

of the old type. It was, however, found that it could readily pull eight roller bearing cars and one old car. This will give some idea of the tremendous amount of friction in the old type of bearings. The new cars are of practically the same design as the old. It was intended that if the roller bearings proved satisfactorily that we would in time replace all of the wheels on the old cars. This will be done at the rate of three cars per month. We have in use twenty-six old cars and eight roller bearing.

#### INCREASE IN FORCE.

On July 12th I was authorized to commence to increase the force underground. This had not been anticipated and for several days there was not sufficient supplies and tools to get the best efficiency out of the new men. Machines and steel were ordered and were received quite promptly. Up to the 12th of July we were working about sixty gangs of miners on ore. On the end of the month we had hired forty-three additional men. On Sept. 1st we were working ninety-eight gangs of miners and were increasing the force as rapidly as it was possible to provide new places. On account of the very large amount of drifting and timbering necessary to open up additional territory, it was natural that we did not immediately obtain the best results. On the 1st of October the force was increased to 110 gangs. During the time that we were increasing our force the Maas Mine was started up and other mines either added additional shifts or increased their working force by putting more men on a single shift. During October the number of gangs were slightly decreased. In November the new men hired just about filled the places of those who were discharged or quit. On the first of the year we had a total of 111 gangs. It should be borne in mind that we never have this entire force working as there are always a certain number of men home. In addition to these 111 gangs, for the past five months six gangs have been on the night shift timbering.

#### WORK ON A SINGLE SHIFT AS COMPARED WITH THE DOUBLE SHIFT.

The largest tonnage previously obtained by this company was in May, 1914, when 38,851 tons were produced. At that time we were working on a

double shift and the total men, surface and underground, was 411. The tons per man underground was 4.47 and the total 3.73. During October, with a total of 353 men, we produced 47,211 tons. The tons per man underground was 6.08 and the total 5.05. With fifty-eight less men than in May, 1914, we produced 8,360 more tons. The tons per man underground increased 1.61 and the total tons increased 1.32. On this basis, assuming working forces of equal size, the increase in efficiency of the single shift over the double is about forty per cent. As times improve and labor becomes scarce, we could not expect to obtain as good results and the efficiency will probably drop. There, however, is no question that in a mine where there is sufficient room to work a large force that much better results can be obtained by keeping all of the miners on the day shift. At the Negaunee it has been necessary to hoist on two shifts. The force at night is comparatively small, just sufficient men being used to handle the ore. During 1915 the mine worked one eight-hour shift for 301 days, while in 1914 it worked two eight-hour shifts for 127 days and one eight-hour shift for 167 days, or a total of 421 shifts in 1914. In 1915 there were 120 less shifts worked than in 1914. The average tons per day in 1915 was 1325, while in 1914 it was 1164. The average number of men employed in 1915 was 270 against 304 in 1914. The average tons per man in 1915 was 4.90, while in 1914 it was 3.73. With an average of twenty-six less men in 1915 the tons per man per day increased practically thirty-two per cent. With 120 less shifts the product was increased 56,611 tons in 1915.

#### INCREASE IN WAGES.

Notices were posted that commencing with August 1st the wages would be restored to the same rate as they were at the time of the cut in October, 1914.

#### TIMBER YARD.

Until the present year there has been sufficient room in the timber yard to store the timber needed for a year's supply. On account of the large increase in production it was necessary to make additional room. On the west end, for a distance of about 200 feet, no grading had been done as there was enough room in the part of the yard to the east. In September we employed

two teams for eight days working scrapers filling a large hole to the south of the railroad track. The filling of this hole and grading to the south will give us sufficient capacity to store the necessary timber.

#### DELAYS.

On Jan. 27th there was one and a half hour's delay due to a broken skip runner.

On Sept. 28th, at twenty minutes past 11 A. M., an armature in the motor generator set burned out. This necessitated a shut down. The men underground were sent to the Maas Mine at noon and were hoisted through that shaft. On the afternoon of the 29th the armature was repaired and the set again placed in commission. On the night shift of the 29th ore was hoisted. The cause of the armature burning out was that the ventilating spaces between the coils had become clogged with dirt. This made the motor overheat. This delay emphasized the great importance of having the cage hoist entirely independent of the motor generator set. With the present arrangement, in order to operate the cage it is necessary to run the entire set. This is expensive unless the skips are also being operated. During the last few months of the year we have been hoisting very rapidly with the skips and the motor generator set has been taxed to its capacity. When the skips are being run rapidly and the cage is also being run there is a perceptible slowing down of the motor generator set. It is not unusual to have to stop the skip hoist until the set gets up to speed.

During December we have had two cars off the trestle. This caused some delay, but we continued to stock with the other car. A part of this trouble on the trestle was due to inexperienced men as it was necessary to change operators.

#### ELECTRIC DELAYS.

On April 12th the current was off from 9:30 A. M. until 5 P. M. due to ice forming in the surge tank at Marquette. It was necessary to send all of the men home at noon. During this time considerable anxiety was felt in

regard to the water on the 10th level. When the pumps were finally started we were making preparations to close the doors leading to the pump house. The sump was full and it was thought that it would be necessary to have the water flood the level.

On the 13th of April, between 2:30 and 4:30 A. M., the current was off due to the burning out of a switch in the Maas Mine engine house.

On April 21st, between 2 and 5 P. M., the current was off on account of trouble on the transmission line. It was necessary to send the entire force to the Maas mine and hoist them through that shaft.

On May 24th, between 2 and 2:40 P. M., there was a delay due to trouble on the transmission line.

On July 13th, from 2:45 to 3:20 P. M., there was a delay due to trouble on the transmission line.

On Sept. 13th there was a delay from 3:15 to 5 P. M. on account of trouble on the transmission line during a very severe electric storm. On the same date there was a delay of one hour on the night shift due to a broken trolley line underground.

On Sept. 14th, during a severe storm, there was no current from the Carp River plant from 12:30 until 2:30 P. M. A small amount of current was received from the Maas Mine but not enough to operate the hoist.

On Sept. 14th the voltage was very low from 8 until 12 A. M. on account of trouble on the transmission line.

On Oct. 4th and 5th there were delays in the engine house due to an oil switch burning out. The first delay was from 8 until 9:40 A. M. The second was from 8:30 until 9:50 A. M. The proper changes were made by the electricians to avoid this trouble in the future.

On Dec. 6th the current was off from 3 to 3:25 P. M. due to trouble on the transmission line.

#### SKIP ROADS.

In the latter part of October a dump wheel on one of the skips struck the center dividing between the two compartments. The Captain and

myself made complete measurements for the entire length of both roads, using an instrument which was made by me several years ago. It was found that the runners had worn badly below the 600 ft. elevation and that the gauge had increased anywhere from 1/2 to 5/8 inches on the wide dimension of the wood. On the narrow dimension there is a still greater amount of wear. These runners were Washington fir. This material has been used quite commonly in a number of shafts in this district. Its use should be discontinued as it has been demonstrated at the Negaunee that it wears too rapidly. Our conditions are particularly unfavorable as the ore is exceedingly wet. In filling the skips a certain amount splashes on the runners and gets behind the shoes. This grinds the runners away, increasing the gauge rapidly. Temporarily the trouble has been overcome by increasing the gauge in the shoes of the skips. It is, however, only a matter of a short time before the runners for the entire length of the shaft must be replaced. We have obtained information from the mines in the copper country and also other deep mines. In the copper country the practice is to use clear Norway or long-leaf yellow pine. At the Newport they use long-leaf yellow pine and it is stated that no appreciable wear can be seen on their runners. In the copper country, in parts of shafts which are crooked they use maple. It is well known that maple will deteriorate rapidly if kept wet. We have always used maple in the upper part of shafts opposite dumps and also in the lower part opposite storage pockets. From all the information which I can get from men who have had a large amount of experience in the use of various woods, I am of the opinion that for skip roads white oak would be the very best material which could be used. The original cost of this material is high, but when the great expense of replacing roads in shafts which are in operation is taken into consideration, the cost of material is a very small part of the total. At the Negaunee mine the only practical time to replace runners is on Sundays and holidays. It is bound to be very expensive work to replace the entire length of our roads.

#### GRADING ORE.

Up to 1914 we had attempted to save isolated pockets of low

phosphorus ore in various parts of the mine. Even fairly close to the footwall at times we find bunches of ore which will run low enough in phosphorus to be hoisted for Bessemer. Our attempting to save this small amount of low phosphorus ore got us into serious trouble. The phosphorus would vary so rapidly that it was impossible to grade the material with any degree of certainty. The consequence was that between the times that stope samples were taken the ore often changed, making the product too high in phosphorus. During the present year we have gotten into a territory directly below the hanging which is uniformly low in phosphorus. This has been graded without serious trouble. We have made no attempt to save small pockets which would be liable to vary rapidly. The consequence is that it has been possible to lower the phosphorus in the Negaunee grade and at the same time to be able to make a Bessemer ore the results of which we are reasonably sure of. Previous to the present year much trouble has been experienced in keeping shipments to furnaces below .100. It has been necessary in former years to select certain low phosphorus chutes underground to go into shipments. This had a very bad effect on the ore which was stocked as we previously took out all of the low phosphorus chutes; consequently, the phosphorus in the stockpile ran high. I have always maintained that it was poor practice to ship the best grade of ore to furnaces to the detriment of improving the general grade on the large mass of ore which was stocked. During the present season the run of mine only has been shipped to furnaces, and with remarkably few exceptions it has not exceeded the guarantee in phosphorus.

In previous years the grading of the Bessemer ore has been done principally by stope samples. These are very unreliable as it stands to reason that a pound or so of material taken from a trench in a breast cannot fairly represent thirty or forty tons of ore. The stope samples are used as a guide or check upon chute samples. The chute sample consists of a large skoopful taken from each motor car before it is dumped at the shaft. As explained in a previous report, our cars are all tagged with the chute number and grade. We have selected especially reliable men to take these samples at the shaft and we have every reason to believe that the results which are

being obtained are accurate. During the present season our cargo results have checked well with lower lake ports. As a general rule, it will be found that the lower lake chemists have averaged higher in iron on the Negaunee grade than mine results.

PRODUCTION.

Month	Bessemer	Negaunee	Total	Rock
January,	5,144	18,420	23,564	152
February,	5,080	18,694	23,774	408
March,	5,080	21,753	26,833	296
April,	2,724	19,222	21,946	204
May,	4,047	21,245	25,292	216
June,	4,796	21,324	26,120	460
July,	9,564	18,863	28,427	296
August,	11,905	24,879	36,784	464
September,	13,746	23,797	37,543	804
October,	16,015	31,196	47,211	380
November,	12,637	30,060	42,697	460
December,	<u>14,996</u>	<u>28,431</u>	<u>43,427</u>	<u>1,180</u>
Total,	105,734	277,884	383,618	5,320
Stockpile Overrun,	<u>666</u>	<u>14,416</u>	<u>15,082</u>	
Total,	106,400	292,300	398,700	
Transferred, From	<u>19,342</u>	To	<u>19,342</u>	
Total,	87,058	311,642	398,700	5,320

ESTIMATE OF PROBABLE ORE.

During the present year I have entirely re-calculated the amount of ore in the mine. Previously I have not been able to obtain complete cross-sections. The estimate of ore in the shaft pillars has always been doubtful as it is impossible for any one to determine the amount which was left in the upper levels. Many of the old square set rooms were filled with rock. In addition, in a large part of the territory around No. 1 Shaft the old rooms were filled with sand which entered the mine during a cave which occurred when the property was worked by the Oliver Iron Mining Co. A very large deduction

has always been made in this area. The present estimate has been checked by measuring all of the sections above the 500 ft. elevation, assuming that no ore had been mined. The total amount mined up to January, 1916, was then deducted. In this way I was able to check my previous estimates and to show that they were conservative. In 1915 it was estimated that above the 600 ft. elevation there was 1,699,300 tons. In 1916 the estimate shows an excess of 141,000 tons. In 1915 the estimate showed 2,686,700 tons between the 500 and 600 ft. elevations. The 1916 estimate shows an excess of 442,700 tons between these elevations. My present estimate above the 600 ft. contour checks closely with the 1915 estimate. The areas for 1916 have been slightly changed in order to facilitate the calculations. In the following estimate, which was submitted to the Tax Commission, I have not assumed the additional amount which I figure is between the 500 and 600 ft. elevations, which is approximately the area between the 9th and 10th levels.

Estimate of Probable Ore.

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Shaft Pillars,	369,000
North of Fault "B", Above 600' Contour:	
Below 690' sub level, from boundary to 950' East,	202,600
Below 733' sub level, East of 950' East,	108,000
Above old 400' level,	<u>31,800</u>
Total North of Fault "B",	342,400
South of Fault "B", Above 600' Contour:	
Below 733' Sub, between 1400' and 1600' E.	19,000
Below 640' Sub to 900' East,	288,000
Hanging side, beyond shaft pillar,	158,000
Above 9th Level to 700' East,	26,000
Below 9th Level to 700' East,	73,000
Below 9th level, East of 700' East,	<u>19,000</u>
Total South of Fault "B",	<u>583,000</u>
Total Above 600' Contour,	1,294,400
Total Between 500' and 600' Contours,	<u>2,686,700</u>



Total Probable Ore Above 500' Contour,	3,981,100
" " " Below 500' "	<u>8,347,000</u>
Total Probable Ore in Mine,	12,328,100

Note: All elevations referred to are above sea level.

In figuring the above estimate the assumption was as follows:

12 cu. ft. per ton; 10% deduction for rock and 10% for loss in mining.

#### SAFETY WORK.

We are particularly proud of the record made at the Negaunee mine during the year. There has been a small number of minor accidents. Not only the Captain but the bosses and men take a decided interest in safety work. During the year there has been two inspections by the Workmen's Committee, consisting of miners from the Negaunee mine; two inspections by the Foremen's Committee, consisting of foremen from various mines of the company; and eight inspections by the Safety Inspector. Out of a total of twelve inspections eight reports were perfect, and in the remaining four there was a single suggestion in each report made. This I believe is an excellent showing and it demonstrates that we are doing all in our power to enforce safety rules and to protect our men. During the latter part of the year we have added a large number of new men and it required continual vigilance on the part of the captain and bosses to see that these men not only learned the rules of the company, but put them into practice. The Safety Inspector has conducted a number of examinations by selecting at random miners to be questioned on the safety rules. These men made a very creditable showing and it was demonstrated that they had read the book of rules given to them by the company. During each successive year the conditions should improve as the longer we keep a man the more familiar he becomes with our rules and the less chance for a violation. The obtaining of results in this safety work depends entirely upon the interest which the captain and bosses take in it. If they are not in sympathy with this movement it stands to reason that they would not make any particular effort to interest the men in it. Our bosses are held strictly responsible for the enforcing of these rules and they realize thoroughly that

it is to their advantage to do so. We have been unusually strict and if any wilful violations are found the men are punished by being laid off or discharged.

Our first-aid team has done excellent work. Every injury which has required first-aid treatment has been attended to by some member of the team. During the year the team won first place in a contest of all of the mines of the company. In the contest of teams from all of the ranges, held at the meeting of the Lake Superior Mining Institute, they were eliminated because they used a method of artificial respiration which has been demonstrated by us in several cases to be perfectly practical but which was not accepted by the officials of the contest. This was very unfortunate as, barring this event, the team would have stood very near the top.

#### METHOD OF MINING.

It has been the practice in the Negaunee Mine to work in sub levels at intervals of 16 feet. With few exceptions this is the common practice through the Marquette Range. I have been convinced for several years that this was not the best system to use. With sub levels 16 ft. apart there is 6 ft. of ore in the back which is taken during the process of withdrawing or pulling back towards the raises. The floor in the upper sub level is first covered down with lagging. When the gang commences to pull back they drill holes in the top of their slice to bring down the 6 ft. of ore. As soon as this ore falls the lagging in the floor of the upper sub level comes down on top of the ore. If rock has entered the upper sub level it naturally comes down on top of the lagging. The lagging in the upper sub level was placed there for the object of separating the rock from the ore. It, however, does not do this as the blast causes the lagging to drop. If a large amount of rock had entered the upper sub level it naturally would fall to the lower, covering the ore which had been brought down and becoming mixed with it. The lagging placed in the floor is therefore useless. If fine rock enters one sub level it is continually drawn down on each succeeding sub level. The loss in ore is considerable as it is often not practical to remove the rock as there is no place to dump it. This method of mining causes a great majority

of the cases of injury from fall of ground. I believe that sub levels should not be at a greater interval than 9 or 10 feet, the caps in the lower sub level taking up the lagging which has been placed in the floor of the upper sub level. This absolutely prevents the mixing of rock on one sub level with the ore on the lower. On each succeeding sub level the mat is made and in time becomes so thick that it is absolutely impossible for rock to find its way through it. From a safety standpoint there is no comparison between the two methods. When the caps of one sub level take up the lagging in the floor of the upper there is practically no chance of falls of ground occurring. I am positive that the grade of ore can be considerably raised. If the percentage of iron can be increased the company will naturally obtain a better price for the product. In addition, the ore will be more desirable and can be disposed of more readily. The loss in mining is reduced to practically nothing. The one disadvantage is the increased cost in mining. From all the figures which I have been able to obtain, the increase in cost due to the larger amount of timber used will be more than counterbalanced by the advance in price due to the increase in the iron contents. You have given me permission to put this system into effect and in the latter part of the year we commenced to do so. It should be remembered that it will take many months before the entire mine can be worked directly under lagging. At the present time we have a number of gangs which are directly under lagging, but I am unable to give you any positive figures as to the cost. It is going to take a large amount of work on our part to establish this system as the majority of men are not familiar with it. Blasting has to be done with great care in order not to let down the lagging in the back. It has been customary to use 7 ft. legs and 7 ft. caps. All of the timber ordered for 1916 is 16 ft. long, making 8 ft. caps and 8 ft. legs. By using this long timber the amount of ore obtained from each foot is increased about twenty-eight per cent. At any time it will be possible to change back to the old system if it is desired to do so.

