 00256	. 00431	. 00378	. 00415	. 00708
4. Taxes . . . . .	. 00218	. 00245	. 00419	. 00374	. 00413	. 00708
5. Depreciation . . . . .	. 05509	. 05834	. 00379	. 00495	. 00664	. 02721
6. Mining . . . . .	. 05486	. 05809	. 06429	. 00495	. 00664	. 02721
7. Exploration and development . . . . .	. 00648	. 00898	. 06389	. 07387	. 07522	. 19711
8. Construction	1. 22206	1. 37212	1. 12199	1. 4554	1. 2335	1. 5555
9. Total cost at mine	1. 21186	1. 35435	1. 45340	1. 36994	1. 32950	1. 43033
Beyond the Mine Cost.						
10. Rail freight . . . . .	. 08821	. 12328	. 08133	. 09671	. 14909	. 20058
11. Boat freight	20230	22745	24725	19922	08334	12028
12. Cargo insurance	1. 64646	1. 86100	2. 05535	2. 01451	1. 82385	2. 22039
13. Analysis at lower lake ports	1. 63497	1. 84194	2. 04676	1. 91483	1. 82246	2. 22039
14. Selling commissions . . . . .	. 39625	. 39142	. 39280	. 39047	. 39285	. 37326
15. Total "Beyond the Mine" cost . . . . .	. 39625	. 39142	. 39280	. 39047	. 39285	. 37326
16. Total cost of delivery to operator	7. 3723	7. 3122	7. 3122	7. 3122	7. 3122	7. 3122
17. Total cost of delivery to operator	7. 3733	7. 3122	7. 3122	7. 3122	7. 3122	7. 3122
18. Total cost of delivery to operator	7. 3733	7. 3122	7. 3122	7. 3122	7. 3122	7. 3122
19. Total cost of delivery to operator	7. 3733	7. 3122	7. 3122	7. 3122	7. 3122	7. 3122
20. Total cost of delivery to operator	7. 3733	7. 3122	7. 3122	7. 3122	7. 3122	7. 3122
21. Total cost of delivery to operator	7. 3733	7. 3122	7. 3122	7. 3122	7. 3122	7. 3122
22. Total cost of delivery to operator	7. 3733	7. 3122	7. 3122	7. 3122	7. 3122	7. 3122

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE GOGEBIC RANGE, GOGEBIC COUNTY, MICH.—Continued
 Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports by the operators

	1906. Per ton.	1907. Per ton.	1908. Per ton.	1909. Per ton.	1910. Per ton.	1911. Per ton.
Beyond the Mine Cost.— <i>Con.</i>						
16. Total cost of delivery.....	{ a \$2. 81909	\$3. 02297	\$3. 14095	\$3. 10406	\$2. 97092	\$3. 11643
17. Royalties.....	{ b 2. 80760	3. 00391	3. 13236	3. 00438	2. 96953	3. 11643
18. Total cost of delivery to operator.....	{ a 3.6788	4.3373	4.3769	4.3333	4.2650	3.2388
	{ b 3.18714	3.45670	3.57857	3.57729	3.39742	3.2277
	{ b 3.17548	3.43740	3.56977	3.43521	3.39521	3.44031
Profit and Loss.						
19. Receipts from sale of ore.....	4. 05982	4. 73564	3. 99683	4. 07636	4. 69212	3. 87255
20. Profit or loss to operator.....	87268	1. 27893	41826	51907	1. 29470	43224
21. Total profit (operator's profit or loss plus royalty and de- preciation).....	88433	1. 29815	42706	54100	1. 29691	43335
22. Assessed valuation per ton by Board of State Tax Commis- sioners.....	1. 25869	1. 73164	97787	1. 17784	1. 84455	91167
		1. 74070	98646	1. 21752	1. 84594	91167
						89663

a. Total of all operations.
 b. Total of all operations excluding non-producers.
 Note.—All items in 1906 and 1907 figured on basis of tons shipped, tons mined not available.
 In all other years items 1 to 9 inclusive figured on tons mined, items 10 to 17, and item 19 on tons shipped.

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE GOGEBIC RANGE, GOGEBIC COUNTY, MICH.—Continued
 Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports by the operators

	1912. Per ton.	1913. Per ton.	1914. Per ton.	1915. Per ton.	1916. Per ton.	1917. Per ton.
Cost of Mining.						
1. General Office expenses.....	{ a \$0. 06157	\$0. 05763	\$0. 06841	\$0. 05757	\$0. 07140	0. 08594
2. Fire insurance.....	{ b 0.06157	0.05760	0.06837	0.05757	0.07138	0.08594
3. Employer's liability insurance.....	{ a 0.00593	0.0526	0.0517	0.0514	0.0345	0.0414
	{ b 0.1913	0.2207	0.0506	0.0514	0.0343	0.0414
4. Taxes.....	{ a 0.1913	0.2207	0.2667	0.1998	0.1898	0.2294
	{ b 13478	1.2522	14182	0.1998	0.1898	0.2294
5. Depreciation.....	{ a 11307	1.2212	14122	1.6451	1.1574	1.2294
	{ b 11307	1.2644	0.9945	1.6340	1.1412	1.2244
6. Mining.....	{ a 1. 19161	1.2594	0.9871	2.2294	1.4381	2.9777
	{ b 1. 37673	1.37673	1.17605	1.00309	1.13900	1.42215
7. Exploration and development.....	{ a 1.2864	1.8028	2.3965	1.6489	1.4048	1.0468
	{ b 1.2864	1.7977	2.3377	1.6489	1.3996	1.0468
8. Construction.....	{ a 0.4681	2.4327	1.8114	1.3189	1.2036	2.5594
	{ b 1.70154	1.8736	1.8082	1.3189	1.0196	2.5594
9. Total cost at mine.....	{ a 1. 70154	2. 13690	1. 94400	1. 77001	1. 60941	2. 31650
	{ b 1. 70154	2. 07685	1. 93032	1. 76875	1. 58558	2. 31650
Beyond the Mine Cost.						
10. Rail freight.....	{ a 38032	44526	40792	40970	43369	44573
	{ b 38032	44520	40762	40970	43369	44573
11. Boat freight.....	{ a 46717	55204	40087	43081	54064	91217
	{ b 46717	55204	40087	43081	54064	91217
12. Cargo insurance.....	{ a 0.0075	0.0132	0.0097	0.0136	0.0153	0.0195
	{ b 0.0075	0.0132	0.0097	0.0136	0.0153	0.0195
13. Analysis at lower lake ports.....	{ a 0.0222	0.0248	0.0288	0.0289	0.0336	0.0317
	{ b 0.0222	0.0248	0.0288	0.0289	0.0336	0.0317
14. Selling commissions.....	{ a 0.4801	0.5374	0.4889	0.4929	0.5261	0.5656
	{ b 0.4801	0.5374	0.4889	0.4929	0.5261	0.5656
15. Total "Beyond the Mine" cost.....	{ a 89847	1. 05484	86153	89405	1. 03183	1. 41958
	{ b 89847	1. 05477	86083	89405	1. 03183	1. 41958

Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports of the operator

	1912.	1913.	1914.	1915.	1916.	1917.	1918.
	Per ton.	Per ton.	Per ton.	Per ton.	Per ton.	Per ton.	Per ton.
Beyond the Mine Cost.—Con.							
16. Total cost of delivery.....	(a) \$2. 60001	\$3. 19174	\$2. 50553	\$2. 66406	\$2. 64124	\$3. 73608	.....
	(b) 2. 60001	3. 13162	2. 79115	2. 66280	2. 61741	3. 73558	.....
17. Royalties.....	(a) 2. 26506	3. 01455	3. 1961	2. 29208	3. 2184	5. 3201	.....
	(b) 2. 26445	3. 0975	3. 1582	2. 29154	3. 2067	5. 3166	.....
18. Total cost of delivery to operator.....	(a) 2. 86507	3. 40633	3. 12514	2. 95614	2. 96308	4. 26809	.....
	(b) 2. 86446	3. 43437	3. 10997	2. 95434	2. 93808	4. 26724	.....
Profit and Loss.							
19. Receipts from sale of ore.....	3. 30027	4. 11367	3. 32000	3. 13869	3. 73400	4. 88694	.....
20. Profit or loss to operator.....	4. 3520	6. 1724	2. 0386	18.255	7. 7092	6. 1865	.....
21. Total profit (operator's profit or loss plus royalty and depreciation).....	8. 1333	1. 0437	2. 503	18.435	1. 23663	1. 44843	.....
22. Assessed valuation per ton by Board of State Tax Commissioners.....	8. 1333	1. 10799	6. 8556	6. 8583	1. 26040	1. 44893	.....
		. 81887	. 75715	. 71260	. 74478	. 73405	\$0. 78826

a Total of all operations.

b Total of all operations excluding non-producers.

Note.—All items in 1906 and 1907 figured on basis of tons shipped, tons mined not available. In all other years items 1 to 9 inclusive figured on tons mined, items 10 to 17 and item 19 on tons shipped.

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE MENOMINEE RANGE, DICKINSON COUNTY, MICH.

Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports of the operators.

	1906.	1907.	1908.	1909.	1910.	1911.
	Per ton.	Per ton.	Per ton.	Per ton.	Per ton.	Per ton.
Cost of Mining.						
1. General office expenses.....	\$0. 06131	\$0. 07640	\$0. 06687	\$0. 04570	\$0. 04250	\$0. 06026
	(a) .06115	.07604	.06655	.04570	.04250	.05975
	(b) .00102	.00121	.00768	.00570	.00531	.00701
2. Fire insurance.....	.00098	.00114	.00758	.00551	.00531	.00701
3. Employers liability insurance.....	.....	.....	.00341	.00143	.00605	.00334
	(a) .04875	.06366	.00341	.00143	.00605	.00333
	(b) .04844	.06331	.11040	.10260	.10141	.15691
4. Taxes.....	.00528	.00691	.10967	.10260	.10141	.15665
5. Depreciation.....	.09528	.00691	.16494	.14697	.14071	.12837
6. Mining.....	98.118	1. 00691	1. 16123	1. 14697	1. 14071	1. 12837
	(a) 98.118	1. 21721	1. 20207	1. 21584	1. 26711	1. 34760
	(b) 98.118	1. 21721	1. 20110	1. 21584	1. 26711	1. 34686
7. Exploration and development.....	.07647	.08296	.13769	.09243	.13863	.16300
8. Construction.....	14.287	.08296	.13769	.09243	.13863	.16300
	(a) 13.598	.16889	.19086	.10095	.07037	.05983
	(b) 1. 31888	.16889	.19086	.10095	.07037	.05983
9. Total cost at mine.....	1. 61720	1. 68858	1. 85392	1. 71143	1. 77209	1. 92290
	(a) 1. 30948	1. 61642	1. 87809	1. 71143	1. 77209	1. 92290
	(b) 1. 30948	1. 61642	1. 87809	1. 71143	1. 77209	1. 92290
"Beyond the Mine" Cost.						
10. Rail freight.....	3. 2025	3. 1908	3. 0214	3. 2006	3. 0832	3. 1708
	(a) 3. 2025	3. 1908	3. 0214	3. 2006	3. 0832	3. 1708
	(b) 3. 2025	3. 1908	3. 0214	3. 2006	3. 0832	3. 1708
11. Boat freight.....	3. 4010	3. 3683	3. 7593	3. 7786	3. 9260	3. 3087
	(a) 3. 4010	3. 3683	3. 7593	3. 7786	3. 9260	3. 3087
	(b) 3. 4010	3. 3683	3. 7593	3. 7786	3. 9260	3. 3087
12. Cargo insurance.....	.00081	.00063	.....	.00207	.00205	.00190
	(a) .00081	.00063	.....	.00207	.00205	.00190
	(b) .00081	.00063	.....	.00207	.00205	.00190
13. Analysis at lower lake ports.....	.....	.....	.....	.....	.....	.....
	(a) .01403	.01336	.00920	.01645	.02251	.00010
	(b) .01403	.01336	.00920	.01645	.02251	.00010
14. Selling commissions.....	.71259	.70049	.70049	.76037	.80337	.65144
	(a) .71259	.70049	.70049	.76037	.80337	.65144
	(b) .71259	.70049	.70049	.76037	.80337	.65144
15. Total "Beyond the Mine" Cost.....	.03740	.04355	.01822	.04393	.07789	.00934
Unclassified.....	.....	.....	.....	.....	.....	.....

