THE

CLEVELAND - CLIFFS IRON CO.

MINING DEPARTMENT

AGENT'S ANNUAL REPORT

FOR

YEAR ENDING

DECEMBER 31ST, 1913

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-:-

I N D E X.

NEGAUNEE MINE:

MAAS MINE:

THE CLEVELAND-CLIFFS IRON COMPANY.

Ishpeming,Michigan,

January 1,1914.

Mr. Wm. G. Mather, Pres.,

Cleveland,Ohio.

Dear Sir:-

I beg to submit the following report of the operations and present conditions of the mines of this Company. The inventories, maps, and statements relating to this report go forward to you under separate cover.

The tinted portions of the maps show the extensions for the year, and the location of each contract is indicated by the corresponding number.

The reports on the different mines of the Company were made by the superintendents in charge, and the reports of the Mechanical, Engineering, Geological, Pension, and Safety Departments by the heads of these departments.

Mr. J. M. Bush, who was Superintendent of the Ashland Mine, was transferred to the Iron River District in January and given charge of the explorations. Owing to the fact that this work is covered by the Geological Department, he has not made a separate report.

NORTH LAKE DISTRICT.

Operations in the North Lake District during the year have been confined to the Morris-Lloyd and Chase mines.

The Lloyd Mine which went on an operating basis April 1st, 1911, has supplied the greater portion of the ore produced in the district during the past year.

The Morris Mine went on an operating basis May 1st, 1913, and by authority of the Auditor, dated June 27th, the Morris and Lloyd Mines were combined and one cost statement made for the two. The two mines had a great deal of equipment in common, making a division of the charges very complicated; the combination also reduced the clerical work.

The Chase Mine went on an operating basis Jan. 1st, 1913, and has continued operations during the entire year. The output has been slightly lower than was estimated, owing to the fact that the mine did not develop as much ore as was expected from the diamond drill holes.

Labor conditions have shown an improvement as compared with the previous year. There is, however, a decided shortage of good men, the majority of the available men belong to the floating class, and are poor and constantly shifting. The Morris Mine is very wet, and it has been very difficult to keep men here; this has resulted in delaying the opening of this mine.

LLOYD MINE.

The hoist for the year 1913 was as follows:

	TONS.	PERCENTAGE.
North Lake Bessemer,	42,091	.303
North Lake,	20,094	.145
North Lake Silica,	76,653	.552
Total Ore,	138,838	1.000
Rock,	1,261	
Total Hoist,	140,099	

This does not include the 23,305 tons of rock that came from sinking the Lloyd shaft and the drift on the 800 ft. level to the new ore body on Section 6, which was hoisted through the Morris shaft.

SHIPMENTS FOR YEAR.

	POCKET.	STOCKPILE.	TOTAL.	BAL. IN STOCK.
Bessemer,	26,775	17,643	44,418	9,381
Non-Bessemer,	4,632	12,356	16,991	12,097
Silica,	41,171	32,055	73,226	120,962
Total,	72,578	62,057	134,635	142,440

There has been an increase in the output of high grade ore during the past year as compared with the previous year. Of the ore mined during the year, 54% has been high grade and 46% Silica, the balance of the Silica ore came from the 2nd level shrinkage stopes. During the past year there was 29,904 tons of ore drawn from the shrinkage stopes on the 2nd level, of which 5,624 tons was Bessemer, 906 tons North Lake and 23,500 tons Silica. The breaking ore cost of all this ore was paid for in 1912. At the close of 1913 there was in the neighborhood of 10,000 tons of ore remaining in the shrinkage stopes on the 2nd level.

During the early months of the year there was a shortage of men, principally trammers, which decreased the output. In the summer labor became more plentiful and a good hoist was maintained the balance of the Considering the number of men working in the mine, the output per man per day has been high since the 1st of June.

On June 27th through authority of the Auditor, this mine was com-

bined with the Morris Mine, the comdination dating as of May 1st, at which time the Morris Mine went on an operating basis. The cost per ton after the combination, showed a large increase, as the only ore produced at the Morris came from development work, but through the low cost at the Lloyd it has been possible to keep the cost of the combined mines down to a reasonable figure during the past year.

ORE ESTIMATE.