## ANALYSIS OF COST SHEET.

Production,	1915,	398,700
	1914,	<u>342,089</u>
	Increase,	56,611 tons.

During 1915 the mine worked one eight-hour shift for 301 days. In 1914 it worked two eight-hour shifts for 127 days and one eight-hour shift for 167 days. The total days in 1915 was 81,327, while in 1914 it was 91,646½, a decrease of 10,319½ days. During January, 1914, there was a fire in the mine which caused a large loss in product. During February, March, and April there was extreme crushing on the footwall side which greatly reduced the product. During 1915 there have been no serious delays. There has been a decided improvement since the mine has worked only on a single shift. The average tons per man underground in 1915 was 5.91, while in 1914 it was 4.53, an increase of 1.38. The total tons per man in 1915 was 4.90, while in 1914 it was 3.73, or an increase of 1.17. The average number of men employed in 1915 was 270, while in 1914 it was 304, a decrease of thirty-four.

GENERAL EXPENSE

No. 26-Insurance,	1915 Amount	\$276.54	-	Cost Per Ton	\$.001
	1914 "	<u>391.71</u>	-	" " "	<u>.001</u>
	Decrease,	\$115.17	-		.000
No. 27-Engineering,	1915 Amount	\$1,322.43	-	Cost Per Ton	\$.003
	1914 "	<u>1,133.51</u>	-	" " "	<u>.003</u>
	Increase,	\$ 188.92	-		.000

The increase in the expenditure is due to a larger amount of work being necessary underground.

No. 28-Analysis,	1915 Amount	\$10,207.30	-	Cost Per Ton	\$.026
	1914 "	<u>8,046.60</u>	-	" " "	<u>.023</u>
	Increase,	\$ 2,160.70	-		\$.003

The increase in the expenditure is due to two

additional samplers on the top tram and a large amount of extra sampling on account of checking the Bessemer shipment. In 1915 the total operating cost for the laboratory was \$6,109.30 and the total number of determinations 70,688. In 1914 the cost was \$4,788.26 and the determinations 57,511. There was an increase in the expenditure of \$1,321.04 and an increase of 13,177 determinations.

No. 30-Personal Injury  
Expense,

1915 Amount	\$4,425.82	-	Cost Per Ton	\$.011
1914 "	<u>2,634.97</u>	-	" " "	<u>.008</u>
Increase,	\$1,790.85	-		\$.003

The heavy increase in the expenditure is due to the fact that during November \$2,770.32 was charged off on account of two fatal accidents which occurred previous to the present year.

No. 30a-Mine Office,

1915 Amount	\$8,341.21	-	Cost Per Ton	\$.021
1914 "	<u>9,499.41</u>	-	" " "	<u>.028</u>
Decrease,	\$1,158.20	-		\$.007

This charge was divided as follows:

	Direct Charges	Central Office
1915,	\$4,915.91	\$3,425.30
1914,	<u>5,343.31</u>	<u>4,156.10</u>
Decrease,	\$ 427.40	\$ 730.80

Total, General Expense,

1915 Amount	\$24,573.30	-	Cost Per Ton	\$.062
1914 "	<u>21,706.20</u>	-	" " "	<u>.063</u>
Increase,	\$ 2,867.10	-	Decrease,	\$.001

The increase in the expenditure is accounted for under accounts No. 28 and 30.

MAINTENANCE

No. 125-Tracks and Yards,

1915 Amount	\$ 861.96	-	Cost Per Ton	\$.002
1914 "	<u>1,285.74</u>	-	" " "	<u>.004</u>
Decrease,	\$ 423.78			\$.002

The decrease in amount is due to a smaller

amount of improvement work being done in 1915.

No. 126-Docks, Trestles,  
and Pockets,

1915 Amount	\$1,200.87	-	Cost Per Ton	\$.003
1914 "	<u>3,173.72</u>	-	" " "	<u>.009</u>
Decrease,	\$1,972.85	-		\$.006

The expense in both years was for grading the stocking grounds and laying 3" solar plank. There was a smaller amount of this work in 1915 than in 1914.

No. 127-Buildings,

1915 Amount	\$610.65	-	Cost Per Ton	\$.002
1914 "	<u>580.07</u>	-	" " "	<u>.002</u>
Increase,	\$ 30.58	-		.000

The expense in both years represent general repairs to buildings.

No. 128-Shop Machinery,

1915 Amount	\$197.28	-	Cost Per Ton	\$.001
1914 "	<u>441.32</u>	-	" " "	<u>.001</u>
Decrease,	\$244.04	-		.000

The expense in 1914 was much heavier than in 1915 due to a considerable amount of new tools and equipment for the new shops.

No. 129-Boiler Plant,

1915 Amount	\$514.64	-	Cost Per Ton	\$.001
1914 "	<u>892.72</u>	-	" " "	<u>.003</u>
Decrease,	\$378.08	-		\$.002

The subdivision of this account between the heating plant at No. 3 and the boiler plant at No. 2, which was used for the steam pumps, is as follows:

	No. 2 Plant	Heating Plant
1915,	\$183.00	\$331.64
1914,	<u>812.24</u>	<u>80.48</u>
Decrease,	\$629.24	Increase, \$251.16

The increase in heating plant is on account of the purchasing of a new stack. The decrease in No. 2 plant is because of its closing down on April 9th, 1915.

No. 130-Hoisting Machinery, 1915 Amount \$1,623.47 - Cost Per Ton \$.004  
 1914 " 751.70 - " " " .002  
 Increase, \$ 871.77 - \$.002

The large increase is due to three hoisting ropes replaced in 1915. In 1914 no new ropes were put on.

No. 131-Compressors and Power Drills, 1915 Amount \$3,209.98 - Cost Per Ton \$.008  
 1914 " 2,902.11 - " " " .008  
 Increase, \$ 307.87 - .000

There were twenty-nine new auger machines charged off in 1915 and twenty in 1914. The subdivision of this account between repairing compressor and power drills is as follows:

	Repairing Compressor	Power Drills
1915,	\$292.78	\$2,917.20
1914,	<u>978.12</u>	<u>1,923.99</u>
Decrease,	\$685.34	Increase, \$ 993.21

No. 132-Pumping Machinery, 1915 Amount \$4,499.39 - Cost Per Ton \$.011  
 1914 " 7,024.44 - " " " .021  
 Decrease, \$2,525.05 - \$.010

The statement is subdivided as follows:

	Steam Pumps	Electric Pumps	Sumps and Ditches
1915,	\$1,122.20	\$3,332.78	\$44.41
1914,	<u>812.00</u>	<u>4,990.75</u>	<u>1,221.69</u>
Incr. \$	310.20	Decr. \$1,657.97	Decr. \$1,177.28

The increase in steam pumps is due to the dismantling and hoisting to surface of large pumps on the 6 1/2 level. A decrease in sump and ditches is on account of the heavy expense in 1914 for improved method of cleaning sump which is described in detail in the 1914 report.

No. 133-Top Tram Engines and Cars, 1915 Amount \$2,252.16 - Cost Per Ton \$.006  
 1914 " 2,382.84 - " " " .007  
 Decrease, \$ 130.68 - \$.001

This account is subdivided below between wire rope and general repairs.

	General Repairs	Wire Rope
1915,	\$1,735.82	\$516.34
1914,	<u>1,749.68</u>	<u>633.16</u>
Decrease,	\$ 13.86	Decrease, \$116.82

No. 134-Skips and Skip Roads,

1915 Amount	\$1,497.66	- Cost Per Ton	\$.004
1914 "	<u>954.79</u>	- " " "	<u>.003</u>
Increase,	\$ 542.87	-	\$.001

The increase is due to heavy expense for repairing skips and cages and also for renewals of parts of the roads.

No. 135-Underground

Tracks and Cars, 1915 Amount \$3,504.14 - Cost Per Ton \$.009

1914 "	<u>2,605.34</u>	- " " "	<u>.008</u>
Increase,	\$ 898.80	-	\$.001

The increase is due to the large number of sub level cars which it was necessary to build on account of the addition of many contracts. These sub level cars are now practically all equipped with the roller bearing trucks. During 1915 we purchased fifty-eight pair at a cost of \$1,284.00 and in 1914 thirty pair at a cost of \$660.00.

No. 136-Electric Tram Plant,

1915 Amount	\$18,985.37	- Cost Per Ton	\$.046
1914 "	<u>18,091.36</u>	- " " "	<u>.053</u>
Increase,	\$ 894.01	- Decrease,	\$.007

The subdivision of this account is as follows:

	Motors	Wiring	Tracks	Cars
1915,	\$5,657.55	\$1,364.27	\$6,561.00	\$5,382.55
1914,	<u>3,187.88</u>	<u>2,189.37</u>	<u>7,852.68</u>	<u>4,848.07</u>
	\$2,469.67	\$ 825.10	\$1,271.68	\$ 534.48
	Increase	Decrease	Decrease	Increase

The increase in motors is on account of the purchase of a new locomotive at a cost of \$2,000.00. During 1914 there was a much larger amount of main level wiring in new drifts than in 1915. The increase



in cars is due to the purchase of ten new roller bearing cars from the Lake Shore Engine Works at a cost of \$2,630.00. This was made necessary by the addition of a large number of gangs.

No. 137-Telephones and Safety Devices,	1915 Amount	\$270.85	-	Cost Per Ton	\$.001
	1914 "	<u>806.50</u>	-	" " "	<u>.002</u>
	Decrease,	\$535.65	-		\$.001

In 1914 there was a much larger amount of general safety work consisting of guardrails, protections for moving machinery, etc. In addition, during 1914 there was a heavy expenditure for oxygen helmets and lungmotor.

No. 140-Fire Expense and Damage,	1915 Amount	00.00	Cost Per Ton	\$.000	
	1914 "	<u>\$3,189.83</u>	-	" " " <u>.009</u>	
	Decrease,	\$3,189.83	-	\$.009	
Total, <u>Maintenance,</u>	1915 Amount	\$39,228.42	-	Cost Per Ton	\$.098
	1914 "	<u>45,082.48</u>	-	" " " <u>.132</u>	
	Decrease,	\$ 5,854.06	-	\$.034	

#### MINING EXPENSE

No. 150-Air Pipes,	1915 Amount	\$2,877.15	-	Cost Per Ton	\$.007
	1914 "	<u>2,861.45</u>	-	" " " <u>.008</u>	
	Increase,	\$ 15.70	-	Decrease,	\$.001
No. 151-Compressors,	1915 Amount	\$ 9,452.32	-	Cost Per Ton	\$.024
	1914 "	<u>14,520.42</u>	-	" " " <u>.043</u>	
	Decrease,	\$ 5,068.10	-	\$.019	

In 1915 the compressor was only operated for a single shift. No pumps underground were run by compressed air. In 1914 the compressor was run on two shifts for 127 days and one shift for 167 days. In addition there were pumps being operated by air.

## No. 152-Hoisting,

1915 Amount	\$13,163.59	-	Cost Per Ton	\$.033
1914 "	<u>13,279.13</u>	-	" " "	<u>.039</u>
Decrease,	\$ 115.54	-		\$.006

Although there was a smaller amount of labor charged against Hoisting in 1915, there was a much larger amount of ore hoisted and the reduction in labor is counterbalanced by the increase in power.

## No. 153-Pumping,

1915 Amount	\$34,394.79	-	Cost Per Ton	\$.086
1914 "	<u>43,501.58</u>	-	" " "	<u>.127</u>
Decrease,	\$ 9,106.79	-		\$.041

In 1914, from January up to May, the water was handled by steam pumps. From May until October the pumping was done by steam and electricity. From October 1914 until February 1915 the pumping was done electrically. In April 1915 the steam plant was abandoned and since that time the pumping has been done entirely by electricity. There has been a heavy decrease in the average monthly cost between 1914 and 1915. In 1914 it was \$3,625.13, while in 1915 it was \$2,866.23. This is largely accounted for by the fact that the pumping in 1915 was practically all electric, while in the previous year it was steam and electric. We have no accurate figures as to the amount of water being pumped. It is known, however, that there has been a decided decrease in 1915.

No. 154-Sinking and  
Shaft Repairs,

1915 Amount	\$389.52	-	Cost Per Ton	\$.001
1914 "	<u>526.29</u>	-	" " "	<u>.002</u>
Decrease,	\$136.77	-		\$.001

The decrease in 1915 is due to a smaller amount of repair work at the pockets at shaft.

No. 155-Rock Drifting, 1915 Amount \$7,690.86 - Cost Per Ton \$.019  
 1914 " 7,230.36 - " " " .021  
 Increase, \$ 460.50 - Decrease, \$.002

The following statement shows the subdivision  
 of the work done:

	Drifting	Raising	Cost Per Ft.
1915,	1392'	1727'	\$2.47
1914,	<u>1187'</u>	<u>723'</u>	<u>3.76</u>
Increase,	205'	Increase, 1004'	Decrease, \$1.29

No. 156-Breaking Ore, 1915 Amount \$136,095.76 - Cost Per Ton \$.341  
 1914 " 144,405.07 - " " " .422  
 Decrease, \$ 8,309.31 - \$.081

The decrease is due to the much better  
 efficiency obtained on a single shift than on the  
 double. It is further due to general labor conditions.  
 In the early part of 1915 labor was plentiful and it  
 was possible to get a larger amount of work out of  
 the men.

No. 157-Tramming, 1915 Amount \$16,394.10 - Cost Per Ton \$.041  
 1914 " 22,486.00 - " " " .066  
 Decrease, \$ 6,093.90 - \$.025

In 1915 changes had been made which made it  
 possible to handle practically all of the ore on a  
 single level. This is a decided advantage and  
 largely accounts for the marked decrease in the amount  
 and the cost per ton. It is \$.025 lower than the  
 best previous year.

No. 158-Filling, 1915 Amount \$2,890.74 - Cost Per Ton \$.007  
 1914 " 2,432.72 - " " " .007  
 Increase, \$ 458.02 - .000

No. 159-Timbering, 1915 Amount \$60,162.94 - Cost Per Ton \$.151  
 1914 " 53,709.25 - " " " .157  
 Increase, \$ 6,453.69 - Decrease, \$.006

The increase in the amount is due principally to the large increase in tonnage. The general conditions in the mine were practically the same in both years.

No. 160-Captain and Bosses,	1915 Amount	\$7,857.71	-	Cost Per Ton	\$.020
	1914 "	<u>8,506.41</u>	-	" " "	<u>.025</u>
	Decrease,	\$ 648.70	-		\$.005

The decrease is due to the mine being operated on a single shift in 1915.

No. 161-Dry House,	1915 Amount	\$4,185.84	-	Cost Per Ton	\$.011
	1914 "	<u>3,993.51</u>	-	" " "	<u>.012</u>
	Increase,	\$ 192.33	-	Decrease,	\$.001

No. 162-Top Landing and Tramming,	1915 Amount	\$3,056.54	-	Cost Per Ton	\$.008
	1914 "	<u>4,010.40</u>	-	" " "	<u>.012</u>
	Decrease,	\$ 953.86	-		\$.004

There was a smaller amount of ore stocked in 1915 than in the previous year. This accounts for the decrease in the expenditure.

No. 163-Stocking Ore,	1915 Amount	\$86.81	-	Cost Per Ton	\$.000
	1914 "	<u>97.38</u>	-	" " "	<u>.000</u>
	Decrease,	\$10.57	-		.000

No. 164-Sorting Ore,	1915 Amount	\$356.33	-	Cost Per Ton	\$.001
	1914 "	<u>578.40</u>	-	" " "	<u>.002</u>
	Decrease,	\$222.07	-		\$.001

No. 166-Cave In,	1915 Amount	00.00	-	Cost Per Ton	\$.000
	1914 "	<u>\$482.91</u>	-	" " "	<u>.001</u>
	Decrease,	\$482.91	-		\$.001

Flooding Lands Rental,	1915 Amount	\$125.00	-	Cost Per Ton	\$.000
	1914 "	<u>125.00</u>	-	" " "	<u>.000</u>
		00.00	-		.000

<u>Total, Mining Expense,</u>	1915 Amount	\$299,180.00	-	Cost Per Ton	\$ .750
	1914 "	<u>322,748.28</u>	-	" " "	<u>.944</u>
	Decrease,	\$ 23,568.28	-		\$ .194

The large decrease in the expenditure and also the cost per ton is due to the better efficiency obtained on a single shift; also on account of the fact that there were no extraordinary delays in 1915. The serious fire in 1914 added largely to the expense for the year. The mining cost for 1915 is the lowest which has been obtained at this property since this company has operated it.