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE MENOMINEE RANGE,
DICKINSON COUNTY, MICH.—Continued.

Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports of the operators.

	1906. Per ton.	1907. Per ton.	1908. Per ton.	1909. Per ton.	1910. Per ton.	1911. Per ton.
Beyond the Mine Cost.— <i>Con.</i>						
16. Total cost of delivery.....	\$2. 02947	\$2. 33065	\$2. 58441	\$2. 47180	\$2. 57546	\$2. 60776
17. Royalties.....	2. 02207	2. 32987	2. 57325	2. 47180	2. 57546	2. 59942
18. Total cost of delivery to operator.....	2.20039	2.88258	2.38856	2.52998	30194	24478
Profit and Loss.	2.24986	2.82297	2.82297	2.72478	2.87740	2.85254
19. Receipts from sale of ore.....	2.24246	2.61245	2.81181	2.72478	2.87740	2.84420
20. Profit or loss to operator.....	3. 13222	3. 89632	2. 93813	3. 32263	3. 49099	2. 79390
21. Total profit (operator's profit or loss plus royalty and de- preciation).....	.88236	1. 28309	1.15116	.59785	.61359	.05864
22. Assessed valuation per ton by Board of State Tax Commis- sioners.....	1. 10803	1. 57258	.51866	.99780	1. 05624	.31551
	1. 11542	1. 57335	.52611	.99780	1. 05624	.32266
						.63752

a. Total of all operations.

b. Total of all operations excluding non-producers.

Note.—All items in 1906 and 1907 figured on basis of tons shipped, tons mined not available.

In all other years items 1 to 9 inclusive figured on tons mined, items 10 to 17 inclusive and item 19 on tons shipped.

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE MENOMINEE RANGE,
DICKINSON COUNTY, MICH.—Continued

Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports of the operators

	1912. Per ton.	1913. Per ton.	1914. Per ton.	1915. Per ton.	1916. Per ton.	1917. Per ton.
Cost of Mining.						
1. General office expenses.....	\$0. 06289	\$0. 04758	\$0. 06062	\$0. 06662	\$0. 05793	\$0. 06507
2. Fire insurance.....	.06084	.04667	.05911	.06192	.05687	.06381
3. Employers liability insurance.....	.00749	.00595	.00763	.00714	.00577	.00465
4. Taxes.....	.01800	.01826	.01805	.01670	.00682	.00458
5. Depreciation.....	.01074	.01823	.01801	.01670	.01807	.02046
6. Mining.....	18.124	16.429	17.651	17.430	11.639	13.316
7. Exploration and development.....	1.778	1.6248	1.7584	1.6985	1.1474	1.3154
8. Construction.....	1.54642	1.4460	1.2758	1.4988	1.6714	1.4266
9. Total cost at mine.....	1.54135	1.42418	1.56567	1.52111	1.74464	1.3723
"Beyond the Mine" Cost.	1.6610	1.4462	1.5022	1.54777	1.6071	2. 01925
10. Rail right.....	2.21059	2.10683	2.24246	2.14317	1.99461	2. 42621
11. Boat freight.....	2.18726	2.09182	2.23443	2.11344	1.99107	2. 41719
12. Cargo insurance.....	.28654	.33679	.31258	.42976	.43243	.47218
13. Analysis at lower lake ports.....	.27718	.33176	.31258	.42968	.43243	.47218
14. Selling commissions.....	.23712	.29436	.25476	.31703	.40788	.47170
15. Total "Beyond the Mine" cost.....	2.3061	2.8994	2.5476	3.1703	4.0788	4.71370
Unclassified.....	.00038	.00048	.00076	.00068	.00084	.00091
	.00036	.00047	.00076	.00068	.00084	.00091
	.00010	.00093	.00110	.00207	.00227	.00244
	.01117	.01677	.01165	.02063	.02905	.03080
	.00949	.01654	.01158	.02014	.02905	.03080
	.58939	.72872	.61438	.72017	.87272	1. 22003
	.57172	.71899	.61431	.76960	.87242	1. 22003
	.05408	.07939	.03353			

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE MENOMINEE RANGE,
DICKINSON COUNTY, MICH.—*Concluded*
Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports of the operators

	1912. Per ton.	1913. Per ton.	1914. Per ton.	1915. Per ton.	1916. Per ton.	1917. Per ton.	1918. Per ton.
Beyond the Mine Cost.— <i>Con.</i>							
16. Total cost of delivery.....	\$2. 79998	\$2. 83555	\$2. 85684	\$2. 91334	\$2. 86733	\$3. 64624	
17. Royalties.....	(a) 2. 75898	2. 81081	2. 84774	2. 88304	2. 86354	3. 63722	
	(b) 1. 9541	2. 1612	1. 8070	1. 9852	2. 4707	4. 3431	
18. Total cost of delivery to operator.....	(a) 2. 9513	3. 02406	3. 03754	3. 11186	3. 11440	4. 08055	
	(b) 2. 95539	3. 02487	3. 02584	3. 07157	3. 10867	4. 07117	
Profit and Loss.							
19. Receipts from sale of ore.....	2. 61715	3. 08203	2. 50720	2. 83601	3. 48817	4. 76762	
20. Profit or loss to operator.....	(a) 3. 7824	.03036	.53034	.27585	.37377	.68707	
	(b) 3. 3496	.05716	.51864	.23556	.37950	.69645	
21. Total profit (operator's profit or loss plus royalty and depreciation).....	(a) .02626	.39108	.22206	.07255	.78798	1. 26404	
	(b) .00282	.40622	.21296	.08498	.78534	1. 26404	
22. Assessed valuation per ton by Board of State Tax Commissioners.....		.51957	.46544	.46981	.55920	.54921	\$0. 63835
a Total of all operations.							
b Total of all operations excluding non-producers.							