	BESSEMER	NORTH LAKE	SILICA.	TOTAL.
1st Level,	1,000	1,200	1,800	4,000
2nd Level,	46,200	32,400	60,400	139,000
Probable ore below 2nd,	112,500	112,500	150,000	375,000
Total,	159,700	146,100	212,200	518,000
Probable Analysis,	58.50 -.051	57.50 -.070	51.00-.054	

The estimate for 1913 is lower than that of 1912 by 307,000 tons, the reduction exceeding the output by 166,000 tons. In 1912, several raises had been put through from the 2nd to the 1st level in the S.W. ore body, from which it was assumed that the area of ore between the levels was practically of uniform dimensions. Sub level mining in this territory the latter part of 1913 showed that the ore area decreased rapidly a short distance below the 1st level, and that it would be impossible to obtain the product from this territory which had been estimated the previous year. Owing to the conditions which have been disclosed by the work above the 2nd, the estimate of probable ore below the 2nd has also been decreased. It is possible, however, that the estimate of probable ore will eventually be exceeded, as very little is known of the ore at the junction of the two faults 100 ft. below the 2nd level.

1st LEVEL.

There are two ore bodies mined on this level, which for convenience have been designated the S.E. and S.W. deposits. The S.E. deposit refers to the ore found in the trough between the slate footwall and the fault, having a S.W.-N.E. strike, while the S.W. deposit refers

to a similar body between the slate footwall and a fault, having a S.E. N.W. strike.

In 1912 mining was in progress in the S.E. ore body. The ore had been mined out in 1912 down to the 144 ft. sub level, the top sub being 200 ft. above the 1st level and within 4 ft. of the sand. When mining first started the subs were opened 9 ft. apart, and the floors were heavily lagged. After opening and caving three subs, the distance between the sub levels was increased to 16 ft., the 144 ft. sub being the 2nd sub opened 16 ft. below the sub above.

The first of the year two contracts were working on the 144 ft. sub. The ore was first outlined by drifts on the foot and hanging side, and when the East end of the ore was reached, slicing was started, taking out the pillars between the two drifts. When two slices had been taken, the 6 ft. of ore in the back was blasted down, the men falling back from the center of the pillar towards their drifts at each side. Mining was completed on the 144 ft. sub early in March. In the meantime another contract had opened the 128 ft. sub level and outlined the ore by drifts. Two contracts continued mining the ore on each sub, the development drifts having been previously driven by another contract. Work was continued in this way until the ore had all been removed down to the 106 ft. sub. The area of the ore had gradually decreased so that when mining was finished on this sub there was no longer room for three contracts to work here. The 88 ft., 70 ft. and 55 ft. subs have since been mined out by two contracts, both of whom were working on the 40 ft. sub at the close of the year. There were three grades of ore produced on these sub levels during the past year, 19.1% Bessemer, 26.7% North Lake and 54.2% Silica.

In Jan. one of the contracts which was working in this deposit, mined some ore at the West end of the 70 ft. sub directly into the shrinkage stope which had been opened further to the West and had been emptied during the previous year. It was possible to obtain about 1000 tons of ore very cheaply in this way.

No. 5 shrinkage stope on the 2nd level was continued about 25 ft.

above the 1st level in a small body of Bessemer ore near the dike on the South side of the deposit. The 44 ft. sub is only 19 ft. above this point, so that there is only a small quantity of Bessemer ore remaining to be mined here. The ore remaining above the 1st level is of Silica grade, and there is only a limited tonnage here, as the ore is only drift wide on the 2nd level. During the past year 23,200 tons of ore was mined here.

In 1912 mining had been completed in the S.W. ore body down to a point 24 ft. above the 1st level. The first of the year six contracts were working on the 16 ft. sub above the 1st level, developing the deposit preparatory to side slicing. These six contracts continued working here until March, mining on this sub being completed in April, when all the contracts were moved down to the main level.

In January one contract started mining the ore under the hanging on the main level at the extreme East end of the ore body. Drifts outlining this ore had previously been driven, and the contract started side slicing across the deposit. After taking out two slices and timbering, they mined all the ore which was above the timbers, working with raising drills. The ore was found to be very irregular, as at several points it extended 25 ft. above the level. It was here that the fatal accident of April 8th occured, whereby John Wisuri lost his life. A large slab loosened from the hanging, slipped over the drift on to the side set where the men were working, crushing the set and burying one of the miners.