<u>Cost of Production,</u>	1915 Amount	\$362,981.72	-	Cost Per Ton	\$ .910
	1914 "	<u>389,536.96</u>	-	" " "	<u>1.139</u>
	Decrease,	\$ 26,555.24	-		\$ .229

The same remarks under "Total, Mining Expense" apply to Cost of Production. This is the lowest yearly cost obtained by this company.

#### UNDERGROUND.

##### 825' SUB LEVEL.

Previous to the present year a drift had been completed near No. 2 Shaft at an elevation of about 16 ft. below the floor of the old third level. On account of this territory being directly below the stockpile at No. 2 Shaft, it was impossible to do any mining until the ore was shipped. During the present season the stockpile was cleaned up and in the latter part of the year we commenced to do a small amount of work. This sub level is 225 ft. vertically above the 9th level and a considerably greater distance on the angle of the raises. It is necessary to procure a large puffer in order to handle timber to this sub level. The original drift had not been timbered and the first work was to put in timber for its entire length. It is also

necessary to completely re-crib an old raise which ran from the 6 1/2 to a short distance of the floor of the third level. During the present year the drifts have not been extended but a very short distance. To the north we are up against a dike which is practically the north side of the original shaft pillar. The drift will be extended through the dike to see if there is any ore left by the previous company in old rooms. Mining in this territory is going to be slow on account of the great height above the main level and the difficulty of handling material. We will have to contend with old open rooms which are supposed to be partly filled with rock. Little is known about this part of the mine and the work will have to be done carefully in order to avoid the possibility of the floor dropping away into openings below. On the end of the year Nos. 46 and 54 are engaged in timbering and crosscutting.

#### 6 1/2 LEVEL.

In the previous year a small amount of ore still remained on the elevation of the 6 1/2 level to the west of 1,000 ft. east. This has been taken.

#### 690' SUB LEVEL.

Practically all of the ore on this sub level has been mined. Due to extreme crushing pillars had to be left on the footwall side. Near the end of the year we are preparing to mine these pillars. No. 69 has raised on the 673' sub level and is now drifting east. From the east end Nos. 60 and 97 are drifting west. The pillars will be divided up between these gangs and pulled out as rapidly as possible. On the hanging side No. 32 has raised from the 673' sub level and is mining some ore which was left. On the east end No. 84 is drifting east to mine a small pillar.

#### 673' SUB LEVEL.

Near the boundary line a pillar is being left to support the land of the American Mining Co. To the east the ore has been blocked out into fairly regular pillars and is being mined back. On the hanging side it will be remembered that a large territory was dropped in order to prevent sand

from entering the mine. We are now endeavoring to drift across from the 673' sub level to get as much of this ore as possible. Nos. 24 and 75 passed through a small amount of rock and have reached the regular hanging. To the east, opposite No. 45 raise, a third crosscut was being driven to the hanging in ore. This place has been stopped as it was found that there was a certain amount of sand above. A small area around this crosscut will be isolated on the present sub level. On the sub level below it will be practical to drift under this area and lag the entire floor.

I call your attention to a number of raises which come up on the hanging side of the 673' sub level. In February, 1914, very severe crushing took place on the footside of this deposit. The majority of the raises above the 9th level were badly crushed. These have given a great deal of trouble and it was finally decided to adopt a new plan. We dropped down 30 ft. below the 9th level and put up new raises, inclining them towards the hanging from the old raises. This was completed in Raises 45, 47, 48, and 49. In the latter part of the present year we commenced in the main drift on the 9th level to complete Raises 40 to 44, inclusive, inclining them towards the hanging. This was practical as the 9th level drift through this part of the territory was in rock.

A large number of gangs are engaged in pulling back the pillars which have been blocked out. This entire sub level is being lagged down and the intention is to take up the lagging by the caps of the lower sub level. We have had a great deal of trouble in this territory due to it being extremely wet and the difficulty of getting men to work steadily. The gangs here have made a smaller amount of money than in other parts of the mine. The ore here is also considerably harder than in the main deposit.

#### 663' SUB LEVEL.

No. 22 is drifting west connecting raises preparatory to opening a new sub level.

#### 646' SUB LEVEL.

During the year we have succeeded in completing Raises 26, 27, and 29

from the 9th level through the territory which was dropped in order to prevent the recurrence of sand runs. The water in this large area has greatly decreased; in fact, on the east end around these new raises, there is practically none. The completing of these raises is difficult as the ground had been badly crushed due to its having been dropped. The raises were completed to the rock, about 20 ft. above the present sub level. Sixteen feet above the present sub level we commenced to cut out in Raises 26 and 27 but found that we were too close to the capping. It was naturally much broken up and very irregular. It was necessary to drop down to the 646' sub level. A small amount of drifting has been done towards the foot. No mining will be done in this direction as the ore undoubtedly extends up for a considerable distance above this sub level. The farther to the north these drifts are extended, the greater the distance to the capping. The ore in this direction will be taken by crosscuts which are now being driven to the south from the sub levels on the footwall side. In each succeeding sub level on the footside the crosscuts will naturally extend to a greater distance to the south. The ore on the hanging side of Raises 26, 27, and 29 will be taken through these raises. It will be noticed by referring to the map that crosscuts have extended to a considerable distance to the south. Even at this elevation the ore is mixed with rock. We, however, will obtain enough ore to pay for the work. On the extreme east end the material has been poor as we are up against old work. To the west of Raise 29 and to the north of the main dike the ore will all be taken by extending crosscuts to the south from raises on the footside.

#### 620' SUB LEVEL.

This small sub level, directly below the hanging, has been entirely completed during the present year.

#### 9TH LEVEL.

On the footwall side small crosscuts are shown extending to the south opposite Raises 45, 47, 48, and 49. These are shown holing into new raises which were brought up from a point 30 ft. below the main level. The main foot



drift has been crushing badly since February, 1914. It was seen that it could not be kept open for motor haulage. These new raises made it possible to send a large part of the ore directly to the 10th level even though the upper part of the old raises on the footside had been crushed so badly that they could not be used. It was found that the ore had a great tendency to hang up at the turn in these raises. In order to get around this difficulty the raises were all connected on the footside at a point 30 ft. below the level by a small drift. It is now possible to enter this drift and break the jams which occur at the bend in the raises. It is a decided advantage to have these new raises inclining towards the hanging as it throws the tops about 100 ft. farther towards the hanging of the ore body. This naturally decreases the distance which it is necessary to tram.

It was difficult to get timber to the workings on the hanging side of the main deposit as the drift to the west of raise No. 35 had crushed. We therefore put in a new drift in rock which is shown between Raises 35 and 30. To the south of No. 30 a drift was extended in ore to connect with the workings on the hanging side. It is now possible to tram timber directly to the hanging side using the motor.

To the east of 1,000 ft. east, ore was left below the floor of the 733' sub level. This could not be mined as it was necessary to keep open the main drift on the 6 1/2 level. Still farther to the east there is the No. 2 shaft pillar which must be taken. In the latter part of the present year we commenced to drive a new rock drift on the 9th level commencing at a distance of about 400 ft. south of No. 2 Shaft. It parallels roughly the old footwall drift on the 6 1/2 level. This, when completed, will connect with the footwall drift of the 9th level in which is located Raises 36 to 56, inclusive. This drift will be approximately 800 ft. in length. On account of the dip of the footwall near No. 2 Shaft, only a part of the ore can be mined by raises which were completed in 1913 which are now being used to mine the ore on the 825 ft. sub level. It will be necessary to put up additional raises from this new rock drift. When this drift is completed it will open up a

large territory.

During the present year the ore which was blocked out in the previous year in the main part of the deposit has been mined. On the west end a strip along the hanging has been taken. Towards the footside, crosscuts have been driven for a distance of 100 ft. and this ore will be pulled back. These crosscuts cannot be extended for a greater distance, otherwise they will undermine ore which has been left at a greater elevation and which will be taken through Raises 26, 27, and 29. Through this entire 9th level, particularly on the west end, there has been much trouble due to sand in the old rooms and also the large amount of timber which it has been necessary to pass through. The conditions will be greatly improved on the lower sub level. It will not be practical to drop directly below the lagging on the west end as it has not been possible to remove the sand in the old rooms.

#### 595' SUB LEVEL.

Practically all of this territory, with the exception of the drift on the footside, has been completed during the present year. Due to the extreme crushing the gangs have been crowded in as close as possible and we are making every effort to remove the ore rapidly and avoid the large cost for retimbering. There is nothing of special interest to mention in connection with this work except that we have been particularly careful to lag down all of the floors with the intention of taking up this lagging by the caps in the next sub level.

#### 580' SUB LEVEL.

This small sub level on the footside consists of a drift connecting the raises preparatory to opening a new sub level.

#### 10TH LEVEL.

During the present year the fourth main crosscut has been driven north, the work being done on a single shift. This drift has been in high-grade Bessemer ore for practically its entire length.

I call your attention to the very large amount of raising which has

been done on the 10th level during the year. These raises have been placed at intervals of 30 ft. centers. In the third main drift, with the exception of a few in the part going due north and south, the remainder have been taken to the hanging.

In November the Maas mine commenced to do preparatory work to mine in the land of the American Mining Co. As the raises from the Negaunee side leading into this territory were lost due to mining operations, it will be necessary for the Maas to do the mining and dump the ore into a raise near the boundary on the 10th level. It will here be divided and each mine given their proper share. In order to reach this raise a new connection was necessary on the 10th level, Negaunee, with the 2d level, Maas. The original connection has therefore been widened so that motors can now pass from the Negaunee to the Maas.

#### NEW FIND.

The hanging on the 9th level had been previously found during the operation of mining. In raising from the third main drift on the 10th level it was found that Raises 162 to 166, inclusive, extended to a height considerably above the 9th level. This was entirely unexpected as it was thought that the main hanging was well established to the north. These raises were sampled and it was found that practically all of the ore was high-grade Bessemer. A sub level was started at an elevation of 646 ft. from Raises 164 and 165. There was a small amount of ore at this elevation but it was determined that we were too close to the capping. This ore was robbed and we dropped down to a lower elevation. Up to the end of the year it has been fairly well determined that this ore occurs in a roll in the capping. The chances are that there is a corresponding roll in the foot and what is gained in the hanging is probably lost on the footwall below the 10th level. In making my estimate this ore has been disregarded. There have been a number of small sub levels opened but not sufficient crosscutting on any one to determine the exact dimensions of the ore body. Below the 9th level the sub levels naturally pass into the main deposit and this ore naturally cannot be

considered as a new discovery.

620' Sub Level.

Four gangs are crosscutting, outlining the ore body.

9th Level.

A certain amount of crosscutting has been done but the ore not completely outlined.

565' Sub Level.

Below the 9th level the farther west we go the more rapidly the hanging drops down. A small sub level has been opened on this elevation and on the south side, directly below the rock, some ore has been mined. There is naturally ore to the east but the drifts to the west are up against the hanging.

545' Sub Level.

Here a few crosscuts have been driven but the ore not completely outlined.

530' Sub Level.

The drifts on the hanging side are going towards the rock. On the west end we are trying to locate the capping. By examining the maps you will notice that these sub levels are not directly below each other. It will therefore be possible to remove the small triangular pieces of ore directly below the rock on these successive sub levels. The longer this work is continued the larger will be the size of the sub levels which will naturally extend to the east or towards the footwall.

WINZE TO 11TH LEVEL.

In May we commenced to drift west in the fourth main drift for the location of the new winze. This drift was completed and sufficient room provided for the location of the hoist. There was considerable delay in getting the plans of the hoist and the winze was therefore not started until August. It was sunk for a few feet and then covered over. The men then

commenced to do the work above the level. The winze is 5 by 11 ft. inside, having two hoisting and one ladder compartment. This winze extends for a height of 80 ft. above the floor of the 10th level. In the main drift, directly opposite the winze, a double compartment raise will be noticed. This raise was taken up at an angle of 65 degrees and holed into the part of the winze which is above the level. When the final dumps are provided and the skips are installed, the ore will run into this double compartment raise and can be easily taken out by the motors. This is a very simple means of providing storage room for ore hoisted from a lower elevation. The plan is comparatively cheap and is perfectly practical. As a rule, the ore hoisted from winzes is dumped directly into motor cars as no pocket capacity is provided. The tying up of several cars for this work is poor practice and we believe that we have solved the problem in a most practical and cheap manner. There was considerable delay in receiving the hoist and also in installing it. There was a mistake in the foundation plans furnished us which caused trouble. On the end of the year everything was practically in readiness to commence sinking. As soon as it is possible, this work will be continued on two shifts. The opening up of the 11th level is a big job and unless it is pushed to its utmost will take several years. The present intention is to carry this on with a small force and it was commenced in sufficient time to enable us to complete the 11th level without the necessity of working a very large force on this new construction. The cost of this work is all going against the ore and is being absorbed each month. The 11th level, as far as diamond drill records show, contains a very large amount of high grade Bessemer. One of the principal reasons for sinking the winze at the present time was to enable us to open up this Bessemer territory and get as much of this ore as practical while the price was high.

#### CONCLUSION.

The mine is in excellent condition and is improving each month as we are gradually getting away from old workings which have always given a great deal of trouble. During the coming year we will have a large percentage

of the gangs in new ground. The supply of good miners is very limited. We are employing every man who we think is a miner. Each month the territory is increasing, making it practical to add a few more gangs. If labor was plentiful it would be possible to produce a very large tonnage. Naturally, the larger the tonnage the lower the cost. During the day shift the hoist is being run to its capacity, while on the night shift we could handle considerably more ore. We are doing all in our power to obtain a maximum product.

#### ROCK DRIFTING AND RAISING.

During the year we have drifted 1392 ft. and raised 1727 ft. in rock.

In addition we have raised 2605 ft. in ore.



NEGAUNEE MINE

AVERAGE MINE ANALYSIS OF OUTPUT FOR YEAR-1915

GRADE	IRON	PHOS.	SILICA
Negaunee Bessemer,	61.61	.056	5.71
Negaunee,	59.64	.086	6.82

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR-1915

GRADE	Mine			Lake Erie		
	IRON	PHOS.	SILICA	IRON	PHOS.	MOIST.
Negaunee Bessemer,	61.57	.057		61.51	.058	12.94
Negaunee,	58.95	.092		59.04		12.17

ORE STATEMENT - DECEMBER 31ST, 1915

	NEGAUNEE BESSEMER	NEGAUNEE	TOTAL	TOTAL LAST YEAR
On Hand Jany. 1st, 1915,	8,908	196,871	205,779	111,174
Stockpile Overrun,		14,416	*14,416	
Output for Year,	#87,058	297,226	384,284	342,089
Total,	95,966	508,513	604,479	453,263
Shipments,	72,710	407,811	480,521	247,484
Balance on Hand,	23,256	100,702	123,958	205,779
Increase in Output-12%			42,195	
Decrease in Ore on Hand,			81,821	

#Includes 666 tons, stockpile overrun, developed during 1915.

\*Stockpile overrun on ore stocked during several years.

1915-- 1-8 Hr. Shift during year.

1914-- 2-8 Hr. Shifts Jany. 1st to June 7th  
1-8 Hr. Shift June 8th to Dec. 31st.

NEGAUNEE MINE

SHIPMENTS FOR YEAR--1915

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Negaunee Bessemer,	46,248	26,462	72,710	37,315
Negaunee,	144,058	263,753	407,811	210,169
Total,	190,306	290,215	480,521	247,484
Total Last Year,	132,357	115,127	247,484	
Increase - 94%			233,037	



NEGAUNEE MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 5.	1 9 1 4.	INCREASE.	DECREASE.
<u>PRODUCT</u>	398,700	342,089	56,611	
General Expense	.062	.063		.001
Maintenance	.098	.132		.034
Mining Expense	.750	.944		.194
<u>Cost of Production</u>	.910	1.139		.229
<u>DEPRECIATIONS.</u>				
Uncompleted Construction	.001	.003		.002
Taxes	.198	.198		
Central Office	.036	.054		.018
Miscellaneous	.003	.015		.013
<u>COST ON STOCKPILE</u>	1.142	1.409		.267
Loading & Shipping	.020	.014	.006	
Administrative	.013	.014		.001
<u>Total Cost on Cars</u>	1.175	1.437		.262
Number Days Operating	301	294	7	
Number Shifts & Hours	1-8hr	2-8hr127 1-8hr167		
Avg. Daily Product	1325	1164	161	
<u>COST OF PRODUCTION</u>				
Labor	.550	.725		.175
Supplies	.360	.414		.054
<u>Total</u>	.910	1.139		.229

NEGAUNEE MINE.

COMPARATIVE WAGES AND PRODUCT.