Note.—All items in 1906 and 1907 figured on basis of tons shipped, tons mined not available.
In all other years items 1 to 9 inclusive figured on tons mined, items 10 to 17 inclusive and item 19 on tons shipped

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE IRON RIVER AND CRYSTAL FALLS DISTRICTS, MICH.
Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports by the operators

	1906. Per ton.	1907. Per ton.	1908. Per ton.	1909. Per ton.	1910. Per ton.	1911. Per ton.
Cost of Mining.						
1. General office expenses.....	(a) \$0. 02142	\$0. 03991	\$0. 06483	\$0. 05917	\$0. 07662	\$0. 09376
	(b) .01914	.03593	.06270	.05847	.07328	.08936
2. Fire insurance.....	(a) .00502	.00546	.00701	.00367	.00434	.00495
	(b) .00499	.00539	.00392	.00354	.00409	.00495
3. Employers liability insurance.....	(a) .00322	.00322	.00322	.00322	.00653	.00652
	(b) .00322	.00322	.00322	.00322	.00653	.00652
4. Taxes.....	(a) .01892	.01942	.03320	.02433	.03625	.03472
	(b) .01634	.01937	.03320	.02433	.03625	.03472
5. Depreciation.....	(a) .01089	.01409	.12249	.13189	.11837	.15109
	(b) .01089	.01409	.12249	.13189	.11837	.15109
6. Mining.....	(a) 1. 00419	1. 08556	1. 25682	1. 8412	1. 17976	1. 21725
	(b) .95729	.84431	1. 25682	1. 8412	1. 17976	1. 21725
7. Exploration and development.....	(a) 26340	10211	22709	86012	24600	1. 20465
	(b) 14520	8955	10211	86012	24600	1. 20465
8. Construction.....	(a) 24753	30177	53603	11833	17450	10174
	(b) 20844	25786	53603	11833	17450	10174
9. Total cost at mine.....	(a) 1. 57137	1. 78346	1. 96529	1. 43899	1. 84702	1. 87503
	(b) 1. 34229	1. 58363	1. 81934	1. 38182	1. 68742	1. 79168
"Beyond the Mine" Cost.						
10. Rail freight.....	(a) .38136	.39220	.37714	.38548	.38549	.36687
	(b) .38134	.39220	.37714	.38548	.38549	.36687
11. Boat freight.....	(a) .56819	.57313	.37474	.43736	.47341	.32513
	(b) .56814	.57313	.37474	.43736	.47341	.32513
12. Cargo insurance.....	(a) .00070	.00079	.00114	.00079	.00114	.00070
	(b) .00070	.00079	.00114	.00079	.00114	.00070
13. Analysis at lower lake ports.....	(a) .08732	.08388	.08556	.09509	.09074	.09058
	(b) .08732	.08388	.08556	.09509	.09074	.09058
14. Selling commissions.....	(a) 1. 03687	1. 04530	.92411	.07241	.07734	.06759
	(b) 1. 03679	1. 04530	.92411	.07241	.07734	.06759
15. Total "Beyond the Mine" cost.....	(a) 1. 03679	1. 04530	.85044	.90113	.93712	.76380
	(b) 1. 03679	1. 04530	.85044	.90113	.93712	.76380

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE IRON RIVER AND CRYSTAL FALLS DISTRICTS, MICH.—Continued

Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports by the operators

	1906. Per ton.	1907. Per ton.	1908. Per ton.	1909. Per ton.	1910. Per ton.	1911. Per ton.
Beyond the Mine Cost.—Con.						
16. Total cost of delivery.....	\$2. 60824	\$2. 83176	\$2. 81573	\$2. 33012	\$2. 78418	\$2. 63583
17. Royalties.....	2. 37908	2. 63193	2. 66978	2. 28295	2. 62454	2. 51875
	20623	27628	25170	23845	27167	23104
	19862	27032	24005	23202	24874	23370
18. Total cost of delivery to operator.....	2. 81447	3. 10804	3. 06743	2. 56857	3. 05885	2. 86687
	2. 57770	2. 90225	2. 90983	2. 51497	2. 87328	2. 74245
Profit and Loss.						
19. Receipts from sale of ore.....	3. 10194	3. 95240	3. 01281	3. 27907	3. 66809	2. 89477
20. Profit or loss to operator.....	28747	84436	5462	61224	61224	62790
21. Total profit (operator's profit or loss plus royalty and de- preciation).....	50459	1. 05015	10298	76410	79481	15232
22. Assessed valuation per ton by Board of State Tax Commis- sioners.....	73375	1. 13473	31948	1. 08084	1. 00228	40996
		1. 33456	46416	1. 12735	1. 16192	52654
						44666

a. Total of all operations.

b. Total of all operations excluding non-producers.

Note.—All items in 1906 and 1907 figured on basis of tons shipped, tons mined not available.

In all other years items 1 to 9 inclusive figured on tons mined, items 10 to 17 and item 19 on tons shipped.

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE IRON RIVER AND CRYSTAL FALLS DISTRICTS, MICH.—Continued

Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports by the operators

	1912. Per ton.	1913. Per ton.	1914. Per ton.	1915. Per ton.	1916. Per ton.	1917. Per ton.
Cost of Mining.						
1. General office expenses.....	\$0. 07995	\$0. 08637	\$0. 11919	\$0. 06907	\$0. 05838	\$0. 08193
	07587	07266	11035	06581	05825	08164
2. Fire insurance.....	00586	00733	00616	00512	00410	00427
	00446	00647	00533	00464	00404	00427
3. Employers liability insurance.....	01008	02012	02950	01907	01887	02620
	00962	01803	02766	01887	01873	02620
4. Taxes.....	08153	09690	13931	11820	08226	10379
	06482	08180	11462	10118	07460	09465
5. Depreciation.....	11376	12853	13560	09768	10548	12976
	11157	12308	12660	08973	10414	12976
6. Mining.....	1. 10252	1. 18226	1. 29722	0. 93148	1. 14334	1. 43898
	07803	1. 17207	1. 26056	0. 91655	1. 13965	1. 43898
7. Exploration and development.....	26915	28649	31585	16197	07648	07078
	16993	14967	21772	13915	07641	05789
8. Construction.....	19837	30065	21799	08619	11567	07396
	11781	18762	19341	06803	08335	07134
9. Total cost at mine.....	1. 86122	2. 10865	2. 26082	1. 48878	1. 49913	1. 92987
	1. 63211	1. 81136	2. 05625	1. 40396	1. 45506	1. 90473
"Beyond the Mine" Cost.						
10. Rail freight.....	37014	42886	44558	43875	42851	47523
	36538	41676	41958	42991	42851	47523
11. Boat freight.....	23496	27170	26330	27286	36345	71340
	23310	26135	24333	26601	36345	71340
12. Cargo insurance.....	00028	00096	00097	00113	00140	00200
	00028	00092	00089	00110	00140	00200
13. Analysis at lower lake ports.....	00046	00227	00319	00302	00370	00495
	00046	00204	00291	00291	00370	00495
14. Selling commissions.....	06269	05675	05355	05622	05342	06641
	06150	05415	04882	05426	05342	06641
15. Total "Beyond the Mine" cost.....	66853	76054	76659	77198	85048	1. 26199
	66072	73022	71553	75419	85048	1. 26199

COSTS, PROFITS, LOSSES AND ASSESSMENTS, IRON MINES OF THE IRON RIVER AND CRYSTAL FALLS DISTRICTS, MICH.—Continued

Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports by the operators

	1912. Per ton.	1913. Per ton.	1914. Per ton.	1915. Per ton.	1916. Per ton.	1917. Per ton.	1918. Per ton.
Beyond the Mine Cost.—Con.							
16. Total cost of delivery.....	\$2 52975 2 29283 2 22019	\$2 86919 2 54658 2 77178	\$3 02741 2 77178 2 8250	\$2 26076 2 15815 2 5014	\$2 34961 2 30534 2 29443	\$3 19186 3 16672 4 0217	.....
17. Royalties.....	2 21170 2 74994	2 22636 3 15817	2 5786 3 30991	2 2177 2 51090	2 28215 2 64404	3 38892 3 59403	.....
18. Total cost of delivery to operators.....	2 50453	2 77284	3 02964	2 37522	2 58769	3 55564	.....
Profit and Loss.							
19. Receipts from sale of ore.....	2 61385	3 00108	2 63285	2 62411	2 90039	4 43539	.....
20. Profit or loss to operator.....	1 3609	—	6 7706	1 1321	2 5635	84136	.....
21. Total profit (operator's profit or loss plus royalty and depreciation).....	1 9786	2 6042	—	24819	31270	87975	.....
22. Assessed valuation per ton by Board of State Tax Commissioners.....	43259	57758	—	46103	65626	1 37329	.....
		34512	35776	32927	35185	37201	\$0. 44972

a. Total of all operations.

b. Total of all operations excluding non-producers.

Note.—All items in 1906 and 1907 figured on basis of tons shipped, tons mined not available.

In all other years items 1 to 9 inclusive figured on tons mined, items 10 to 17 and item 19 on tons shipped.

COSTS, PROFITS, LOSSES AND ASSESSMENTS, MICHIGAN IRON MINES

Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from the reports of the operators

	1906. Per ton.	1907. Per ton.	1908. Per ton.	1909. Per ton.	1910. Per ton.	1911. Per ton.
Cost of Mining.						
1. General office expenses.....	\$0. 06368	\$0. 08084	\$0. 06619	\$0. 05704	\$0. 05792	\$0. 08406
2. Fire insurance.....	06206	08021	06539	05563	05652	08177
3. Employer's liability insurance.....	00190	00206	00579	00409	00419	00545
4. Taxes.....	00174	00200	00550	00394	00407	00517
5. Depreciation.....	.....	.....	00418	00399	00599	01280
6. Mining.....	04807	05599	00415	00399	00592	01258
7. Exploration and development.....	04731	05583	07330	06869	06968	15022
8. Construction.....	00481	00636	07222	06794	06898	14592
9. Total cost at mine.....	1 16233	1 29348	1 2043	1 2407	1 0092	1 4592
	1 14413	1 28889	1 40644	1 30734	1 0060	1 2575
	1 0683	1 14406	1 40057	1 30143	1 31023	1 39408
	08433	11399	12097	09864	13937	13862
	15695	18758	15741	07897	11135	15218
	14374	17959	15494	11996	09994	14150
	1 54457	1 77037	1 95555	1 0275	08804	08261
	1 48812	1 72687	1 92386	1 78396	1 78824	2 01689
				1 73872	1 74092	1 98112
"Beyond the Mine" Cost.						
10. Rail freight.....	33341	33639	34304	34590	34547	31765
11. Boat freight.....	33340	33639	34244	34404	34547	31266
12. Cargo insurance.....	53102	53428	48666	49555	53537	37546
13. Analysis at lower lake ports.....	53101	53428	48638	49555	53537	37108
14. Selling commissions.....	00066	00080	00006	00150	00182	00159
15. Total "Beyond the Mine" cost.....	00066	00080	00006	00150	00182	00159
Unclassified.....	00015	00012	00009	00239	00114	00109
	00015	00012	00009	00239	00114	00109
	03078	03221	03933	04023	03920	03950
	03078	03221	03917	04023	03920	03834
	90564	91318	87169	89295	93426	73681
	90564	91318	87065	89109	93426	72628
	00964	00938	00251	00738	01126	00152

COSTS, PROFITS, LOSSES AND ASSESSMENTS, MICHIGAN IRON MINES.—Continued
 Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports of the operators