In April when the work was finished on the 16 ft. sub, there were eight contracts mining out the ore on the main level. During May and June there were six contracts working on the main level, in July four, August three, Sept. two, and in Oct. and Nov. one. As work was finished on the 1st level, the contracts were moved to the subs below the 1st where several sub levels have since been opened up. A horse of jasper which persisted through all the subs mined out during 1912, was found on both the 16 ft. sub and on the main level. To the West of this jasper horse, the ore was Non-Bessemer, to the East there was a fair sized area of Bessemer ore, and at the extreme East end under the hanging, the ore was practically

all North Lake, on the North or footwall side, all of the ore was of Silica grade. The caving of the 6 ft. of ore from the back when mining was being done on the 1st level, allowed some quicksand to come down at the West end of the ore body, and it was necessary to bulkhead off a small portion of the level to prevent the sand from spreading.

About the time that the 16 ft. sub was completed, a raise was put up on the South side of the deposit a little to the East of the limits of the ore on the 16 ft. sub level. A drift was driven from this raise out to the sub, and from this point the capping was broken down to fill the open space which was left after this sub was blasted in. From this same raise a drift was also driven out over the territory where ore had been mined on the main level under the hanging, and the capping was broken here also. One contract worked about three months filling in this part of the mine.

2nd LEVEL.

On the 2nd level in Jan. 1913, there were five gangs working in the shrinkage stopes which had been opened during the previous year in the S.E. deposit. Mining in the main South shrinkage stope in which two contracts worked, was finished on Feb. 10th at an elevation of 60 ft. above the 2nd level. The width of the ore gradually decreased and finally became too low for mining.

No. 16 shrinkage stope was completed the 15th of Feb. at an elevation of 70 ft. above the 2nd level. No. 5 shrinkage stope, the Bessemer stope at the East end of the level, was completed in Feb., at which time they had reached a point 25 ft. above the 1st level. The ore rapidly decreased in size as they gained in elevation above the 2nd level; half way between the levels it had an area of 20 x 40 ft., while at the 1st level it was only 20 x 20 ft. in size. No. 10 shrinkage stope immediately West of No. 5 stope, was worked until Jan. 20th, when work was temporarily stopped. At this time it was up 60 ft. above the 2nd level. When No. 5 finished their stope they started working in No. 10 stope, in which they completed work the last of April. This stope was stopped at

a point 15 ft. below the 1st level, the ore being about 10 ft. wide here. When mining is finished in the S.E. deposit above the 1st level, it is planned to blast out the floor of the 1st level drift down to the stope. This completed the shrinkage stope mining in the S.E. deposit above the 2nd level.

In Sept. exploring work was started in the pillar between the S.E. and S.W. deposits, or in other words that piece of ground which lies above the junction of these two deposits. A contract started working at a point 350 ft. South of the shaft and drove a drift 70 ft. to the South through this pillar. The drift was in Silica ore averaging from 46 to 51% iron. Another contract started working at the same time exploring the East end of this pillar. A raise was put up 30 ft. and a crosscut driven 22 ft. to the North. However, the grade of the material here did not exceed 46% iron, and work was abandoned here. This contract then started a drift across the pillar at a point 50 ft. East of the drift which was being driven by the other contract. They drifted 50 ft. to the South and holed to the crosscut on the South side of the deposit.These two contracts then timbered their drifts and put up a number of raises, and the last of the year started opening a shrinkage stope. A number of analysis of samples taken here indicated that the product from the stope would run about 51% iron. There will probably only be a limited tonnage available here, as the point where they are working is undoubtedly close to the jasper hanging, but the ore which they will mine will be obtained at a lower cost than would be possible with the regular sub level mining.

Tramming from the shrinkage stopes was started at the opening of the shipping season, and during the past year nearly 30,000 tons of ore was taken from the stopes. There is probably about 10,000 tons left in the old stopes, and it is probable that the new stope will yield at least 2,000 tons. There is now about 10,000 tons of broken ore which will be available for hoisting during the coming year, on which the cost of breaking has already been paid.