	1915.	1914.	INCREASE.	DECREASE.
<u>PRODUCT</u>	398,700	342,089	56,611	
No.Shifts & Hours	1-8hr	2-8 127 1-8 167		
<u>AVERAGE NUMBER MEN WORKING</u>				
Surface	44	51		7
Underground	222	251		29
Total	266	302		36
<u>AVERAGE WAGES PER DAY</u>				
Surface	2.33	2.42		.09(3.72%)
Underground	2.77	2.78		.01(.36%)
Total	2.69	2.72		.03(1.1%)
<u>WAGES PER MONTH OF 25 DAYS</u>				
Surface	58.25	60.50		2.25
Underground	69.25	69.50		.25
Total	67.25	68.00		.75
<u>PRODUCT PER MAN PER DAY</u>				
Surface	27.61	21.23	5.38(25.3%)	
Underground	5.70	4.53	1.17(25.8%)	
Total	4.73	3.73	1.00(26.8%)	
<u>LABOR COST PER TON</u>				
Surface	.085	.114		.029
Underground	.485	.615		.130
Total	.570	.729		.159
Avg.Product Breaking & Trimming	8.38	7.95	.43	
" Wages Contract Miners	2.91	2.92		.01
" " " Trammers	0	0		
" " " Labor	2.91	2.92		.01
Total No. of Days (Surface)	13,918½	16,111		2,192½
Underground	67,408½	75,535½		8,127
Total	81,327	91,646½		10,319½
<u>Amount for LABOR</u>				
Surface	32,521.67	38,981.06		6,459.39
Underground	186,562.19	210,210.89		23,648.70
Total	219,083.86	249,191.95		30,107.09
Prop.Surface to Underground Men;				
1915 - 1 to 5.05				
1914 - 1 to 4.69				
1913 - 1 to 4.51				
1912 - 1 to 2.68				
1911 - 1 to 2.95				
	<u>NOTE:</u>			
	Oct.1,1914,	Wage rates reduced 10% from schedule adopted Feb.1,1913.		
	Aug.1,1915,	Wages restored to scale in effect prior to Oct.1, 1914.		
	Avg.wages 9	Mos. Jan.1-Sept.30,1914	..... 2.76	
	" " 10	Oct.1-1914,-Aug.1,1915	.... 2.56	
		Decrease during 10 Mo.period	... .20	
		Percent " " "	....7.25%	

NEGAUNEE MINE.

TIMBER STATEMENT FOR THE YEAR ENDING DECEMBER 31, 1915.

KIND.	LINEAL FEET.	AVG. PRICE PER FOOT.	AMOUNT 1 9 1 5.	AMOUNT 1 9 1 4 .
6" to 8" Timber	86,441	.02	1,729.78	1,249.64
8" to 10" "	193,727	.04	7,945.56	5,815.10
10" to 12" "	23,567	.06	1,414.02	143.88
12" to 14" "	12,616	.08	1,012.03	
14" to 16" "	600	.08	48.00	
Total 1915	316,951	.0383	12,149.39	
Total 1914	288,189	.0316		7,208.62
	LINEAL FEET.	PER 100'		
7' Lagging	1,090,886	.5431	5,925.02	4,885.28
Poles	192,767	.8864	1,708.80	1,142.74
Lagging & Poles-15	1,193,653	.6395	7,633.82	
" " 1914	1,026,796	.587	6,028.02	
			1 9 1 5.	1 9 1 4 .
Product for Year			398,700	342,089
Feet Timber per ton of Ore			.795	.667
Feet Lagging " " "			2.736	2.63
Feet " per foot of Timber			3.441	3.95
Cost per ton for Timber			.0307	.021
" Lagging			.0148	.014
" Poles			.0043	.003
" Timber, Lagging & Poles			.0496	.039
Equivalent of stull timber to Board Measure			482,222	300,794
Feet of Board Measure per ton of Ore			1.209	.879
Total Cost of Timber, Lagging & Poles 1915				19,783.21
" " 1914				13,236.64
" " 1913				12,327.95
" " 1912				12,191.04
" " 1911				15,137.84
" " 1910				14,654.57
" " 1909				14,530.85
" " 1908				11,992.30

NEGAUNEE MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICES.	AMOUNT 1 9 1 5.	AMOUNT 1 9 1 4.
30% Powder				251.63
40% "	91,275	.095	8,671.13	12,864.95
50% "	48,150	.105	5,055.75	572.25
80% " Gelatin	14,055	.14	1,967.70	1,295.00
Total Powder	153,480	.102	15,694.58	14,983.83
Fuse	474,050	4,2905	2,033.81	1,481.45
Caps	99,330	8.127	805.93	573.31
Cap Crimpers	127	.25	31.75	
Electric Exploders	100	3.38	3.38	
Connecting Wire	15	.275	4.13	
Total Fuse, Etc.			2,879.00	2,054.76
" All Explosives.			18,573.58	17,038.59
Product			398,700	342,089
Pounds Powder Per Ton Ore			.385	.447
Cost per ton for Powder			.039	.044
" Fuse, Caps, Etc.			.007	.006
" All Explosives			.046	.050
Avg. Price per Lb. for Powder			.102	.098

MAAS MINE.

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RESUMING WORK.

On July 20th you notified me to reopen the mine as soon as possible. Captain Thomas, during the time that the mine was idle, was transferred to the Athens. He remained in charge of the Athens until the first of August but spent a half of each day at the Maas from July 20th to the 1st of August supervising the work of cleaning up and retimbering preparatory to hoisting ore.

AIR IN MINE.

In the latter part of the previous year it was reported that the air in some of the sub levels was extremely bad. This condition got worse and in January it became so stagnant that it was difficult to keep a light burning. Work in some of the sub levels above the 1st level had to be stopped. During the winter months the current in the shaft was upcast, the ventilating drifts between the Maas and Negaunee being tightly closed by doors. It was not practical to open these doors as this would cause the Negaunee shaft to become strongly downcast and freeze. It was decided to put the cage hoist in commission as soon as possible. This hoist has caused more or less trouble due to an old style of gear which continued to rack it to pieces. In November of the previous year it was dismantled. Upon a close examination it was found that the cylinders had worn badly and that some of the bearings needed a general overhauling. The cylinders were sent to Ishpeming and on the end of January one was returned to the mine and the erection of the hoist was immediately started. The hoist was put in commission early in February.

TIMBERING.

From the first of the year up to July 20th four shift bosses were engaged in the work of retimbering through the entire mine. They were able to keep the main drifts, and the new drifts in sub levels which were not

caving, in fair condition. It was found that in many sub levels and main drifts dry-rot had set in and practically all of the old timber had to be replaced. Above the 1st level, in an area which is under pressure, due to a large amount of broken rock above, little work could be done and most of this territory closed. This very large amount of timbering has greatly delayed the adding of additional contracts.

#### WINZE TO 4TH LEVEL.

A general description of the winze was given in my previous report. After the mine was shut down on Oct. 1st in the previous year, work in the winze was stopped. On Feb. 6th you authorized me to continue this sinking. We immediately started to do the necessary work in the engine house so that the skip hoist could be placed in commission. It was also necessary to put on all of the ropes and to hang the skips in the shaft. In addition, the transfer engine had to be connected. On the morning of the 15th two miners, picked men from the Negaunee mine, commenced to work on each shift. These were placed in charge of a shift boss. It was found necessary to have a pumpman on each shift in order to prevent the water from overflowing the sump and entering the skip pit at the shaft. Previously the main pump was only run on one shift as the shaft was used as a sump. The pumpmen and the shift bosses removed all of the ore from the storage pocket at the winze and dumped it at the shaft. Every second day sufficient ore accumulated at the shaft to fill the pockets making it necessary to hoist to the surface. The work of loading the skips was also taken care of underground by the pumpman and shift boss. On the surface the ore was handled by the machinist and helper. No extra men were necessary in the engine house as the regular man who looks after the turbine had sufficient time to do the small amount of hoisting. In the latter part of February a laborer was added to each shift in the shaft. In February the winze was sunk 25 feet, making the total depth from the collar 61 feet. In order to economize in air the drilling was all done on the day shift. This made it unnecessary to run the Negaunee compressor at night. The miners on the night shift mucked and put their timber in place.

The progress in March was 66 feet, making the total depth 127 feet. This work was looked after by Captain Ware and the underground foreman at the Negaunee mine. The shaft was inspected at least once a day by one of these men.

On April 12th, 13th, and 21st there were electric delays which stopped work in the winze. For practically the entire month the material was rock. In addition to the electric delays the month was broken up by two holidays. The progress for April was only 53 feet, making a total of 180 feet. In order to reduce the cost for running the underground haulage set a telephone was installed at the winze. When the current was not needed the engineer would telephone to the engine house and it would be shut off. The cost was still further reduced by installing a small transformer at the winze so as to provide lights from the high tension line.

During May the amount sunk was 55 feet, making the total depth 235 feet. Thirty-five feet of this was in rock. During this month a laborer was engaged in cleaning the large accumulation of ore on each side of the main 3d level track. Before the mine was shut down it was reported that the old motor cars were in extremely bad repair. It was impossible to prevent a large part of the ore from running out of the doors and spilling on the tracks. Two modern cars, which were built for the Maas by the Negaunee and which were sent to North Lake temporarily, were returned to the mine and sent underground. From this time on there was little trouble in keeping the tracks clean as in these new cars the doors are tight. A little trouble was experienced in the shaft due to bad air. A fan which was obtained at the Negaunee mine was set on a concrete foundation at the collar of the winze. This was, however, not operated as the weather condition changed and the ventilation in the winze improved. It was not until near the end of the year that the fan was finally put into commission when the drifts on the 4th level had been extended for some distance in both directions.

In June the winze was sunk 55 feet, making the total depth 290 ft. This is the back of the plat on the 4th level. At this point the miners

commenced to put in special timbers in order to commence the plat. Below the 4th level the winze was increased in size 2 ft. 6 in. to the east in order to provide a ladder-road on each side. The object of this was to make it practical for a man to travel on each side of the shaft and operate the chutes of the pockets.

There was a serious delay in July due to a large amount of water entering the mine on the 3d. Sinking in the winze had to be stopped. A small amount of work was done on a single shift up to the 9th but between the 9th and 13th it was entirely stopped. The miners were needed in the upper levels of the mine to build bulkheads. It was not thought safe to have them in the winze until we were reasonably sure that the large increase in water was not an indication of a cave which might run to the surface. From the 13th up to the 22d work was continued and the shaft completed at a depth of 317 ft. They then commenced the work of cutting the plat and pockets. The timber for the pocket was originally framed and set up on the surface so that there would be absolutely no delay in putting it in place underground. It has been found that this is good practice as there is much delay in putting in pockets if the pieces do not fit absolutely. It is difficult for ordinary miners to construct a pocket unless the pieces have been previously accurately framed and set up on the surface. The various parts are then marked and the miners have no trouble in putting them in place if they can see exactly how to do this work. During August the plat was cut and the pockets put in. On the end of the month the miners were ready to commence to drift.

Drifting continued east and west during September, both headings being in ore. The drift west was extended 40 ft. and east 60 ft. The location of the bottom of the winze is not exactly on line with the correct course of the main east and west drift, it being about 75 ft. too far to the south. This could not be avoided unless the winze was taken down for the greater part of its distance in rock. It was very desirable to sink the winze in ore and for this reason the angle had to be made quite flat. Going



east it was necessary to put in a reverse course so as to get 75 ft. farther to the north. Going west the indications were that we were close to the footwall. It was therefore decided to turn this drift sharply to the south in order to get into good ore and to reach the Bessemer territory in as short a time as possible.

During October the east heading was extended 55 ft. and the west 51 feet.

In the early part of November the drift going east struck rock. This was expected and for the remainder of its length it will be in rock. It is necessary to push this drift in order to get under the east end of the 3d level where we are doing considerable mining. This work is only about 50 ft. above the 3d level and some means of handling the ore must be provided before the 3d level commences to crush. Going west the breast continued in ore, the progress for the month being 107 ft.

Both headings have been continued during December. The progress east was 36 ft. in rock, making the breast of the drift 198 ft. from the winze on the end of the year. Going west the drift was extended 150 ft. in ore, making the breast 348 ft. from the winze on the end of the year. The greater part of the west drift has been in Bessemer ore.

#### ORE LOADING MACHINE.

The Lake Shore Engine Works was exceedingly anxious to send us an ore loading machine on trial at their own expense. This machine was sent underground on the 10th of October. On account of its size there was difficulty in taking it down the winze as the angle sheaves interfered. The work in one heading was not sufficient to keep the machine busy. We therefore put in a "Y" at a short distance to the west of the pocket in order to be able to turn the machine around. This "Y" was not completed until near the end of October. The radius of the tracks is exceedingly short, being only 20 feet. There was considerable delay on the start due to the tracks of the "Y" not being in perfect alignment. There was difficulty in turning the shovel until the defect was remedied. The shovel has not worked steadily and there has

been more or less delay due to numerous small defects. The Lake Shore Engine Works have kept a man continually on the job and are doing all in their power to rectify the defects which have shown up. During December the shovel worked for three weeks without delay. It was shown in this time that it could easily load a ton and a half car in a minute and a half. In the early part of December considerable water was encountered in the west drift. It ran out of the breast and made the ore so soft that it was almost like soup. The water softened the belt, causing it to slip. The ore worked into the movable parts of the machinery damaging them. In the latter part of December the machine was put out of commission and will be practically rebuilt. The movable parts will all be protected so that iron ore cannot work into them. The belt will be operated by a chain-drive which will prevent it from slipping. The improvements which they are making on the machine should help it greatly. If they are able to make it stand up it will be a tremendous help in drifting, making it possible to break all previous records for the Lake Superior district. The machine was sent underground with the understanding that it would be there a month. On account of numerous defects which have been found, the Lake Shore will undoubtedly allow it to remain until it has been thoroughly demonstrated whether it is a success or a failure. It has been proven by us that it will load rock as readily as ore. On the end of the year we have been using two small saddle-back cars of a ton and a half capacity. A new locomotive has been ordered which should be delivered in January. When this is received it will be sent to the 4th level and the machine will be used to load into motor cars. At the present time four trammers cannot possibly keep the machine busy as the distance to tram is too great.

On the end of the year the drift going west is turning along the boundary line of the race course track to drive east. During the coming year we will be able to raise and commence to mine Bessemer ore in the neighborhood of No. 9 drill hole.

From the west drift we are preparing to continue to the south along the boundary line and also to turn north and drift back towards the foot and to connect with the shaft. This will mean a very large amount of rock drifting.

During December the west drift has encountered considerable water. There have been several delays due to the pump not being able to handle it fast enough. An electric pump was ordered several months ago which is due early in January. This will save considerable money as it is now necessary to pump with air. In order to relieve the conditions we will start early in January to put in a 6 in. discharge line as the present line from the air pump is not large enough.

#### ELECTRIC FAN.

In order to be able to increase the drifting and to make it possible to blast at any time, the fan was connected and the suction pipe extended both east and west from the bottom of the winze. This was put into operation in the latter part of December. When the motor is received and we are able to work the shovel without serious delay, it is expected that the fan will be a great help and that we will be able to blast several times a shift in each heading. When we commence to mine to the south the fan will be necessary as it is expected that the ventilation will be very poor.

#### INCREASE IN WATER.

On the afternoon of July 3d the miners who were engaged in timbering noticed that water was pouring through several raises on the 2d level which had previously been dry. Accompanied by Captain Ware I immediately made an examination. I suspected that this water was coming in above the 1st level on the west end of the ore body. An examination of the sub levels above the 1st level showed that considerable pressure was being exerted on the 762' sub level and that towards the hanging side it was practically closed. Directly to the south of this sub level there is a territory which has been worked towards the hanging to a point about 60 ft. below the 1st level. In this area the ore body had been undercut for its greatest width, there being only a small horse of rock separating the 1st level ore from that which extends below. It was perfectly evident that the water was finding its way to the 2d level from a point near the hanging. A very large amount of filling had

previously been blasted in this territory. A crack undoubtedly extended to the ledge which allowed the surface water to enter the mine. There was a much larger amount of water than could be handled by the centrifugal pump in the main station on the 3d level. Men were immediately procured and commenced to build a bulkhead on the 2d level to impound the water. Near the shaft on the 2d level is a small station in which is located a No. 10 pump with a discharge line extending to the Negaunee mine. The Maas compressor was immediately started and all the water which could not be handled by the No. 10 was pumped by air to the Negaunee. As an extra precaution, a bulkhead was built on the 1st level. There was no water entering the main drift on this level, but if a cave should occur we wanted to be perfectly sure that no sand could enter the shaft and endanger the men working below. Shortly after the water came into the mine a cave occurred on the 2d level which shut off the outlet to the Negaunee mine. It was thought at the time that there was a connection between the collapsing of the drift on the 2d level and the water entering the mine from a higher elevation. This was subsequently shown to be simply a coincidence and that the cave on the 2d level was due to the timber having rotted out. In the early part of July it was decided to install the large reciprocating pump, E. & A. No. 247. The foundations were commenced on the 12th and completed on the 15th. On the end of the month the heavy parts were all taken underground and set up on the foundation. The pump was put into operation in the middle of August. During July we were pumping between eight and nine hundred gallons per minute. Directly after the flow of water started, and before the bulkhead on the 2d level was put in, a large volume of water flowed down the main drift and entered the shaft. This washed down a great deal of dirt and on the 22d it was necessary to stop work and clean the skip pit. Near the end of July we roofed over the back of the drift on the 2d level through which the large volume of water was flowing and commenced to repair the broken part beyond. This work was rushed as hard as possible and completed early in August. The entering of this large amount of water into the mine greatly retarded the reopening of the property. The 1st level for a distance of about 200 ft. was badly crushed.