	1906. Per ton.	1907. Per ton.	1908. Per ton.	1909. Per ton.	1910. Per ton.	1911. Per ton.
"Beyond the Mine" Cost.—Con.						
16. Total cost of delivery.....	\$2. 45023	\$2. 68355	\$2. 82724	\$2. 67691	\$2. 72250	\$2. 75370
17. Royalties.....	2. 30276	2. 64005	2. 79451	2. 62981	2. 67518	2. 70740
18. Total cost of delivery to operator.....	2. 22434	2. 67550	2. 94749	2. 74457	2. 96332	2. 92099
Profit and Loss.						
19. Receipts from sale of ore.....	3. 44813	4. 08242	3. 56079	3. 59276	3. 97701	3. 34723
20. Profit or loss to operator.....	77250	1. 15025	43348	.63137	.94952	.33144
21. Total profit (operator's profit or loss plus royalty and de- predation).....	83003	1. 17487	47149	.68838	1. 00551	.38228
22. Assessed valuation per ton by Board of State Tax Commis- sioners.....	1. 00271	1. 40523	.85482	1. 04006	1. 35543	.72325
	1. 05918	1. 44873	.88671	1. 08702	1. 40243	.76555
						.504

a. Total of all operations.
 b. Total of all operations, excluding non-producers.
 Note.—All items in 1906 and 1907 figured on basis of tons shipped, tons mined not available.
 In all other years items 1 to 9 inclusive figured on tons mined, items 10 to 17 inclusive and item 19 on tons shipped.

COSTS, PROFITS, LOSSES AND ASSESSMENTS, MICHIGAN IRON MINES.—Continued
 Compiled by the Appraiser of Mines for the Board of State Tax Commissioners from reports of the operators

	1912. Per ton.	1913. Per ton.	1914. Per ton.	1915. Per ton.	1916. Per ton.	1917. Per ton.
Cost of Mining.						
1. General office expenses.....	\$0. 07639	\$0. 08700	\$0. 08053	\$0. 06163	\$0. 06625	\$0. 08509
2. Fire insurance.....	0.7408	0.9275	.07648	.05995	.06580	.08446
3. Employer's liability insurance.....	0.0543	0.0561	.00541	.00465	.00369	.00387
4. Taxes.....	0.1325	0.1903	.02362	.01964	.00361	.00385
5. Depreciation.....	12900	11945	.25363	.01959	.01863	.02208
6. Mining.....	10969	11623	1.966	1.4311	1.0613	1.2088
7. Exploration and development.....	1.30084	1.0818	1.2070	1.5006	1.2569	1.1668
8. Construction.....	1.29085	1.35407	1.28482	1.07326	1.2444	1.8814
9. Total cost at mine.....	1.5305	1.6383	1.28472	1.07070	1.22652	1.53503
"Beyond the Mine" Cost.						
10. Rail freight.....	32962	38361	36805	38349	39717	42055
11. Boat freight.....	33091	30875	30485	38129	39717	42055
12. Cargo insurance.....	32874	30425	31374	34823	45780	78819
13. Analysis at lower lake ports.....	0.0096	0.0107	.00972	.00149	.00149	.00236
14. Selling commissions.....	0.0114	0.0288	0.0306	.00310	.00360	.00393
15. Total "Beyond the Mine" cost.....	0.3668	0.9302	0.8799	.03737	.04117	.04562
Unclassified.....	70524	82667	73587	73340	90123	1.26065
	69959	82665	72352	.76893	90117	1.26065
	.00653	.01105	.00445			

AVERAGE ANALYSES OF BESSEMER ORES AND PERCENTAGE OF BESSEMER AND NON-BESSEMER GRADES.—Continued

Range.	Year.	Tonnage.	Average Iron (Natural).	Average Phosphorus.	Average Silica.	Average Mang.	Average Moisture.	Per Cent. of Bessemer.
Menominee.....	1916	177,979	53.0572	.04019	8.5137	.1834	7.8323	3.4
	1915	126,307	53.1999	.03522	8.6426	.....	6.9490	3.2
	1914	59,380	56.3874	.02609	6.7459	.....	7.1041	2.5
	1913	107,837	55.3393	.02940	.....	.....	6.9719	3.0
	1912	85,389	55.2117	.02522	.....	.....	7.0276	2.5
	1911	105,643	54.5578	.03302	.....	.....	7.3354	3.7
	1910	185,715	56.3310	.04323	.....	.....	.....	5.0
	1909	311,257	53.2389	.04180	9.8633	.....	.....	7.4
	1908	84,703	53.6941	.03457	.....	.....	.....	4.0
	1907	161,765	56.6136	.03425	.....	.....	.....	4.3
	1906	234,732	55.8079	.03630	.....	.....	.....	6.0
	1905	169,327	56.8037	.03197	.....	.....	.....	4.6
	1904	102,830	57.5432	.02687	.....	.....	.....	4.2
1903	104,069	57.7855	.02084	.....	.....	.....	4.0	
1902	86,018	57.7141	.01674	.....	.....	.....	2.8	
Vermillion.....	1916	1,466,732	57.6797	.04048	7.1228	.1135	6.5281	76.1
	1915	1,391,516	57.9406	.03870	6.5605	.....	6.7106	81.6
	1914	1,200,374	58.4848	.03919	6.1354	.....	6.5052	73.8
	1913	1,200,674	58.8072	.03861	.....	.....	6.2763	77.6
	1912	1,369,602	59.3093	.03847	.....	.....	5.7806	74.9
	1911	800,419	59.5940	.03837	.....	.....	5.2695	82.8
	1910	923,147	60.1133	.03745	.....	.....	.....	78.2
	1909	868,690	60.3238	.03904	4.8776	.....	.....	81.7
	1908	698,606	60.4392	.03718	.....	.....	.....	83.9
	1907	1,543,834	60.1441	.03750	.....	.....	.....	92.6
	1906	1,505,321	60.1254	.03924	.....	.....	.....	89.3
	1905	1,413,067	60.6032	.03857	.....	.....	.....	85.7
	1904	1,119,684	60.0782	.04031	.....	.....	.....	94.5
1903	1,463,998	60.4772	.04098	.....	.....	.....	84.6	
1902	1,639,408	61.5522	.03948	.....	.....	.....	80.1	