LLOYD MINE.

In Feb. two of the contracts which had completed work in the shrinkage stopes, started two raises in the main crosscut from the shaft, in the S.W. deposit. The 1st raise struck the hanging at 75 ft. above the level and the 2nd at 60 ft. On completing these raises, the contracts were moved a short distance to the East where they put up two more raises. These two raises struck the hanging at an elevation of 25 ft. The work done by these two contracts in the territory above the 2nd, was very discouraging, as it indicated that only a very small amount of ore would be found in this territory.

As the ore areas below the 1st level were smaller, it was necessary to operate several subs at the same time in order to maintain a good output, and this rendered it necessary to have more raises through which to handle the ore. In August a contract started a raise from the 2nd level between two raises which had been previously put up. This raise passed through 40 ft. of slate into ore; it was then turned due West and put up at an angle of 65 degrees, holing to the 138 ft. sub early in November. Another contract came to the top of a raise which struck jasper at the elevation of the 100 ft. sub, turned this raise to the West and continued it through to the 120 ft. sub level. Even with the addition of these two raises to the five which were already put up in this territory, there was hardly enough to permit of as many contracts working here as is desirable in order to maintain a good hoist. The difficulty as stated before, is due to the changes in the grade of the ore, which renders it difficult for two contracts to dump into one raise.

In April a contract came to the 100 ft. sub level which had been opened the previous year, and drove a drift to the North at the West end of this sub. The drift was continued North into the footwall, from which a raise was put through in rock to the 138 ft. sub, connecting with the timber slide on this sub level. All the timber for the sub levels below the 1st is handled through this raise.

In Feb. a contract started opening a sub level 12 ft. below the

1st level, or as has been designated in the monthly reports, the 138 ft. sub level. This contract came down and opened out from one of the raises near the hanging at the East end of the deposit. After drifting West and connecting with the other raises in this territory, they drifted 75 ft. to the North into the rock, from which point they raised, holing to the main haulage drift on the 1st level. This provided a road for taking timber to this sub level and through a raise which was later put up from the 100 ft. sub, provided a timber slide for the sub levels which have been opened in this territory during the past year. On completing this work the contract started drifting to the South under the hanging beneath that part of the 1st level which had already been mined out and caved.

In April a contract came to this sub and started drifting to the West from the timber slide along the North side of the deposit. This drift reached the West end of the ore body in July, and this contract then started side slicing. As mining was completed on the 1st level, other contracts came down to the 138 ft. sub, and in June there were four contracts working here. In July the 130 ft. sub was opened. The main part of the ore body by this time had a good timber mat. At the East end of the deposit where the ore had been mined on the 1st level and capping broken here to form a mat, there was, of course, only a small amount of timber mat. It was decided that to avoid danger of the rock mixing with the ore, that it would be best to carry the subs in this part of the deposit directly under each other, the floor lagging of one sub to form the back lagging of the next. Accordingly, when the 138 ft. sub was mined out, the 130 ft. was opened directly beneath. Later on in the year the 120 ft. sub was opened directly beneath. The West end of the deposit just below the 1st level was mined on the 138 ft. sub level instead of dropping down 16 ft., on account of the quicksand which had caused some trouble on the main level. When the ore on the 138 ft. sub was mined out in this same territory, no trouble was experienced, as the sand was found to be fairly dry, with no tendency to run. It was there-

fore decided to open the next sub at this end of the deposit 16 ft. below, and for convenience, this sub has been designated the 125 ft. sub level.

At the close of the year mining had not been completed on the 136 ft. sub. The West end of the deposit had been mined out, as also the East end. Three contracts were working here in the small area remaining. The ore has been mined out next the fault on the South side of the deposit, and the three contracts are now falling back towards the footwall, removing all the ore.

The 130 ft. sub which was opened under the East end of the deposit only, has practically all been mined out. One contract is now working here finishing the pillars left near the raises. Development drifts have been completed on the 125 ft. sub immediately to the West of the 130 ft. sub, and mining is now in progress here, with two contracts working. Caving of the 6 ft. of ore in the back is now in progress at the West end, as also at the S.E. part of the sub adjoining the 130 ft. sub. The work of opening the 120 ft. sub was started in November, two contracts working, and mining has also been nearly completed on this sub. The area being mined here is the same size as that which was mined on the 130 ft. sub level, being about 100 ft. square.