This made it impossible to use the locomotive and to reach the transfer chute. Work above the 1st level could not be started until the main drift was reopened. The mine could not be immediately started after word was received as when it was shut down we sold all of our supplies to other mines. It was necessary to buy new machines and supplies of every description.

#### HOISTING ENGINES.

On the night shift of August 6th the crosshead on the cage hoist broke. The mine was idle on the 7th. On the 9th and 10th the miners were sent through the Negaunee shaft to their working places at the Maas. On the end of the shift on the 10th a number of the chutes had become filled and on account of our inability to get timber to the working places it was necessary to shut down. The crosshead was received on the 14th and on the morning of the 16th the hoist was again put in commission. This was a serious delay, causing a big reduction in the product for August and greatly retarding the important retimbering work preparatory to increasing the force.

On Sept. 17th, shortly after 11 A. M., the floor man took the skip hoist to relieve the regular brakeman. He had a lapse of memory and over hoisted with a full head of steam. The loaded skip was sent to the top of the shaft house where the rope broke. The ore was thrown against the transfer building, breaking all of the windows on the east side. The skip dropped down the shaft and luckily overturned at a short distance above the collar and became wedged after passing partly through the casing between the cage and skip compartments. At this same time the cage was being hoisted. It is a most fortunate thing that the skip did not become wedged below the collar, as in that case the cage might have been greatly damaged and possibly causing a fatality. The road from the collar up to the top of the shaft house was wrecked. The dumps were badly bent and the large sheave smashed. The mine was idle until Monday morning, the 20th. I have reported a number of times that neither the cage nor the skip hoist are provided with overwinding devices. After this accident Mr. McClure promised me that they would immediately start to work out some overwinding device. We have had several cases of overwinding

at the Maas, causing great damage to the equipment but luckily no fatalities.

On the night shift of the 29th a nut in the piston of the skip hoist worked loose. This dropped into the cylinder and was forced against the head. On the return stroke the nut dropped into one of the ports. It took sometime to determine just what the trouble with the hoist was. The head was finally removed and the nut was found. This came near being an exceedingly bad accident as it would naturally be supposed that the piston driving this nut against the head would cause the head to blow out. If this had occurred it would have wrecked the compressor. After the nut was removed and the head was replaced it was still found that the hoist did not work properly. Upon further examination, it was determined that the piston rod had been badly bent. A new piston rod had to be turned out. This was received at the mine in time to commence hoisting on the morning of Oct. 2d.

#### NEW GEAR FOR CAGE HOIST.

Much of the trouble with the cage hoist was caused by the old gear. This created an excessive amount of vibration and continually threw the hoist out of adjustment. It could not be operated smoothly and riding in the cage was extremely unpleasant. There has been much complaint of this from the men. In the last week of October a new herringbone gear was received. Commencing at 6 o'clock on the 30th the mechanical department started to replace the old gear. This work was completed on Monday morning, Nov. 1st. The difference in operating the hoist was tremendous. The large amount of vibration and jerking in the cage was stopped. The gear is practically noiseless and it is thought that we will have no further trouble with this hoist. A new throttle valve has been ordered which should still further improve the conditions.

#### TURBINE.

From the first of the year up until April the turbine was run at intervals. In March the supply of coal was getting low and we commenced to load at the Negaunee mine, No. 2 dock, and shipped to the Maas.

**ELECTRIC DELAYS.**

On April 12th there was a delay from 9:30 until 5 P. M. due to ice forming in the surge tower at Marquette.

On April 13th, from 2:30 until 4:30 A. M., the current was off on account of the burning out of a switch in the Maas mine engine house.

On April 21st, due to trouble on the transmission line, there was a delay from 2 until 5 P. M.

On May 24th, from 2 to 2:40 P. M., there was a delay due to trouble on the transmission line.

On July 13th, from 2:45 to 3:20 P. M., there was a delay due to trouble on the transmission line.

On Sept. 13th, during an electric storm, the current was off from 3:15 to 5 P. M.

On Sept. 14th, on account of trouble on the transmission line, the current was off from 12:30 until 2:30 P. M. On account of the small sump capacity, which is only large enough to hold the coming water for about thirty minutes, the shaft was flooded. At 1:30 we received current from the Maas generator and started up the pump. While the current was off a large amount of water ran down the 2d level, washing ore and dirt into the shaft. This filled the skip pit. This caused a delay of four hours on the 17th as the skip pit had to be cleaned.

On Dec. 6th the current was off from 3 to 3:25 P. M. due to trouble on the transmission line.

**TRANSFER ENGINE.**

On Dec. 27th a spider on one side of the transfer engine broke. New wheels had to be ordered and they were not put in until the early part of January. During the latter part of December there was a delay due to the fact that ore could only be handled with one half of the transfer.

**COOLING TOWER.**

Mine water has been used for cooling purposes around the compressor. It has been found that this is coating the jackets with iron ore and it was

decided to discontinue its use. At a short distance to the west of the engine house, outside of the improved area, the foundation for a small cooling tower similar to that at the Negaunee and Athens was put in. Up to the end of the year we have not commenced to erect the cooling tower. When this is completed we will use city water. The cost will be small as this water will be used over and over again, being handled by a small electric pump.

#### NEW LOCOMOTIVE AND CARS.

In the latter part of October a new locomotive and twenty new saddle-back cars were received. Early in November this locomotive and a few cars were sent to the 3d level. From this time on to the end of the year, between 5 and 7, we have continued to lower cars when they were needed. Up to the first of November we were short of cars as the old ones in the mine were in extremely bad repair. Previous to this time it was necessary to hoist on two shifts as all of the ore on the 3d level had to be handled with one locomotive and five cars. We commenced to hoist on the double shift in the early part of September and discontinued in the early part of November when we had sufficient cars underground to get the ore to the shaft.

#### STOCKING TRESTLE.

In October we commenced to erect trestle for the Maas grade in its old location, which is directly south of the pocket tracks. Up to the end of October we could not actually erect these bents as the spotting tracks used in connection with the steam shovel interfered. On the end of November the track had been removed and 338 ft. of trestle was erected. We commenced to stock ore on Nov. 11th.

#### ROCK TRESTLE.

In the early part of August, while tramping a loaded car over the rock trestle, two bents a short distance to the south of the shaft, collapsed. This was due to the legs having completely rotted away. From a superficial examination they were apparently sound, but it was found that the center was entirely gone. The splices on the rails and the bolts through the caps



prevented the stringers from falling. These two bents were held in position by ropes which were placed under the trestle temporarily. The loaded car was then pulled back on the part of the trestle which was still standing. It was necessary to take the stringers down and erect two new bents.

#### SHIPPING TIMBER TO NEGAUNEE MINE.

In March the Negaunee mine was run short of timber. Our requirement had not been filled on account of the condition of the ore market and it was decided that our shortage would be made up by teaming from the Maas mine. We continued to team timber and lagging, only hauling it as fast as it was needed at the Negaunee. This was stopped when the ore business improved and it was believed that there was some chance of resuming work at the Maas.

#### DRAINS FROM DRY.

In the early part of October trouble was experienced due to water from the shower baths and washtroughs backing up in the dry. It was found upon examination that the old drains, which consisted simply of hemlock launders, had rotted away. Opposite the entire length of the dry these wooden launders had to be dug up and replaced with 6 in. tile. The joints were all set in concrete and this new drain should be permanent.

#### FATAL ACCIDENT.

On Oct. 30th, at about a quarter of eleven, Ferdinand Gronzotto was instantly killed by a fall of ground in contract No. 11 on the 746' sub level, which is above the 1st level. No. 11 contract was engaged in removing a pillar which had been formed by a drift which followed a dike around the hanging side and a crosscut about 30 ft. to the north. In the morning the boss instructed this gang to put in a prop as the place was evidently taking weight. These instructions were followed. Later on the place was uneasy. The miners stopped work for awhile and after it became quiet they again started. At about a quarter of eleven a slab of ore settled off from the dike, broke through the lagging between the sets, instantly killing Gronzotto. At the time of the accident the captain and shift boss were only about 30 ft. away and if they

had had time to get into the place they undoubtedly would have saved the man's life. Demartin, who was Gronzotto's partner, was an old miner and should have had sense enough to take no chances when he knew that the ground was working. The place had been well timbered and there were no other precautions which we could have taken to have saved this man's life. In the Negaunee mine report I have described in detail the changing of the system of mining. It is the intention to adopt the same system at the Maas. From the time that the mine was reopened we commenced to close-lag every floor in order to make it possible to take this lagging up in the succeeding sub levels.

#### COAL DOCK.

During November two breaks have occurred in the side of the coal dock. In one case the plank simply gave away. In the other, two large timbers on the outside rotted away in the bottom. These were replaced as they were necessary to support the track above. During the coming summer, when the dock is empty, a careful examination will have to be made to determine how many of the outside legs should be replaced. On account of the very large amount of coal which had to be stored, no attempt was made to replace the boards on the side of the trestle. In order to provide additional room the coal was allowed to spread out on the surface.

#### FLOW OF SAND.

On the morning of Sept. 20th a small amount of sand commenced to come into the workings of the land of the American Mining Co. Previous to this time the bulkheads on the 1st level had been removed and all of the sand which had entered the mine on March 2d, 1914, had been cleaned up. A new bulkhead was immediately put in and the sand was prevented from flowing through the level. The entering of this sand has greatly delayed the work of opening up the shrinkage stope in the land of the American Mining Co. In order to protect the men on the sub levels above the 1st level, bulkheads were built at all points connecting with the shrinkage stope.

#### WORKING FORCE.

On the end of August we were working twenty-eight gangs of miners.

There was some delay in increasing the force rapidly as all supplies had been sold when the mine was previously shut down. When the Maas was started labor was plentiful and no trouble was experienced in hiring as many men as necessary. Due to crushing and the large flow of water in the early part of July, there was considerable delay in reopening the 1st level. A part of the main drift had to be retimbered as it had crushed to such an extent that a motor could not be sent through it. The force has been increased as rapidly as possible. The product, however, has not been large on account of the excessive amount of new work necessary. In another part of this report I will describe the large amount of new drifting and raising which has been done. Early in the following year we will be able to increase the force and I feel quite sure that the amount of ore which I have estimated will be produced. I also expect to make up for the shortage which has occurred during the present year. There have been a number of serious delays which has thrown us back considerably. On the end of the year we are working forty-eight contracts.

#### STOCKPILES.

On June 30th the shovel commenced to load from the west end of the north pile of Maas grade. To my great surprise the samples showed that the ore was exceedingly low in iron. The head sampler took samples from the surface of the three piles. The result of these samples was most alarming. It showed that the north and middle pile was low in iron while the south pile ran 58.50. The next time that the shovel loaded it was therefore put in the south pile. The result of this small shipment showed exceedingly low iron. I was entirely unable to explain this as the daily analysis and the average monthly analysis showed good iron. I immediately started four men to trench the north and middle piles in order to get samples which were representative. These trenches were dug into the pile at intervals of twenty-four feet until the vertical face was at least nine feet high. In May, 1914, we were cramped for stocking room. It was necessary to add about 100 ft. of trestle on the north pile and in addition to fill up the sides of this pile by using a side-dump car. The special samples which were taken from the trenches proved

conclusively that the daily output samples from June until the mine was closed in October were incorrect. They also proved that the great bulk of the ore was much higher in iron than the part dumped from the extension of the trestle and that part dumped on the face of the pile with the side-dump cars. The taking of the samples, both underground and surface, has been done with the greatest care and check samples have always been obtained. It is absolutely impossible for samplers to select their samples in order to make them check or to discard the rock for the reason that when these samples are taken the ore is moist and the rock cannot be distinguished because it is discolored. The only place where the rock can be discarded is in the crusher room. After the ore has been dried and put on the bucking board the rock naturally shows up as soon as it is broken. I have every reason to believe that the boy in the crusher room, in order to save himself the hard work of pounding down the rock, deliberately threw it out. In September rolls were placed in the crusher house, making it unnecessary for the sampler to buck any samples. It has been proven at the Maas mine that the incorrect samples were between June and September, or previous to the time when the rolls were installed. I also have further proof that there was an irregularity in the samples at the Negaunee mine during this same period. The ore dumped on the west trestle by the side-dump car was found to be considerably lower in iron than the original pile. The samples for two cuts have been plotted and this fact is brought out very clearly. The condition at the Negaunee was not nearly so serious as at the Maas for we were hoisting exceptionally good ore from the shaft which raised the percentage of iron in the total daily shipments. Neither the captain nor myself had the slightest idea that there was anything wrong with the daily results from the Maas. Neither the chemist nor the head sampler suspected that the boy in the crusher room was not doing his work properly. This serious error in the Maas results caused the captain and myself the greatest anxiety. It has emphasized the fact that too much care cannot be taken in the continual watching and checking of mine analysis. It has shown that one boy in a very menial position could cause such a very large amount of trouble. I believe

that every laboratory should be equipped with rolls. This would provide against the recurrence of any such serious trouble as was experienced at the Maas. Rock entered the daily product from the mine and it was the place of the captain and the bosses to see that this did not occur. They naturally were guided by the samples, but this is no excuse and they are certainly greatly to blame for this trouble. This has been a serious lesson to all of us and I guarantee that in the future it will not occur at any mine under my charge. When we continued to load it was shown that the great mass of the ore was of a fairly good grade and the condition was not as serious as preliminary samples on the face of the piles indicated. With the exception of a few thousand tons of low grade material in the extreme south pile, the remainder of the ore in stock is of a good grade. During the present year the ore stocked has been high in iron, averaging around 60 per cent.

## PRODUCTION.

Month	Bessemer	Maas	Total	Rock
January,				
February,		182	182	
March,		497	497	
April,		238	238	164
May,		262	262	356
June,		437	437	39
July,		735	735	57
August,	1,186	8,561	9,747	129
September,	2,868	12,992	15,860	144
October,	3,525	16,608	20,133	228
November,	2,899	13,926	16,825	342
December,	<u>2,360</u>	<u>15,860</u>	<u>18,220</u>	<u>555</u>
Total,	12,838	70,298	83,136	2,014
Transferred,	From	<u>2,669</u>	To	<u>2,669</u>
Total,	10,169	72,967	83,136	2,014

## ESTIMATE OF PROBABLE ORE.

Such a small amount of ore has been mined during the present year that the estimate has not been recalculated. I have simply deducted the amount mined from the various areas. The following is the estimate submitted to the Tax Commission.

## Estimate of Probable Ore.

Above 1st Level,	56,500
At D. D. Hole No. 11,	<u>5,300</u>
Total Ore Above 1st Level,	61,800
Between 1st and 2d Levels,	836,000
" 2d " 3d "	<u>2,067,500</u>
Total Ore Above 3d Level,	2,965,300

Assumption: 12 cu. ft. equal to one ton; 10% deduction for rock; 10% deduction for loss in mining.

Area Third Level: 237,500 Sq. Ft.  
 Percentage of Bessemer, 2

It is impossible to figure the percentage of Bessemer in the mine. I submitted a very low estimate to the Tax Commission in order to be safely conservative.

## UNDERGROUND.

## 777' SUB LEVEL.

During the previous year practically all of the pillars, with the exception of a few on the west end, had been taken. When the mine was idle the air in the sub levels above the 1st level was so bad that for a few months previous to reopening no timbering could be done. During the present year we have reopened the small part of the drift under the Roman Catholic cemetery and No. 3 contract has removed the last remaining pillar. We have not yet attacked the pillars on the west end.

## 762' SUB LEVEL.

Under the Roman Catholic cemetery there are a few small pillars.

Near the boundary line it is necessary to leave three pillars to support the territory of the American Mining Co. Those under the land of the Roman Catholic cemetery are being pulled out by contract No. 6. On the west end Contracts 1 and 2 have reopened the footwall drift and are drifting west preparatory to taking the ore which was left on the footwall on the 777' sub level.

#### 746' SUB LEVEL.

The two pillars next to the boundary line will be left to support the raises leading to the land of the American Mining Co. Farther to the west Nos. 7, 9, and 12 are removing pillars which have been blocked out. This is also true of Contracts 8, 11, and 14. This entire sub level is being close-lagged preparatory to commencing a new sub level directly below.

#### 1ST LEVEL.

Between the second and third rooms a drift has been completed in rock in order to connect with raises which were brought up from the second level. You will notice on the map that during the present year a number of these raises have been completed from the second to the first level. They were practically all started in the previous year and have been completed in the present.

Since the mine has been reopened a great deal of retimbering has been necessary in the main drift between Raises 4 and 12. Under the heading of "Increase in Water" it was described that this drift was taking a great deal of weight. At the present time it is possible to get the motor through but the drift is so tight that we could not take the cars to the shaft. This is unnecessary as all of the ore from above the 1st level is transferred to the 2d through raises.

In order to provide a second outlet in case the main drift should close, or in case of any other trouble, raise No. 43 has been provided with a ladderroad from the 1st to the 2d level.