Cuyuna.....	1916	68,867	53.23	.044	10.25	.11	10.86	5.8
Total Old Range.....	1916	6,337,425	54.7892	.04059	7.8968	.3042	9.7547	29.8
	1915	4,546,616	55.4953	.03939	7.4173	.....	9.2566	29.9
	1914	3,248,715	55.3773	.03897	7.0986	.....	9.7933	33.6
	1913	4,678,575	55.3237	.03936	.....	.....	9.6065	36.2
	1912	5,022,247	55.7112	.04000	.....	.....	9.2751	37.2
	1911	3,488,659	55.7213	.03881	.....	.....	9.0489	39.9
	1910	5,297,877	55.3540	.04132	.....	.....	.....	41.5
	1909	4,919,680	55.5184	.04226	.....	.....	.....	39.8
	1908	3,340,820	55.8013	.04174	.....	.....	.....	43.6
	1907	5,273,456	56.2895	.04060	.....	.....	.....	42.1
	1906	5,786,938	56.3648	.04204	.....	.....	.....	44.4
	1905	5,787,840	56.7445	.04106	.....	.....	.....	46.3
	1904	4,058,936	57.3598	.04035	.....	.....	.....	47.3
1903	4,857,193	57.5701	.04043	.....	.....	.....	49.9	
1902	5,576,428	57.9523	.04097	.....	.....	.....	47.4	
Mesaba.....	1916	15,605,590	53.0956	.04565	7.5403	.5437	11.2352	37.1
	1915	10,471,532	52.8959	.04348	8.3145	.....	10.7617	35.9
	1914	8,075,955	52.5751	.04512	7.9688	.....	11.0121	38.8
	1913	13,877,060	53.2644	.04427	.....	.....	11.1898	41.5
	1912	13,996,278	53.2513	.04685	.....	.....	10.3739	45.3
	1911	10,608,310	52.9224	.04620	.....	.....	10.6586	49.3
	1910	13,164,962	53.3587	.04608	.....	.....	.....	46.3
	1909	13,391,617	53.2625	.04528	6.6415	.....	.....	48.0
	1908	9,788,068	54.0142	.04459	.....	.....	.....	57.2
	1907	16,488,531	54.0681	.04558	.....	.....	.....	63.2
	1906	15,988,550	54.6196	.04408	.....	.....	.....	69.0
	1905	13,914,139	55.3543	.04215	.....	.....	.....	70.1
	1904	9,306,695	56.3171	.04010	.....	.....	.....	79.9
1903	9,451,328	55.8573	.04044	.....	.....	.....	74.9	
1902	10,618,878	56.6690	.03948	.....	.....	.....	80.6	

AVERAGE ANALYSES OF BESSEMER ORES AND PERCENTAGE OF BESSEMER AND NON-BESSEMER GRADES—Continued

Range	Year.	Tonnage	Average Iron (Natural)	Average Phosphorus.	Average Silica.	Average Mang.	Average Moisture.	Per Cent. of Bessemer.
Total Bessemer.....	1916	21,943,015	53,5848	.04419	7.6433	.4728	10.8097	34.6
	1915	15,018,148	53,5829	.04224	8.0429		10.3060	33.8
	1914	11,324,670	53,5789	.04335	7.7192		10.6625	37.2
	1913	18,555,635	53,7836	.04303			10.7906	40.0
	1912	19,018,525	53,9009	.04504			10.0862	42.9
	1911	14,096,969	53,6151	.04438			10.262	46.6
	1910	18,462,839	53,3313	.04472				44.8
	1909	18,311,297	53,8686	.04446	6.8092			45.1
	1908	13,128,888	54,4090	.04387				53.0
	1907	21,761,987	54,6064	.04437				56.4
	1906	21,775,488	55,0834	.04354				60.2
	1905	19,701,979	55,7627	.04183				60.9
	1904	13,365,631	56,6377	.04018				65.1
	1903	14,308,521	56,4388	.04043				63.7
	1902	16,193,306	57,1109	.03995				64.9

AVERAGE ANALYSES OF NON-BESSEMER ORES

Range.	Year.	Tonnage.	Average Iron (Natural.)	Average Phosphorus.	Average Silica.	Average Mang.	Average Moisture.	
Gogebic.....	1916	4,206,702	53,0255	.08454	7.1994	.6298	12.0535	
	1915	2,690,524	53,8477		6.5784		11.6101	
	1914	1,387,006	53,5142		6.8816		11.7310	
	1913	1,345,784	53,0517				11.3487	
	1912	1,691,851	53,2912				11.0214	
	1911	625,237	52,9294				11.6417	
	1910	733,953	52,5195		9.0157			
	1909	973,405	51,9749					
	1908	698,062	52,2528					
	1907	614,512	52,5835					
	1906	497,539	51,8580					
	1905	339,972	52,1136					
	1904	303,647	53,1802					
	1903	405,797	52,3980					
	1902	397,726	53,7872					
	Marquette.....	1916	4,103,426	52,4393	.14709	7.9313	.4652	10.3947
		1915	2,975,180	53,6162		8.0197		10.4158
1914		1,676,825	53,0141		7.1943		9.7563	
1913		3,024,893	52,7030				10.0813	
1912		3,058,000	52,7308				10.9176	
1911		1,712,619	52,4737				10.7352	
1910		2,904,774	52,7952					
1909		2,724,318	52,9033		8.2618			
1908		1,465,357	52,2748					
1907		2,912,995	52,9362					
1906	2,838,201	53,9861						
1905	2,853,024	54,3907						
1904	1,848,429	54,7825						
1903	1,715,304	54,0844						
1902	2,464,187	55,1032						

AVERAGE ANALYSES OF NON-BESSEMER ORES.—Continued

Range.	Year.	Tonnage.	Average Iron (Natural.)	Average Phosphorus.	Average Silica.	Average Mang.	Average Moisture.
Menominee.....	1916	5,075,912	51.6237	.33905	7.3271	.2994	8.1377
	1915	3,778,585	51.6456		7.1171		8.0303
	1914	2,360,684	51.5970		7.9312		7.7380
	1913	3,527,423	50.8530				7.8918
	1912	3,252,805	51.0527				7.9620
	1911	2,729,715	51.4315				
	1910	3,489,460	51.0734				7.9469
	1909	3,861,127	51.3061		8.3880		
	1908	2,018,487	50.9742				
	1907	3,588,366	51.4400				
	1906	3,697,403	52.2508				
	1905	3,290,402	52.8159				
	1904	2,296,537	53.7339				
	1903	2,500,897	53.8048				
	1902	2,919,762	54.1020				
Vermillion.....	1916	459,630	58.8053	.09884	8.9090	.0890	3.7660
	1915	312,973	58.3377		8.2415		4.3308
	1914	262,946	58.7976		7.0564		4.3588
	1913	347,158	58.6264				4.0317
	1912	457,332	58.7775				4.7197
	1911	185,116	59.5984				
	1910	259,268	60.2483				4.0908
	1909	200,437	61.2379		4.6960		
	1908	134,231	61.2246				
	1907	122,215	63.9432				
	1906	190,550	64.5798				
	1905	235,603	64.3330				
	1904	70,005	66.4676				
	1903	255,934	62.9809				
	1902	406,784	61.9984				