The contract which put the raise through from the 2nd level, was moved to the 100 ft. sub, where they have since worked outlining the ore at the West end of the deposit.

4th LEVEL.

The drift from the Morris to the Lloyd shaft reached the line of the Lloyd shaft on April 22nd, which completed this drift. The contract which was driving this drift then started a drift to the South towards the new ore body on Section 6, and after driving this far enough so that a switch could be installed, they returned and started cutting the plat for the 4th level of the Lloyd. Electric haulage went into commission on the 10th of May, and the working force here was then increased. The work of cutting the plat was completed the last of May, after which the tail room drift for the electric haulage was driven in

70 ft. to the North of the shaft. On completing this work the shaft was raised full size for 21 ft. and timbered, and a pocket built with chute to handle the rock which would come from raising the shaft 372 ft. to the present bottom of the Lloyd shaft. It was decided to put up a raise 9 x 9 ft. in size; cribbing one half only, which would provide two compartments, one for pipes and ladders and one for the broken rock.

Work in the raise was started on the 1st of July, and 94 ft. was made for the month. In August 110 ft. was made, in Sept. 112 ft., and in Oct. the 32 ft. intervening between the top of the raise and the bottom of the shaft was cut through. The balance of October was used in opening out near the top of the raise to the full size of the shaft, and in cleaning out the dirt which came into the raise when it holed to the Lloyd shaft. The last of the month one set of bearers and one set of timber were installed about 20 ft. under the bottom of the shaft, there being left a 15 ft. rock pentice under the cage and skip roads. In November the shaft was stripped and timbered 70 ft. Early in December three eight-hour shifts were authorized for this work, and during this month after stripping and timbering 77 ft., they reached the elevation of the 3rd or 600 ft. level of the Lloyd shaft, and the work of cutting the plat was started on Dec. 20th. At the end of the year 15 ft. of ground had been removed to the South the full width of the shaft, also 15 ft. to the West the full width of the shaft.

The ground in the shaft raise was extremely dry, and it was necessary to obtain respirators for the men. Seams of gray-whacke were encountered in the slate, which were very hard to drill. This hard ground also interfered with the progress of the raise. Some delays occured in October after holing the raise, on account of several feet of quicksand which was at the bottom of the Lloyd shaft, and which came down into the raise blocking it. The timber from the shaft is lowered from the 2nd level of the Lloyd, at which point it is transfered from the cage to the level, and is lowered by a puffer down into the shaft.

It will require nearly another month to complete the plat, and

then when sinking is resumed, it will be necessary to cut out for the eighty-ton storage pocket. It is probable that the shaft will be completed to the 800 ft. level about the 15th or 20th of March. It will then be necessary to sink 85 ft. below the 800 ft. level to provide room for the storage pocket, skip pit and sump. After completing this work it will be necessary to return to the shaft and remove the pentice to make the connection with the Lloyd shaft. It is thought that all this work will be completed and the shaft in operation by the 1st of July, 1914.

On the 10th of May a contract was started driving a drift to the new ore body on Section 6. This drift was started from the stub drift which had already been started by the gang that was cutting the plat. The drift was continued to the South about 275 ft., then was curved to the East until it was on a due East course. Drifting has been continued throughout the year, and at the close of the year the drift was in 1706 ft. from the shaft. Ingersoll Leyner drills have been used in this drift, and artificial ventilation has been provided through an electric driven fan and a 10 in. suction pipe. The monthly advance has been as follows: May 150 ft., June 182 ft., July 205 ft., August 215 ft., Sept. 204 ft., Oct. 215 ft., Nov. 205 ft., and Dec. 220 ft. The rock is shoveled from iron plates, which are laid near the breast, into the motor cars. The motor cars stand 4 ft. 10 in. above the rail, so that the rock has to be thrown by the shoveler to a height of 5½ ft. The problem of rapid drifting here has been the removal of the broken rock. Mr. McClure has designed and built a loader which was brought to the mine and tested out the last of November. Some changes were found to be necessary for its successful operation, and until these have been finished, the loader will not be available for use. The object of the loader is to carry the dirt from a low elevation up into the car, it being planned that the men will shovel the rock on the loader, this requiring a lift of about three feet, as compared with over 5 ft. when shoveling into the motor cars. At the present time it requires at least thirty minutes to load one 3½ ton