#### 610' SUB LEVEL.

During the present year this sub level, midway between the 1st and 2d levels, has been driven for about 125 ft. east in order to divide up the

distance which it is necessary to raise from the 2d to the 1st level. Raise No. 50, which is completed to the 1st level, will be used as a transfer chute for all of the ore coming from the land of the American Mining Co. The connection with the Negaunee mine in the drift on the 2d level will make it possible to divide the ore between the two properties.

#### 2D LEVEL.

The Negaunee mine has completed the widening of the east end of the main footwall drift in order to be able to tram their proportion of the ore from the land of the American Mining Co. which will be dumped in raise No. 50.

In the center drift, under the land of the Roman Catholic cemetery, raises from No. 60 to 65, inclusive, have been put up. These six raises have all reached an elevation of about 100 ft. above the back of the drift. There is a triangular piece of ore between this drift and the hanging which could be mined without endangering the territory above. It was expected that all of these raises would be in ore, but to our great surprise, three of them, Nos. 60, 61, and 62, have been practically all in rock. Sufficient work has not been done to determine whether this rock comes in from the foot or hanging. Nos. 60 and 61 have from 70 to 75 ft. of rock and from 10 to 15 ft. of ore. No. 62 had 60 ft. of rock and 30 ft. of ore. Nos. 63, 64, and 65 had practically no rock. In October we commenced to reopen this old drift which had to be timbered for its entire length. These raises have been pushed as hard as possible as it is extremely desirable to open up these new places rapidly. During November and December three gangs of miners have worked here on two shifts. In the latter part of December we commenced to drift between Nos. 62 and 61 in order to try and outline the ore and to determine the limits of the rock. In the early part of the year we should be able to put several gangs in this territory. The finding of rock in the first three raises has thrown us back considerably and the present indications are that the amount of ore which we will get from this end of the drift is extremely small. Between 200 and 400 ft. west two other raises, Nos. 96 and 97, have been brought up from the 3d level, a distance of about 200 feet, and are practically on the elevation of the 2d level.



These have struck the hanging at a short distance to the south of an old square set room shown on the 2d level. These raises will be connected at the top and a drift then completed to the present hanging drift on the 2d level. It will then be practical to remove the triangular piece of ore on the 2d level between 200 and 400 ft. west. In the meantime we are putting up additional raises from the 3d level which will open up a larger territory farther to the east. The connecting of these two new raises with the 2d level will make it possible to get timber to the new sub level with great ease.

#### 422' SUB LEVEL.

The larger part of this sub level was taken in the previous year. There were a few very small pillars which have been mined in the present year. I call your attention to the horse of rock in the center of this sub level. On the end of the year No. 26 is removing the small pillars on the hanging side.

#### 401' SUB LEVEL.

This sub level is being mined as rapidly as possible. In the center part the crosscutting was all done in the previous year. Since the mine was reopened we have removed all of these pillars with the exception of a few along side of the main drift. In the center of this sub level the crosscuts extended below the horse of rock which is shown on the 422' sub level. This has been encountered in all sub levels below the 2d level. When an attempt was made to remove the ore which had extended under it on the 401' sub level, it naturally commenced to settle. During October the gangs in the immediate vicinity had to be removed as there was danger of the large mass of rock settling suddenly and closing the working places. It was necessary to stop work on the 401' sub level in the two contracts which were directly below it. These gangs were sent to the 422' sub level to cut up the rock and to drill long holes into it in order to cause it to settle. We succeeded in accomplishing this and during November and December we have made a particular effort to remove the ore on the 401' sub level as rapidly as possible. On the end of the year gangs are engaged in pulling from the center to the east and also the west. We are anxious to get the gangs off the 401' sub level in order to make

it possible to start the crosscut in the new sub level below.

On the extreme west end a small amount of mining has been done where No. 34 contract has been robbing the few pillars.

On the east end No. 30 has continued to drift east in ore, the drift running parallel to the main drift on the 3d level. The object of this is to connect with raises which are being taken up throughout the entire length of the 3d level. On this end of the mine the raises will naturally extend through to the 2d level.

#### 395' SUB LEVEL.

During the present year practically all of the work on this elevation has consisted of crosscutting. On the hanging side the drifts shown are very close to the rock and it is found that the entire territory opened up is by no means all in ore. I was anxious to start this sub level as high as possible in order to be sure that no ore would be left behind. Towards the north side practically all of the crosscuts which have been driven have been in ore. It is not practical at the present time to remove the ore in these pillars as it is necessary first to do a large amount of mining at a higher elevation.

#### 385' SUB LEVEL.

The work here consists of a single drift which has connected with raises from the 3d level. As soon as mining is finished in the center part of the 401' sub level, it will be possible to drop the gangs down and take up the lagging in the floor of that sub level.

#### 375' SUB LEVEL.

This sub level consists of crosscuts and has been opened up entirely during the present year. The ore is being blocked out and cannot be mined until the upper sub level has been completely removed. There are seven contracts on this elevation which are crosscutting.

#### 355' SUB LEVEL.

It will be noticed that the hanging side is farther to the south than on the upper sub levels. The rock here is close and it is therefore practical

to remove the triangular piece of ore directly below it. When this ore is taken the floor is lagged and filling blasted from the back in order to protect the new working places which will be started below.

#### 335' SUB LEVEL.

No. 46 gang has been engaged in removing a small pillar of ore only a short distance above the 3d level between the eight and tenth rooms. They have worked back as close to the main drift as is practical and early in the following year this place will have to be stopped.

#### 3D LEVEL.

During the time that the mine was idle the four shift bosses were engaged in timbering, spending most of their time on the 3d level. The main drift is difficult to keep open and timbering is constantly necessary. This drift is fairly close to the foot and the ore slabs off in large masses. This is probably due to the percentage of lime in the ore. In places the main drift has gone up as high as 30 ft. Retimbering therefore is very difficult. It will either be necessary to drive a new footwall drift in rock or to arrange to dump the ore to the 4th level when the pressure becomes so great on the 3d that it cannot be maintained. It will be noticed that three small drifts have been driven to the north from the main drift. The object of these was to locate the footwall. It has always been supposed that the foot was very close to the main drift. In the first crosscut it was found at 20 ft. and in the third at 30 ft. In the center crosscut it was 45 ft. to the north.

During the present year we have had men raising continually from the 3d to the 2d level and also on the east end putting up short additional raises in crosscuts to the sub levels above. In another part of this report the total raising will be given. During the past three months we have had between six and seven gangs engaged in this work. It is hard at the present time to have such a large proportion of the men doing dead work, but it is absolutely necessary to provide a large number of additional places.

#### AMERICAN MINING CO.

In the latter part of August we commenced to do preliminary work

to reopen the land of the American Mining Co. and to mine. On Sept. 20th, after the sand of a previous cave had been removed from the main drift on the 1st level, another run occurred. This has been described under "Flow of Sand". The main drift was immediately bulkheaded and the place abandoned. This sand entered the mine through the workings of the American Mining Co. where it had connected with the Negaunee mine. On the Negaunee mine side the ore directly east of the American Mining Co. had been taken. The filling was naturally drawn down. This, as explained a number of times, causes a bad condition along side of the pillar as it makes it possible for open places to occur and for sand to enter the workings. There was, however, no possible way to avoid this as the mining on the Negaunee side was far in advance of that on the land of the American Mining Co. At the time that the sand entered the Maas it was thought that a cave would occur to the surface on the Negaunee side close up to the boundary. Up to the end of the year this has not taken place. It was not thought safe to immediately re-enter the American Mining Company's land as a run of sand was liable to occur at any time. After Sept. 20th there was a large amount of water flowing through the shrinkage stope. This has continued up to December when there was a marked decrease. The water is now probably coming through to the east, or over a large area which is being undercut by the Negaunee. It is extremely desirable that the ore in the American Mining Co. property should be removed as soon as possible as it makes a dangerous condition for not only the Maas but the Negaunee. In October we commenced to do preparatory work to remove this ore. On account of the fact that work on the Negaunee side near the line had destroyed the upper parts of Raises 56A and B, these could not be used by the Negaunee and the work therefore has to be done from the Maas side. The plan of operation has been carefully figured out and we believe that the ore can be removed without endangering the men. On the main level, to the west of 56B, a bulkhead has been built. In the shrinkage stope, on the 595' and 853' sub levels, bulkheads have been completed to the east of raise No. 56B. This practically eliminates the possibility of sand breaking through

from the Negaunee side and entering No. 56B raise. In the previous cave there was no indication that sand had come into the shrinkage stope, which is at a considerably lower elevation than the above sub levels. A very large flow might possibly break into the shrinkage stope but the chances of such a thing occurring are not great. As an extra precaution we have built a bulkhead to the west of No. 56B on the elevation of the 746' sub level. This sub level is not connected with the Maas. The building of this bulkhead further eliminates the possibility of sand entering the Maas. We have commenced on the Maas side on the 762' elevation and have continued the drift east and have connected it with the small raises above the 1st level. On the end of the year we are preparing to open up from these small raises and to commence a shrinkage stope similar to the one started on the Negaunee side. As long as possible this shrinkage stope on the Maas side will not be connected with the old shrinkage stope of the Negaunee. Commencing early in the year we expect to be able to mine out this ore rapidly. It will be pushed as hard as possible and every attempt made to remove it without endangering our men.

#### ROCK DRIFTING AND RAISING.

During the year the rock drifting and raising has been as follows: Rock Drifting 281 feet; Rock Raising 709 feet. In addition we have raised 593 feet in ore.

#### OVERRUN.

When the mine was reopened the bottoms of all raises were in bad condition. In many places, particularly on the 3d level, the chutes were so low that the cars could not be filled properly without a great deal of extra work on the part of the loaders. We worked men day and night shift tearing out the old chutes and putting them up high enough so that the cars could be filled without extra labor. It has been demonstrated at the Negaunee mine that if the chutes are about 5 1/2 ft. above the cars that there is no difficulty in making the loaders fill every car properly. On the other hand, if the chutes are just above the tops of the cars a great deal of extra work is necessary; consequently the cars are brought to the shaft not completely

full. The result of the new work at the Maas has been that in each month that we shipped we have obtained an overrun of 16 per cent, figuring the cars at four tons. This is certainly worth doing as this extra ore is obtained at no additional price to the contractors. When the mine was previously worked we were not able to figure the cars higher than 3.75 and the overrun was never more than 8 per cent. At the end of August it was immediately seen that the cars could be safely figured at four tons.



MAAS MINE

AVERAGE MINE ANALYSIS OF OUTPUT FOR YEAR-1915

GRADE	IRON	PHOS.	SILICA
Maas Bessemer,	62.21	.051	6.43
Maas,	60.21	.108	6.86

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR-1915

GRADE	IRON	Mine	Lake	Erie
		PHOS.	IRON	MOIST.
Bessemer,	All mixed			
Maas,	58.66	.100	58.73	11.29
Maas Special,	57.64	.099	58.54	11.77

ORE STATEMENT - DECEMBER 31ST, 1915.

	MAAS BESS.	MAAS	TOTAL	TOTAL LAST YEAR
On Hand Jany. 1st, 1915	4,042	289,972	294,014	143,243
Output for Year,	10,169	72,967	83,136	206,674
Total,	14,211	362,939	377,150	349,917
Shipments,	6,053	261,937	267,990	55,903
Balance on Hand,	8,158	101,002	109,160	294,014
Decrease in Output,			123,538	
Decrease in Ore on Hand,			184,854	

1915-- 1-8 Hr. Shift Aug. 1st to Dec. 31st,  
Mine closed Jany. 1st to July 31st.

1914-- 2-8 Hr. Shifts Jany. 1st to Sept. 30th,  
Mine closed Oct. 1st to end of year.

MAAS MINE

SHIPMENTS FOR YEAR--1915.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Maas Bessemer,	6,053		6,053	10,062
Maas,	46,427	215,510	261,937	45,841
Total,	52,480	215,510	267,990	55,903
Total Last Year	52,612	3,291	55,903	
Increase - 379%			212,087	



MAAS MINE.

COMPARATIVE MINING COST PER YEAR.

<u>PRODUCT</u>	Producing	1 9 1 5.	1 9 1 4.	INCREASE.	DECREASE.
		5 mos. 83,136	9 mos. 206,674		123,538
General Expense		.140	.057	.083	
Maintenance		.177	.150	.027	
Mining Expense		1.020	.978	.042	
<u>Cost of Production</u>		1.337	1.185	.152	
<u>DEPRECIATIONS.</u>					
Original Purchase		.200	.200		
Plant Account		.250	.255		.005
Equipment		.007	.010		.003
Uncompleted Construction			.003		.003
<u>Total Depreciation</u>		.457	.468		.011
Taxes		.316	.161	.155	
Central Office		.073	.064	.009	
Supply Inventory		.009		.009	
Miscellaneous		.006	.005		.011
Idle Expense		.543	.081	.462	
Sundry Expense		.083	.017	.066	
<u>COST ON STOCKPILE</u>		2.812	1.981	.831	
Loading and Shipping		.061	.007	.054	
<u>Total Cost on Cars</u>		2.873	1.988	.885	
Number Days Operating		124	207		.083
Number Shifts and Hours		1-8hr	2-8hr		
Avg. Daily Product		671	998		327
<u>COST OF PRODUCTION.</u>					
Labor		.755	.841		.086
Supplies		.582	.344	.238	
<u>Total</u>		1.337	1.185	.152	

MAAS MINE.

COMPARATIVE WAGES AND PRODUCT.

	1 9 1 5 .	1 9 1 4 .	INCREASE.	DECREASE.
	5 mos.	9 mos.		
PRODUCT	83,136	206,674		123,538
No.Shifts and Hours	1-8hr	2-8hr		
<u>AVERAGE NUMBER MEN WORKING</u>				
Surface	26	31		5
Underground	65	181		116
Total	91	212		121
<u>AVERAGE WAGES PER DAY</u>				
Surface	2.44	2.38	.06	
Underground	2.80	2.77	.03	
Total	2.69	2.71		.03
<u>WAGES PER MONTH OF 25 DAYS</u>				
Surface	61.00	59.50	1.50	
Underground	70.00	69.25	.75	
Total	67.25	67.75		.50
<u>PRODUCT PER MAN PER DAY</u>				
Surface	9.94	20.85		10.91
Underground	4.22	3.81	.41	
Total	2.96	3.22		.26
<u>LABOR COST PER TON</u>				
Surface	.245	.114	.131	
Underground	.665	.728		.063
Total	.910	.842	.068	
Avg.PRODUCT BREAKING & TRAMMING	8.14	7.11	1.03	
" WAGES CONTRACT MINERS	2.94	2.89	.05	
" " " TRAMMERS	0	0	0	
" " " LABOR	2.94	2.89	.05	
<u>TOTAL NUMBER OF DAYS</u>				
Surface	8,360	9,911 $\frac{3}{4}$		1,551 $\frac{3}{4}$
Underground	19,701 $\frac{1}{2}$	54,297		34,595 $\frac{1}{2}$
Total	28,061 $\frac{1}{2}$	64,208 $\frac{3}{4}$		36,147 $\frac{1}{4}$
<u>AMOUNT FOR LABOR</u>				
Surface	20392.70	23,621.84		3,229.14
Underground	55249.99	150,484.89		95,234.90
Total	75642.69	174,106.73		98,464.04

PROP. Surface to Underground Men;	AVERAGE WAGES PER DAY.		
	DAYS.	AMOUNT.	RATE.
1915 - 1 to 2.5			
1914 - 1 to 5.48	As Above	28,061 $\frac{1}{2}$	75,642.69 2.69
1913 - 1 to 6.18	Develop-work	344 $\frac{3}{4}$	949.28 2.75
1912 - 1 to 2.88	Total	28,406 $\frac{1}{4}$	76,591.97 2.70
	Avg.rate last yr.		2.71
	Actual decrease all labor incl'd		.01

NOTE.

Oct.1,1914-Wage rates reduced 10% from schedule adopted Feb.1,1913.  
 Aug.1,1915-Wages restored to scale in effect prior to Oct.1,1914.  
 Avg.Wages 9 mos. Jan. 1st to Sept.30,1915 ..... 2.71  
 " 10 " Oct.1,1914, to Aug.1,1915 ..... 2.52  
 Decrease during 10 month period ..... .19  
 Per Cent " " " ..... 7.01%

MAAS MINE.

TIMBER STATEMENT FOR THE YEAR ENDING DECEMBER 31, 1915.