Cuyuna.....	1916	1,109,484	50.3779	.19058	8.5660	.6728	11.1646
	1915	897,782	50.0573		9.0636		10.7502
	1914	736,573	50.0926		10.0217		11.5863
Total Old Range.....	1916	14,955,154	52.3701	.19478	7.5920	.4518	9.9656
	1915	10,655,044	52.8161		7.4302		9.7314
	1914	6,424,034	52.5031		7.7161		9.4519
	1913	8,245,258	52.2179				9.0989
	1912	8,459,988	52.5245				9.4668
	1911	5,252,637	52.2184				9.1599
	1910	7,447,455	52.2185				
Mesaba.....	1909	7,759,287	52.2074		8.3271		
	1908	4,316,137	51.9414				
	1907	7,238,088	52.3503				
	1906	7,223,693	53.2308				
	1905	6,719,001	53.8529				
	1904	4,518,618	54.3229				
	1903	4,877,932	54.2675				
	1902	6,188,459	54.9995				
	1916	26,432,396	49.1925	.07715	7.6579	.9149	13.3977
	1915	18,718,088	49.5407		7.7671		13.3046
1914	12,726,980	49.5887		7.4631		13.2306	
1913	19,584,395	49.3445				13.4379	
1912	16,886,587	49.4922				13.1639	
1911	10,905,782	49.4934				13.0884	
1910	15,261,849	49.7468					
1909	14,511,821	49.8474					
1908	7,329,543	50.8403		6.6090			
1907	9,574,061	51.4601					
1906	7,179,989	50.8088					
1905	5,932,495	51.6239					
1904	2,645,470	52.3964					
1903	3,171,423	53.1948					
1902	2,546,936	53.5531					

AVERAGE ANALYSES OF NON-BESSEMER ORES—Continued

Range.	Year.	Tonnage.	Average Iron (Natural)	Average Phosphorus	Average Silica.	Average Mang.	Average Moisture.
Total Non-Bessemer.	1916	41,387,550	50.3407	.11887	7.6349	.7274	12.1575
	1915	29,373,132	50.7288		7.6449		12.0084
	1914	19,151,024	50.5663		7.5480		11.9631
	1913	27,829,653	50.1958				12.1523
	1912	25,346,575	50.5043				11.9299
	1911	16,158,469	50.3792				11.8114
	1910	22,709,304	50.5574				
	1909	22,271,108	50.6696		7.2076		
	1908	11,645,680	51.2484				
	1907	16,812,149	51.8434				
	1906	14,403,682	52.0235				
	1905	12,651,496	52.8077				
1904	7,164,088	53.6115					
1903	8,049,355	53.8449					
1902	8,737,395	54.5778					

AVERAGE IRON (Natural) OF OLD RANGE MANGANIFEROUS, LOW GRADE AND SILICIOUS ORES, AND OF THE TOTAL OF THE OLD RANGE, MESABA AND ALL RANGES

Range.	Year.	Tonnage.	Average Iron (Natural)
Old Range Mang. Low Grade and Silicious	1916	2,075,110	42.2555
	1915	1,463,311	43.7797
	1914	976,865	41.2884
	1913	1,416,687	42.4114
	1912	1,454,780	42.9236
	1911	1,175,460	42.0179
	1910	890,339	40.9814
	1909	1,297,333	42.3017
	1908	811,377	41.7162
	1907	1,608,988	43.6423
	1906	1,474,528	41.7246
	1905	1,380,414	42.3812
1904	906,269	42.2480	
1903	1,372,074	43.3450	
1902	1,846,400	44.1636	
Total Old Range	1916	23,367,689	52.1280
	1915	16,664,971	52.7536
	1914	10,649,614	52.3512
	1913	14,340,520	52.2624
	1912	14,937,015	52.6609
	1911	9,926,806	52.2313
	1910	13,635,671	52.7030
	1909	13,976,200	52.4534
	1908	8,468,334	52.4844
	1907	14,120,532	52.8292
	1906	14,485,159	53.3126
	1905	13,887,255	53.9177
1904	9,483,823	54.4688	
1903	11,107,199	54.3625	
1902	13,611,287	54.7393	
Total Mesaba	1916	42,037,986	50.6415
	1915	29,189,620	50.7443
	1914	20,802,945	50.7480
	1913	33,461,455	50.9701
	1912	30,882,865	51.1958
	1911	21,514,092	51.1842
	1910	28,426,811	51.4195
	1909	27,903,438	51.4864
	1908	17,117,611	52.6552
	1907	26,062,592	53.1100
	1906	23,168,539	53.4386
	1905	19,846,634	54.2392
1904	11,932,165	55.4493	
1903	12,622,751	55.1884	
1902	13,165,814	56.0663	
Grand Total—All Ranges	1916	65,405,675	51.1726
	1915	45,854,591	51.4746
	1914	31,452,559	51.2908
	1913	47,801,975	51.3578
	1912	45,819,880	51.6734
	1911	31,440,898	51.5148
	1910	42,062,482	51.8356
	1909	41,879,638	51.8091
	1908	25,585,945	52.5987
	1907	40,183,124	53.0113
	1906	37,653,698	53.3901
	1905	33,733,889	54.1069
1904	21,435,988	55.0155	
1903	25,729,950	54.8018	
1902	26,777,101	55.3917	

In working out these tables, ores containing not more than .001 of one per cent of Phosphorus to each unit of Iron in the natural condition were classed as Bessemer.