car; in the trial run with the mechanical loader, it was possible to load the car in fifteen minutes. The successful operation of the loader will make it possible to blast two cuts per shift. This will mean an advance of at least 300 ft. per month of twenty five working days. As stated before, this drift is now in 1706 ft. from the shaft, the breast being within 750 ft. of the ore body on Section 6. There is a large tonnage of ore available here above the 800 ft. level, the ore extending entirely through to surface at the extreme East end of the deposit. At this point there is about 225,000 tons of very high grade ore which it will be possible to strip. There is hardly sufficient ore here to warrant grading and building the railroad into this point from the main line of the L. S. & I. Ry. By stripping this ore, it can be milled down to a sub level at the bottom from which point it will be trammed and dumped down to the 600 ft. level of the Lloyd Mine. From this point it will be taken by electric haulage to the Lloyd shaft where it will be hoisted. Before mining can be started here, it will be necessary to complete the drift on the 800 ft. level as well as the drift on the 600 ft. level, which has not yet been started; also a drift must be driven North into the footwall and a permanent raise put up for ventilation, a traveling road and for taking timber into the sub levels which will be opened above the 600 ft. level. At the earliest calculations, allowing for rapid progress in both drifts and raises, it will be at least three years before a large tonnage will be available from this deposit. In the meantime the ore body at the Lloyd now being mined above the 2nd level will be opened by raises from the new 600 ft. or 3rd level, and mining will be started. It is not thought that the ore will be found to extend below the 600 ft. level in this ore body.

DIAMOND DRILLING.

One hole was drilled during the past year at the Lloyd Mine on the 800 ft. level or 4th level. It was drilled to the South from a point 460 ft. directly South of the shaft, through slate 392 ft. and 112 ft. in the ore formation, a total depth of 504 ft. It was thought that the ore

trough between the slate footwall and the fault, with a S.W.-N.E. strike, extended down to the 800 ft. level, at which point the trough was figured from the geological cross sections to be 50 ft. in width. A dike was encountered in the slate footwall at the point where the trough should have been cut, and the hole continued on to the South in slate, striking the ore formation in its true position. No ore was shown up after drilling 112 ft. across the formation, and the hole was stopped. The bottom of the trough is evidently some distance above the 800 ft. level, and if ore exists, it will doubtless be found on the 600 ft. level 200 ft. above.

LLOYD MINE.

AVERAGE MINE ANALYSIS OF OUTPUT F OR 1913.

GRADE	IRON	PHOS.	SILICA
North Lake Bessemer	58.16	.051	
North Lake	58.02	.068	
North Lake Silica	51.34	.052	17.55

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR 1913.

	Mine		Lake Mine	
	IRON	PHOS.	IRON	PHOS.
North Lake Bessemer	All Mixed			
North Lake	No Shipments			
North Lake Silica	49.80	.048	51.55	

ORE STATEMENT FOR DECEMBER 31ST.

	N.LAKE BESSEMER	NORTH LAKE	NORTH LAKE SILICA	TOTAL	TOTAL LAST YEAR
On hand Jan.1,1913,	12,633	9,180	117,535	139,348	43,937
Output for year	41,352	20,833	76,653	138,838	139,635
Total	53,985	30,013	194,188	278,186	183,572
Shipments	44,604	17,916	73,226	135,746	44,224
Balance on hand	9,381	12,097	120,962	142,440	139,348
Decrease in Output				797	
Increase in Ore on hand				3,092	

1913 - 2-8hr.shifts during year.
1912 - 2-10-hr.shifts to Mar.11th; 2-8hr shifts from Mar.11th to close of year.

SHIPMENTS FOR 1913.