KIND.	LINEAL FEET.	AVG. PRICE PER FOOT.	AMOUNT 1915.	AMOUNT 1914.
6" to 8" Timber	52	.02	1.12	53.36
8" to 10" "	26,012	.04½	1,105.55	2,315.15
10" to 12" "	12,364	.06½	796.97	1,656.18
12" to 14" "	3,658	.08½	300.10	278.79
Total 1915	42,086	.0524	2,203.74	
Total 1914	88,148	.0488		4,303.48
7' Lagging	299,362	.50	1,538.74	3,003.92
8' "	816	1.00	8.16	
Total Lagging	300,178	.515	1,546.90	3,003.92
Poles	24,003	.95	230.00	104.45
Total Lagg. & Poles-15	324,181	.548	1,776.90	
" " 1914	556,957	.558		3,108.37
			1915.	1914.
Product for Year			83,136	206,674
Feet Timber per ton of Ore			.506	.427
Feet Lagging per ton of Ore			3.61	2.64
Feet Lagging per foot of Timber			7.13	6.19
Cost per ton for Timber			.0265	.020
" Lagging			.0186	.013
" Poles			.0027	.003
" Timber, Lagging & Poles			.0478	.036
Equivalent of stull timber to Board Measure			78,005	137,922
Feet of Board Measure per ton of Ore			.938	.668
Total cost for Timber, Lagging & Poles 1915				3,980.64
" 1914				7,411.85
" 1913				11,005.86
" 1912				3,726.32
" 1911				0
" 1910				5,770.97
" 1909				6,324.50
" 1908				4,373.23

MAAS MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICES.	AMOUNT 1 9 1 5.	AMOUNT 1 9 1 4.
40% Powder	31,750	.09½	3,016.25	1,143.18
50% "	10,700	.10½	1,123.50	8,904.75
80% " Giant	500	.14	70.00	
80% " Gelatin	5,100	.14	714.00	
Total Powder	48,050	.1025	4,923.75	10,047.93
Fuse	136,400	4.65	652.11	946.32
Caps	29,200	9.01	262.22	322.14
Cap Crimpers	38	.25	9.50	9.00
Tamping Bags	0	0	0	2.41
Electric Exploders	1,248	5.92	73.88	
Leading Wire	10.10	.291	2.94	
Connecting Wire	19	32.26	6.13	
Total Fuse, Etc.			1,006.78	1,279.87
Total All Expl.			5,930.53	11,327.80
Product			83,136	206,674
Pounds Powder per ton Ore			.578	.473
Cost per ton for Powder			.0592	.047
" " Fuse, Caps, Etc.			.0121	.006
" " All Explosives			.0713	.053
Avg. price per lb. for powder			.1025	.102

ATHENS MINE.

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GRAVEL.

It was reported in the previous year that it was necessary to obtain gravel from the Cliffs Shaft mine at Ishpeming. There is a very large bed of this material at the Cliffs Shaft and it can be loaded at a small cost. The railroad only charges \$3.00 for a car switched to the Athens mine.

HANDLING WATER.

There has been considerable trouble due to water finding its way through the concrete wall of the shaft. In the previous year a gutter was cut at a depth of 150 ft. below the collar. This consists of excavating the concrete, forming a trough completely around the circumference of the shaft. In January a second gutter was cut at an elevation of 330 ft. This prevented a large amount of the coming water from reaching the bottom of the shaft, as a pump was located a short distance below the gutter. On the first part of May a third gutter, at an elevation of 500 ft. below the collar, was cut. The concrete was removed around the entire circumference of the shaft and the ground excavated at an angle of about 20 degrees to a depth of 7 ft. The bottom of this excavation was then covered with a layer of rich concrete. Above the gutter a truncated cone, made out of 1/4 in. iron and extending out from the side of the shaft about a foot, was placed in position a short distance above the gutter. Where the cone intersected the circumference of the shaft the triangular space was filled with concrete. Near the bottom of the cone a pipe was put in which leads to the main gutter. The object of the cone was to catch the water which runs down the face of the shaft and to prevent it from going to the bottom. Below the gutter a pump was located. This work was a great help in sinking as it greatly decreased the time lost in handling the small pump.

On June 3d the pump located below the main gutter at an elevation of

500 ft. was replaced by an electric pump. It was soon determined that the installing of this electric pump meant the saving of a large amount of money. It is started and stopped automatically and it works with great satisfaction. In August this pump was shifted to an elevation of about 600 ft. In November the distance was getting so great that we were having trouble with the small pump in the bottom of the shaft. A tank was placed at an elevation of 850 ft. Above this tank two truncated cones, made out of 1/4 in. iron, closely fitting the circumference of the shaft, were put in. The water was lead from these troughs to the tank where it was pumped by air to the electric pump. This made a tremendous difference in the bottom of the shaft and since that time it has been unnecessary to pump except during Sundays. An electric pump, capable of throwing water 1200 feet, has been ordered. When this pump is received it will make it unnecessary to do any pumping with air.

In the early part of the year we attempted to shut off the water which was coming through the concrete by using a grouting machine. Holes were bored through the wall of the shaft to the rock and concrete pumped in under pressure. We were able to shut off the water at one point but it would break through in another. This grouting work was then stopped as it was found that it did little good.

#### BLASTING.

During March we used delay action fuses. For a short time we did not experience serious trouble, but as soon as the shaft became very wet their use had to be discontinued. A large amount of experimenting was carried on on the surface and in addition the DuPont people sent an expert to try and solve our difficulty. This man did not help us. In the latter part of March we discontinued their use and started to fire the holes with the ordinary electric exploder. Much trouble was experienced in May with these exploders. I was convinced that this was entirely in the current and that the holes were not getting the proper amount of electricity. The DuPont expert could not help us with this question. We ordered a blasting machine capable of firing fifty holes and the trouble immediately stopped. In October we commenced to

experiment with electric fuse igniters. These consist of a piece of fuse from 6 to 12 in. long, on the end of which is an igniter which, when exploded electrically, sets the fuse on fire. On the other end of the fuse an ordinary electric cap is placed. We had previously experimented with these igniters, but they were not waterproof and for this reason their use had to be discontinued. In October we commenced to wrap the exploders with electric tape and then dip them into ordinary roofing cement. This cement makes the exploder waterproof. Up to the end of the year we have fired the holes by using these igniters and very few misses have occurred. The reason for discontinuing the ordinary electric exploder was that too many holes went off at the same time, causing a tremendous concussion in the shaft and at times damaging the sets. By using the electric fuse igniters, as many delays as desired can be obtained by simply cutting the fuses to the proper lengths. I understand that the DuPont people have now greatly improved the delay action fuses and, from results in the Newport shaft, it would seem that these could be used with good results. They, however, have no advantage over electric fuse igniters with the exception that there is not quite as much work in preparing the charges.

#### ROCK HOIST.

In May the small hoist used to handle the rock car was changed from air to electricity. A special reduction box was obtained which made it possible to reduce the speed of the hoist and to use a very small motor. This speed-reducing device is remarkably simple and cheap. The gears all run in oil and it has a number of decided advantages over the ordinary method of reducing speed.

#### CAGE HOIST.

Up to and including June there was continual trouble due to grids in the engine house burning out. There were not a sufficient number of these grids and when the cage was being moved slowly they became overheated and burned out. This caused a considerable delay as the trouble always occurred when we were handling forms. The electrical department greatly increased the

number of grids and since that time no trouble has been experienced. The master mechanic figures that below 1,000 ft. the present hoist will be overloaded and that it will be necessary to decrease the load by about 200 lbs. for each 100 ft. in depth. The present plan is to operate the cage by the skip hoist as soon as that can be obtained. This hoist has been ordered but I am unable to say when it will be delivered.

#### ROCK CAR.

In September it was decided to increase the size of the car, which is used in handling rock from the shaft, by building up its sides. The addition of these side boards made it possible to increase the capacity from one to one and a half yards. As soon as the depth of the shaft increases there is naturally more time consumed in hoisting and lowering. The increasing of the capacity of the car has been a great advantage in sinking.

#### MINING CAPTAIN.

On Aug. 1st Captain Thomas, who had charge of the work in the shaft, returned to the Maas mine. His place was taken by John Tregoning, who had previously been underground foreman at the Negaunee.

#### ROCK FOR CONCRETE.

In August a cylinder 4 ft. in diameter and 20 ft. long was set up to the south of the shaft house. The lower end of this is just above the elevation of the top of the car on the main landing. The angle of the cylinder is about 40 degrees. The rock and large stones, which is screened out of the gravel, can be hoisted and dumped into this cylinder. During concreting rock is drawn off into a special car and placed on the cage and lowered. The shaftmen have sufficient time to dump this rock behind the forms into the wet concrete. Each section that was concreted contain seven or eight yards of rock. This decreased the amount of concrete necessary to fill the space and also improved the strength of the concrete. The cost of handling this material was very small.



#### CONCRETING.

For the entire year we have continued to send concrete through a 6 in. pipe, dumping it into a large bucket as described in my previous report. Towards the end of the year a little trouble was experienced due to the tremendous force with which it fell into the bucket. It was getting difficult to make this bucket stand up. At two or three points where the concrete pipe was not plumb the constant wear of this rough material wore it out, causing the concrete to spill. It looks as if we have about reached the limit where concrete can be dropped, without taking some special means to retard its flow, through the pipe. There are several plans for doing this and we will probably have to adopt one of them. Failures in the forms have occurred twice. In April we had practically completed a 20 ft. section when the forms collapsed, allowing a large part of the material to flow out into the shaft. We immediately commenced to dig out the wasted concrete and hoist it to the surface. Before all of this could be removed and the damaged forms taken out of the shaft, the concrete naturally set up. The break occurred on the 16th and it was not until the night shift of the 21st when the forms were again in position ready to be filled. It could not be determined at that time just what had caused the failure, but it was thought that one of the wooden filling pieces had given away. On the second failure, which occurred on June 10th, a comparatively small amount of concrete spilled and the forms were removed much easier than they were in April. On the 13th they were again placed in position and filled. After concreting it was found that there was a certain weakness in all of the forms. A part of them had been used for a considerable length of time. In certain places the small angles had rusted badly. In other cases some of these angles were broken. Near the joints there was a space of about 6 in. which was not sufficiently braced. The forms were all taken out of the shaft and sent to Ishpeming and thoroughly reenforced. Since that time no trouble has occurred.

#### ELECTRIC FAN.

In September an electric fan, purchased from North Lake, was set up on the northeast side of the shaft. This was connected temporarily with the

6 in. air line and arranged so that it could be run as a blower or exhauster. It was found that the line was entirely too small and a 12 in. spiral riveted pipe was ordered. Up to the end of the year this fan has not been placed in operation, although most of the pipe has been put in. It will be started early in the following year.

#### PROTECTING SETS.

In September, while blasting, we damaged two sets to such an extent that they had to be removed. In October we started in to protect the steel members by hanging a matting of timbers below them. Since that time no damage has occurred.

#### SHAFT CREW.

Up to July the crew consisted of six miners on each shift. In August we commenced to use two muckers on the shifts on which rock was being hoisted. In September and October, in order to drill the shaft over more rapidly, the force of miners was increased to eight. In addition to this, we had two muckers on two shifts. This force was continued up to the end of the year.

#### DRILL MACHINES.

At the time when we commenced to sink the shaft we did a great deal of experimenting with drill machines. At that time the Cleveland Sinker gave the best results. During the year much trouble has been experienced with these machines due to the manufacturer not putting the proper material into repair parts. Mechanically the machine is all right, but we were never able to make it stand up properly. In November we experimented with a small sinker manufactured by the Sullivan Machinery Co. This is a recent machine and showed a marked improvement in drilling speed over the Cleveland and other sinkers. It was decided to replace the Cleveland Sinkers with the Sullivan machines.

#### CHANGING SHAPE OF SHAFT.

In December it was decided to change the shape of the shaft from

circular to rectangular, using steel of the proper dimensions to form a shaft of standard size. This steel was ordered but up to the end of the year has not been received. A circular shaft, 17 ft. inside diameter, or 20 ft. outside diameter, contains approximately 300 cu. ft. in the solid for each vertical foot. A standard shaft contains about 200 cu. ft. In the circular shaft it is necessary to concrete at regular intervals. This means the loss of a great deal of time in sinking. By using steel sets and changing the shape to rectangular, it is unnecessary to concrete until the entire shaft is completed. These steel sets will be hung at intervals of 6 ft. and the distance between them lathed up with 2 in. plank. This lathing will protect the men working in the bottom and also serve as the final concrete forms. At intervals of 100 ft. bearers will be placed in position to support the sets above. I am confident that we will be able to materially increase the speed of sinking by using the steel sets of rectangular design.

#### ELECTRIC DELAYS.

On April 12th, at 9:30 A. M., the current went off due to trouble in the surge tank at Marquette. It did not return until 5 P. M.

On April 13th, from 2:30 until 4:30 A. M., the shaft was idle due to a switch being burned out in the Maas mine engine house. On April 21st the current was off from 2 until 5 P. M. due to trouble on the transmission line.

On July 13th, from 2:45 to 3:20 P. M., there was no current because of trouble on the line.

On Sept. 13th there was a delay from 3:15 to 5 P. M. on account of trouble on the transmission line during a very severe electrical storm.

On Sept. 14th, due to a severe storm, there was no current from 12 until 2:30 P. M.

On Dec. 6th the current was off from 3 to 3:25 P. M. due to trouble on the transmission line.

#### INCREASE IN WAGES.

Notices were posted that commencing with August 1st the wages would be restored to the same rate as they were at the time of the cut in October, 1914.

## SINKING.

During the entire year the rock has been unfavorable for sinking. Many short sections have been necessary as on the north side of the shaft there is a dike. This is soft and has a tendency to slab off. Much time is lost in concreting small sections as they take just as long to set up as the large sections. Up until August the crew in the shaft was small. We were trying to balance the force in such a way so as to obtain the greatest economy in cost. During the period of concreting a large force of men is not necessary. After August the force was increased as it was desired to sink the shaft more rapidly. The conditions after August were improved as we had succeeded in cutting off the larger part of the water and had gotten away from delays due to pumping and also serious delays due to trouble in blasting. The following statement shows the progress for the year:

## Sinking Statement.

	Con- creted	Sunk	Total Concreted	Total Sunk	Remarks
1913 & 1914,			290' 6"	327' 6"	
January,	62	45	352' 6"	372' 6"	Dike. Short sections concreted. Cutting off water.
February,	60	45	412' 6"	417' 6"	" " " " "
March,	40	61' 6"	452' 6"	479'	" " " " "
April,	40	40	492' 6"	519'	" " Break in forms.
May,	50	40	542' 6"	559'	" " Cutting off water.
June,	30	50	572' 6"	609'	" " Break in forms.
July,	60	70	632' 6"	679'	" "
August,	100	60	732' 6"	739'	" Cutting off water.
September,	70	70	802' 6"	809'	"
October,	70	70	872' 6"	879'	"
November,	60	85	932' 6"	964'	"
December,	<u>110</u>	<u>80</u>	1,042' 6"	1,044'	"
Total,	752'	716' 6"			
Ave. 1915,	62.7	59.7'			

## SINKING IN ROCK.

From the beginning of the work in the shaft we have kept accurate detail records of every item of cost. I submit some of these statements. I call your attention to the marked decrease in the cost per foot for the year. If a comparison between our cost and that of the work of the New York aqueduct is made, it will be found that we are way below them in every item.

## Detail Cost, Sinking in Rock.

Labor	Total to Dec. 31, 1914.		Year 1915.		Total to Dec. 31, 1915.	
	Amount	Per Ft.	Amount	Per Ft.	Amount	Per Ft.
Mining Captain,	\$ 1,072.50	\$ 3.87	\$ 2,035.01	\$ 2.84	\$ 3,107.51	\$ 3.13
Miners,	6,907.68	24.94	14,277.15	19.93	21,184.83	21.32
Landers,	1,603.56	5.79	1,979.54	2.76	3,583.10	3.61
Pufferman,	55.77	.20			55.77	.06
Compressor,	62.70	.23			62.70	.06
Hoisting,	847.49	3.06	1,593.61	2.23	2,441.10	2.46
Blacksmith Labor,	852.00	3.08	1,119.38	1.56	1,971.38	1.99
Teaming,	10.63	.04			10.63	.01
Surface Foreman,	70.99	.25	171.63	.24	242.62	.24
Labor on Drill Machines,	154.35	.55	335.48	.47	489.83	.49
Dry House,	71.13	.26	201.12	.28	272.25	.27
Muckers,			1,054.57	1.47	1,054.57	1.06
<b>Total Labor,</b>	<b>\$11,708.80</b>	<b>\$42.27</b>	<b>\$22,767.49</b>	<b>\$31.78</b>	<b>\$34,476.29</b>	<b>\$34.70</b>
<b>Supplies</b>						
Powder, Fuse, and Caps,	1,322.57	4.77	2,405.65	3.35	3,728.22	3.75
Small Supp. for Miners,	259.34	.94	547.74	.76	807.08	.81
Air Hose,	346.03	1.25	205.57	.29	551.60	.56
Drill Steel,	348.24	1.26	293.20	.41	641.44	.65
Pipe and Fittings,	106.42	.39	104.78	.15	211.20	.21
Teaming,	117.19	.42			117.19	.12
Electric Power,	61.82	.22	.24	.00	62.06	.06
Machine Repairs,	95.48	.35	1,293.58	1.80	1,389.06	1.40
Hoisting,	781.88	2.82	3,405.67	4.75	4,187.55	4.21
Top Landing,	11.67	.04	56.86	.08	68.53	.07
Dry House,	100.89	.36	327.69	.46	428.58	.43
Drill Machines,			1,904.20	2.66	1,904.20	1.92
<b>Total Supplies,</b>	<b>\$ 3,551.53</b>	<b>\$12.82</b>	<b>\$10,545.18</b>	<b>\$14.71</b>	<b>\$14,096.71</b>	<b>\$14.19</b>
<b>Grand Total,</b>	<b>\$15,260.33</b>	<b>\$55.09</b>	<b>\$33,312.67</b>	<b>\$46.49</b>	<b>\$48,573.00</b>	<b>\$48.89</b>
Feet Sunk,	277'		716' 6"		993' 6"	
Average Wages,	1914		1915			
Underground,	\$3.09		\$3.44			
Surface,	2.46		2.39			
Total,	\$2.68		\$2.97			