	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
North Lake Bessemer	26,775	17,829	44,604	21,557
North Lake	4,781	13,136	17,916	12,647
North Lake Silica	41,171	32,055	73,226	10,020
Total	72,727	63,019	135,746	44,224
Total Last year	30,436	13,788	44,224	
Increase 207 %			91,522	

MORRIS MINE.

At the close of the year 1912, drifting was in progress on both the 1st and 2nd levels of the Morris Mine. The 1st level drift was in 1200 ft. from the shaft, and had just crossed the boundary line between the Chase Lease and the Excelsior Iron Co. land. The 2nd level drift was in 1660 ft., and had advanced 230 ft. on the Chase Lease. Both of these drifts were in jasper, while according to the cross sections made from the diamond drill holes, they should have been in ore. One raise was being put up from the 2nd to the 1st level in order to explore the ground and provide ventilation on the 2nd level.

During the past year the 1st level drift has been advanced 510 ft. to the West, and one crosscut driven to the North to prove up the width of the small body of ore on the Excelsior Iron Co. land. Fourteen raises have been put up on the 1st level in the ore, twelve of which have been completed, having reached the hanging. One sub level has been opened in the small ore body on the Excelsior Iron Co. land, and one in the main ore body on the Chase Lease.

Development work has been seriously interfered with owing to the large amount of water encountered in both the drifts and raises. However, the indications are that the water is decreasing in the ground which has been opened, except near the breast of the 1st level drift and in the raises near it. This is borne out by the records of the amount of water pumped, which has remained almost constant for the last four months. The 1st level drift has not yet reached the point from which it will be possible to mine all of the ore indicated by the drilling on the Moore-Chase Lease, and it is now planned to extend it about 200 ft. further. Mining has already been started at the top of the ore body on the Excelsior Iron Company land, which was proven by raises, drifts and crosscuts to only extend 50 ft. above the level.

On the 2nd level the main haulage drift has been extended 250 ft. to the West in jasper, with some lean ore, while two crosscuts have been

driven North of the main drift, one on the Chase Lease and one on the Excelsior Iron Co. land. The last of the year a shrinkage stope was opened in the small body of ore which was found along the footwall on the Excelsior Iron Co. land.

Hoist for the year at the Morris Mine:

Bessemer,	20,223 tons,
Morris,	3,913 "
Silica,	13,106 "
Total Ore,	37,242 "
Rock from Morris Mine,	16,369 "
Rock from raising and stripping Lloyd shaft and drift to new ore body Sec. 6,	23,305 "
Total Hoist,	76,916 "

	SHIPMENTS. TONS.	BALANCE IN STOCK.
Bessemer,	14,902	7,035
Morris,	1,060	2,913
Silica,	3,242	12,741
Total,	18,394	22,689

Of the ore hoisted during 1913, 16,313 tons came from the Chase Lease. All of the ore mined during the year came from development work, seventy five percent coming from the work on the 1st level.

ESTIMATE OF ORE IN SIGHT.

	BESSEMER	MORRIS	SILICA	TOTAL TONS.
Above 2nd level,	400,000	30,000	70,750	500,750
Probable ore below 2nd,	102,000	75,000	23,000	200,000
Grand total,	502,000	105,000	93,750	700,750

This estimate shows a large reduction from the original estimate made from diamond drilling. The discouraging conditions disclosed by the 2nd level drift does not at this time warrant a larger estimate, although it is possible a large tonnage may eventually be developed at greater depth.

The first of the year four contracts were working in the mine; at the close of the year there was nine contracts working, eight in ore and one in rock. Last year there was an average of twenty men working on each shift, in 1913 there has been an average of about thirty two men on each

shift. New contracts were added as fast as places could be found for them, but owing to there being so much water, it has been impossible to keep the contracts filled.

1st LEVEL.

On Jan. 1st, 1913, the 1st level drift was in 1200 ft. from the shaft, four feet over the boundary line of the Chase Lease. The breast had just struck jasper after passing through 65 ft. of Bessemer ore. The drift was continued to the West 65 ft. in jasper, with no change of ground, and was then turned 45 degrees to the N.W. After advancing 30 ft. in rock, it struck Bessemer ore, and after advancing 30 ft. in this ore, the drift waa turned to the West to follow this ore. The drift advanced slowly to the West, raises being cut out on the South side or hanging side of the drift, with 25 ft. pillars between. It continued West for 250 ft. in Bessemer ore, and was then turned slightly to the S.W. in order to gain away from the lean ore and dike which was showing on the North side of the drift. It was continued in ore 110 ft. further, when jasper was encountered in the breast. A crosscut was turned off to the South in the ore near the jasper, which also struck a full breast of rock after advancing 20 ft. in lean ore.