## Detail Cost of Concreting.

	Total to		Year 1915.		Total to	
	Dec. 31, 1914	Per Ft.	Amount	Per Ft.	Dec. 31, 1915.	Per Ft.
Labor Mixing & Pouring,	\$ 403.74	\$ 1.68	\$ 708.57	\$ .94	\$ 1,112.31	\$ 1.12
Cement & Other Supplies,	1,987.91	8.28	4,481.80	5.96	6,469.71	6.52
Heating Gravel,	277.22	1.16	623.88	.83	901.10	.91
Total,	\$2,668.87	\$11.12	\$ 5,814.25	\$ 7.73	\$ 8,483.12	\$ 8.55
Labor Mov. & Set'g forms,	2,211.77	9.22	5,331.25	7.09	7,543.02	7.60
Hoisting Supplies,	319.54	1.33	1,744.43	2.32	2,063.97	2.08
Total,	\$2,531.31	\$10.55	\$ 7,075.68	\$ 9.41	\$ 9,606.99	\$ 9.68
Labor on Gravel,	814.99	3.39	1,307.52	1.74	2,122.51	2.14
Supplies on Gravel,	193.79	.81	686.33	.91	880.12	.89
Total,	\$1,008.78	\$ 4.20	\$ 1,993.85	\$ 2.65	\$ 3,002.63	\$ 3.03
Grand Total,	\$6,208.96	\$25.87	\$14,883.78	\$19.79	\$21,092.74	\$21.26

No. of Yards Constructed,	885.5	1,900.5	2,786
Average Thickness,	19.9"	14.3"	14.9"
No. of Yards Per Foot,	3.69	2.53	2.81
" " Bags Cement,	5,485	12,330	17,815
" " " " Per Yard,	6.19	6.48	6.39
Cost Per Yard for Concrete,	\$7.01	\$7.83	\$7.57
Vertical Feet Constructed,	240'	752'	992'

## Cost of Shaft in Rock.

	Total to		Year 1915.		Total to	
	Dec. 31, 1914.	Per Ft.	Amount	Per Ft.	Dec. 31, 1915.	Per Ft.
(2016' 6" Final Dep.) Sinking in Rock,	\$15,260.33	\$55.09	\$33,312.67	\$46.49	\$48,573.00	\$48.89
Temporary Surf. Struct. & Equipment,	7,547.10	3.74	4,085.12	2.02	11,632.22	5.77
Steel Shaft Frames,	2,127.03	8.86	5,671.73	7.54	7,798.76	7.86
Concreting,	6,208.96	25.87	14,883.78	19.79	21,092.74	21.26
Steel Forms,	2,072.88	1.02	1,191.10	.59	3,263.98	1.61
Compressed Air,	4,362.39	15.75	8,342.82	11.65	12,705.21	12.78
Pumping,	325.22	1.17	4,722.39	6.59	5,047.61	5.08
Total,	\$37,903.91	\$111.50	\$72,209.61	\$94.67	\$110,113.52	103.25
Feet Sunk,	277'		716' 6"		993' 6"	

The original estimate for sinking in rock was \$105.00 per foot.

## Summary as per New Construction Cost Sheet for December, 1915.

1. Mining Captain,	\$ 3,257.50
2. Maintenance,	6,252.26
3. Sinking in Sand,	3,709.46
4. Sinking in Rock,	57,972.17
7. Miscellaneous,	27,062.99
9. Temporary Equipment,	14,741.91
10. Power Drills,	1,904.20
Total,	\$114,900.49
Less #3, Sinking in Sand,	4,786.97
	\$110,113.52

Cost of Shaft in Sand.  
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<u>Collar to Ledge, 50' 6"</u>	Amount	Per Ft.
Sinking in Sand, 43' 6",	\$2,183.58	\$ 50.19
Temporary Surface Structures & Equipment,	20.52	.41
Steel Shaft Frames,	1,148.13	22.73
Concreting, 50' 6",	1,339.24	26.51
Steel Forms,	45.50	.90
Compressed Air,	<u>50.00</u>	<u>1.00</u>
Total,	\$4,786.97	\$101.74

The original estimate for sinking in sand was \$132.00

*W. H. ...*

SOUTH JACKSON AND CRUSHER.

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On May 6th word was received to commence work in the pit. A few men were hired on that day and on the 7th we commenced to load ore. The force was rapidly increased until on the end of the month we were mining about twelve cars. This product was maintained during the month of June. In July we put on a few additional men as we had cleaned up the track to the south and were able to spot more cars. During that month we shipped about fourteen cars per day, or 575 tons. In August at times we mined fifteen cars, or approximately 600 tons. On Sept. 25th our requirement had been filled and work in the pit was stopped. During the entire season, with the exception of a very short period, the ore held up well to grade. In August, on the west face we exposed a bunch of ore, special samples from which ran as high as 58 per cent. At our present elevation the amount of this ore is limited. It, however, may increase in size below the floor of the pit. The larger part of the ore has come from the east face. In this direction it has been necessary to strip for most of the season. The distance to tram is getting greater each year and in addition we are now up against an old rock dump on the north side. The face of ore directly below is decreasing in height. It will not pay to continue to strip on the North side. Towards the south end of the pit the face is increasing gradually. It is only possible to spot a certain number of railroad cars on the present track. During the following year, on account of the reduction in the length of the face on the east side, it will be necessary to reduce the number of cars which can be loaded daily. Little ore can be obtained from the west face as for practically its entire length we are up against very low grade material. This face is extremely high, being 80 or 90 feet. On account of the loss in working space it has been necessary to reduce the estimated tonnage for the following year.

No trouble was experienced in hiring sufficient men for work in the pit. For a few days in August we were short of men who were looking for work



in other mines which were starting up. Their places were easily filled by others.

During the month of May it was necessary to have two miners retimbering the part of the tunnel which runs below the county road. This timber was found to be in bad condition and lining sets had to be put in.

The following statement shows the production from the pit by months:

May,	7,917
June,	10,544
July,	12,732
August,	13,989
September,	<u>10,844</u>
Total,	56,026

#### CRUSHER.

On May 12th work was started at the crusher on a single shift. On July 20th, on account of handling ore from other mines and also because of the large accumulation of cars in the yard due to a breakdown, the second shift was added. We continued to work on two shifts until Nov. 1st when the crew was reduced to a single shift. The crusher was shut down on Nov. 27th.

On July 15th some of the teeth in the main gear on the hoist broke. The crusher was idle for a day while temporary repairs were being made. The hoisting engine is operated by electricity, the controller being on the crusher landing. The brake is also operated from this point; the engine, however, being in a building about 50 ft. to the north. If for any reason the current is suddenly shut off, the operator is not able to control the loaded skip quick enough with his brake. The loaded skip rushes down the shaft and usually snaps the rope. On July 20th the gears which had been temporarily repaired broke out, and in addition others were destroyed. Upon an examination it was found that the main shaft was bent. The crusher was idle until the night shift of Aug. 2d. During this time a very large number of cars accumulated in the yard. On Oct. 30th the current was suddenly shut

3

off and the skip again ran away and snapped the rope. It, however, did not damage the hoisting engine. During August a new gear was received to replace the damaged one. In October there was much delay at the crusher due to the great shortage of cars. For the last week of the month the night shift did not work a single day. This naturally caused great dissatisfaction and it was finally decided to work the crusher on a single shift.

Much trouble was experienced in the latter part of November due to the freezing of the ore. Since the plant has been electrified it has been assumed that the crusher would not have to operate after extremely cold weather set in. It is strictly a summer proposition. No provision has ever been made to heat the plant. No coal has been stored there. The plant was not designed to handle soft ore as the angle of all of the pockets and chutes is entirely too flat. The results on Maas, Lake, and North Lake ores is very poor. Even in mild weather a large amount of extra labor is necessary as this ore will not run through the pockets or chutes. In freezing weather it is hopeless to attempt to handle this moist material. A large number of cars accumulated in November due to the small amount of soft ore which it was possible to send through the crusher. Cold weather set in and the ore froze solid. It was necessary to hire an engine to steam the cars. The ore froze to the dumps below the crusher. There were no steam coils around the crusher and the oil froze, making it impossible to start the machine. In the latter part of the month three cars of coal were switched to the plant and one of the boilers was started. This, however, did little good as the necessary piping to heat the plant had not been put in. Radical changes must be made if we are going to be required to crush ore during winter weather.

During the year the amount of ore which has been sent through the crusher was as follows:

South Jackson,	56,026
Chase,	39,059
North Lake Silica,	36,151
North Lake,	11,218
Maas,	9,616
Lake,	3,645
Scotch,	3,479
Morris,	1,118
Republic,	1,070
Negaunee,	<u>53</u>
Total,	161,435



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SOUTH JACKSON MINE

AVERAGE MINE ANALYSIS OF OUTPUT FOR YEAR-1915

GRADE	IRON	PHOS.	SILICA	MANG.
South Jackson,	40.29	.078	33.51	2.07

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR-1915

GRADE	Mine				Lake Erie		
	IRON	PHOS.	SILICA	MANG.	IRON	MOIST	MANG.
South Jackson,	40.27	.074	33.31	2.01	39.46	7.99	2.48

ORE STATEMENT AND SHIPMENTS FOR YEAR-1915

	SOUTH JACKSON	LAST YEAR
Output for Year,	56,026	20,241
Shipments,	56,026	20,241

Mine operated from May 8th to September 26th, 1915.

SOUTH JACKSON MINE.

COMPARATIVE MINING COST PER YEAR.

	1 9 1 5 .	1 9 1 4 .	INCREASE.	DECREASE.
<u>PRODUCT</u>	56,026	20,241	25,785	
General Expense	.020	.018	.002	
Maintenance	.010	.005	.005	
Mining Expense	.363	.400		.037
<u>Cost of Production</u>	.393	.423		.030
<u>DEPRECIATIONS.</u>				
Original Purchase	.200	.200		
Equipment	.006		.006	
<u>Total Depreciation</u>	.206	.200	.006	
Taxes	.029	.058		.029
Central Office	.018	.018		
Sundry Expense	.065	.030	.035	
Fire Loss		.007		.007
<u>COST ON STOCKPILE</u>	.711	.736		.025
Loading & Shipping		.001		.001
<u>Total cost on Cars</u>	.711	.737		.026
Number Days Operating	112	42	70	
Number Shifts and Hours	1-10hr	1-10hr		
Avg. Daily Product	500	482	18	
<u>COST OF PRODUCTION.</u>				
Labor	.270	.252	.018	
Supplies	.123	.171		.048
<u>Total</u>	.393	.423		.030

SOUTH JACKSON MINE.

COMPARATIVE WAGES AND PRODUCT.

	1 9 1 5.	1 9 1 4.	INCREASE.	DECREASE.
<u>PRODUCT</u>	56,026	20,241	25,785	
No.Shifts and Hours	1-10hr	1-10hr		
<u>AVERAGE NUMBER MEN WORKING</u>				
Surface	7	2	5	
Underground	35	26	9	
Total	42	28	14	
<u>AVERAGE WAGES PER DAY</u>				
Surface	2.08	2.32		.24(103%)
Underground	2.14	2.26		.12(5.3%)
Total	2.14	2.27		.13(5.7%)
<u>WAGES PER MONTH OF 25 DAYS</u>				
Surface	52.00	58.00		6.00
Underground	53.50	56.50		3.00
Total	53.50	56.75		3.25
<u>PRODUCT PER MAN PER DAY</u>				
Surface	75.84	121.6		45.76
Underground	9.12	9.85		.73
Total	8.14	9.11		.97
<u>LABOR COST PER TON</u>				
Surface	.027	.019	.008	
Underground	.235	.230	.005	
Total	.262	.249	.013	
<u>TOTAL NUMBER OF DAYS</u>				
Surface	738 $\frac{3}{4}$	166 $\frac{1}{4}$	, 572 $\frac{1}{4}$	
Underground	6,145 $\frac{3}{4}$	2,056 $\frac{3}{4}$	4,088 $\frac{3}{4}$	
Total	6,884 $\frac{1}{4}$	2,223 $\frac{1}{4}$	4,661	
<u>AMOUNT FOR LABOR</u>				
Surface	1,534.44	386.90	1,147.54	
Underground	13,164.65	4,654.17	8,510.48	
Total	14,699.09	5,041.07	9,658.02	
<p>Prop. Surface to Underground Men - Oct.1,1914, Wage rates reduced 10% from                      1915 - 1 to 5 schedule adopted Feb. 1, 1913.                      1914 - 1 to 13 Aug. 1, 1915, Wages restored to scale in                      effect prior to Oct.1,1914.</p> <p align="right">Avg.wages 9 Mos. Jan.1 to Sept.30,1914 ..... 2.34                      " " 10 " )ct.1,1914, to Aug.1,1915, 2.04                      Decrease during 10 Mo.period .30                      Percent " " " 12.82%</p>				

NORTH JACKSON.

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This property is shut down and there is nothing of interest to report.

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LUCY MINE.

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This property is shut down and there is nothing of interest to report.

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MORRIS-LLOYD MINE.

The hoist for the year 1915 at the Morris-Lloyd was as follows:

GRADE.	MORRIS	LLOYD	TOTAL TONS.
Bessemer,	60,316	16,400	76,716
Non-Bessemer,	8,527	65,000	73,527
High Phos. North Lake,		5,700	5,700
Silica,	<u>8,242</u>	<u>57,400</u>	<u>65,642</u>
TOTAL ORE,	77,085	144,500	221,585

PERCENTAGE OF GRADES.

Bessemer,	78%	11%	35%
Non-Bessemer,	11%	45%	33%
High Phos. Non-Bessemer,		4%	4%
Silica,	11%	40%	30%

ROCK HOIST.

From Morris-Lloyd Mine proper,		7,754
Sinking winze to 1200 ft. level, Morris,		7,233
Drifting on 1200 ft. level, Morris,		13,632
New work, Sec. 6, also raising and sinking Sec. 6 shaft,		<u>48,612</u>
TOTAL ROCK HOIST, 26%		77,231
TOTAL ORE HOIST, 74%		<u>221,585</u>
GRAND TOTAL, ORE AND ROCK,		298,816

SHIPMENTS.

MORRIS MINE.	GRADE.	FROM STOCK.	FROM POCKET	TOTAL	BAL. IN STOCK.
Bessemer,		35,082	36,675	71,757	13,538
Non-Bessemer,		7,710	235	7,945	3,138
Silica,		<u>688</u>	<u>156</u>	<u>844</u> ✓	<u>26,342</u>
TOTAL,		43,480	37,066	80,546	43,018
LLOYD MINE.					
Bessemer,		1,776	8,975	10,751	30,523
Non-Bessemer,		12,385	44,399	56,784	25,019
High Phos.,					5,700
Silica,		<u>87,978</u>	<u>40,462</u>	<u>128,440</u> ✓	<u>45,805</u>
TOTAL,		<u>102,139</u>	<u>93,836</u>	<u>195,975</u>	<u>107,047</u>
GRAND TOTAL,		<u>145,619</u>	<u>130,902</u>	<u>276,521</u>	<u>150,065</u>

#### MORRIS-LLOYD MINE.

The Morris Mine ore hoist in 1915 shows an increase of 14,529 tons over that of 1914. The output of Bessemer ore increased 28,540 tons, the Morris increased 2,921 tons, and the Silica decreased 16,932 tons. The Bessemer ore hoist increased 90%, the Morris 52%, and the Silica decreased 67%, as compared with the 1914 hoist of these grades. A comparatively small amount of development work has been necessary in 1915, and the greater part of the ore came from regular mining operations above the 1st level. Sixty five thousand tons were mined above the 1st level, and 12,000 tons between the 1st and 2nd levels.

There were 67,523 tons of ore from the Chase Lease, which makes a total of 120,103 tons from this lease since the mine was opened, on which royalty must be paid.

The hoist of ore from the Lloyd Mine shows an increase of 14,911 tons. The hoist from the old Lloyd ore body shows a decrease of 9,366 tons. The 3rd level produced 24,277 tons of ore from development work, of which 7,277 tons came from the old Lloyd ore body, and 17,000 tons from the Section 6 ore body. A new grade of ore has been made since opening the Section 6 ore body, which is called North Lake High Phosphorous ore; it was found near the footwall of the ore body, as also in the crotch between the fault and the footwall. The area of high grade ore on the sub levels between the 1st and 2nd levels of the Lloyd Mine, has shown a further decrease in area, consequently a smaller hoist is now being obtained. Practically no Silica ore is now being mined, other than that encountered in development work, which also reduced the output from the Lloyd ore body.

The Bessemer ore hoist decreased 18,146 tons, the Non-Bessemer increased 54,900 tons, or if the high phosphorous ore from Section 6 is included, 60,600 tons, while the Silica ore decreased 27,543 tons. The output of high grade ore increased 42,543 tons in 1915, or 95%, while the low grade ore decreased 27,543 tons, or 32%. The decrease