The last of the year after being idle for over a month, the drift was continued to the West in jasper, and at the close of the year had advanced 15 ft. The breast of the drift is now in 1710 ft. from the shaft, measured along the line of the drift. It is 710 ft. South and 1100 ft. West of the Morris shaft. The contract which drove the drift, cut out and timbered eleven raises during the past year, ten on the South side of the drift and one on the North side near the breast.

During the past year the drift advanced 510 ft., 405 ft. in ore and 105 ft. in jasper. It has proven that the main ore body on the Chase Lease has a length on the 1st level of approximately 400 ft. The raises which have been put up from this drift by other contracts, have proven that the ore body pitches to the East, as the first raise was only 30 ft. in height and the last raise which had been completed near the breast, found the ore extending practically 100 ft. above the level.

MORRIS MINE.

In 1912 the main haulage drift showed up 65 ft. of ore on the Excelsior Iron Co. land near the Chase Lease. In 1913 a crosscut was driven 60 ft. to the North in this ore before striking jasper. The raise which was put through from the 2nd level for ventilation, reached the elevation of the 1st level at a point 25 ft. directly South of the point where this crosscut was started. A drift was driven 25 ft. to the South to this raise directly opposite to this crosscut. This showed that at this point the ore body was 100 ft. wide. In Feb. a contract started putting a raise up in this ore. A short time later two other contracts started working here. These three contracts put up three raises which have been designated raise 1, 2 and 3. Raise No. 1 near the East side of the ore body, reached an elevation of 106 ft., the last 30 ft. being in lean ore; raise No. 2 reached an elevation of 80 ft., while raise No. 3 struck jasper at 50 ft.

A sub level was opened at an elevation of 50 ft., and crosscuts driven to the North from the raises to prove up the width of the ore. On completing these crosscuts, two of the contracts were moved further West to put up raises on the Chase Lease, while one contract remained to explore this ore body from the top of No. 1 raise which was 106 ft. above the level. They drove a crosscut to the North, also to the East, but both of these failed to discover any merchantable ore. The contract was then brought down to open a sub level at an elevation of 80 ft., on which considerable drifting and crosscutting was done, but only a narrow seam of high grade ore was found. It was then decided that the ore did not extend far enough above the 50 ft. sub to warrant opening a sub level above that elevation, so the contract was moved down to the 50 ft. and started outlining the ore preparatory to mining. They drifted to the West and at one point found a small seam of high grade ore extending about 20 ft. over the boundary of the Chase Lease. This seam was followed in the hoped that it would connect with the main ore body on the Chase Lease, but this work was abandoned after striking a full breast of jasper. The contract then drove a crosscut to the South almost on the line of the

Chase Lease, this being the Western limit of the main ore body. At the close of the year they had taken two side slices to the East of this crosscut, and had back stoped the ore out up to the jasper. They then put poles down on the floor, covering them with several thicknesses of lagging, and started breaking capping down to form a mat. It is planned to cut off the top of the ore over its entire area and break down capping in order to prepare this ore body for sub level mining.

On the Chase Lease, raises No. 4 to 14 inclusive, have reached the hanging at various elevations above the 1st level. The raises are located 35 ft. from center to center, with 25 ft. pillars between. Starting with No. 4 which reached the hanging at an elevation of 30 ft. above the level, each raise gains approximately 10 ft. in height, No. 13 being up 110 ft. above the level. Raises No. 10 and 11 were abandoned on account of water, so much coming in that it was impossible to continue them up to the hanging. Raise No. 9 was continued in lean ore until an elevation of 108 ft. was reached above the 1st level. At an elevation of 100 ft. a sub was opened and a drift driven to the West. This drift it was thought would cross the tops of No. 10 and 11 raises, and would drain the ground here so that it would be possible to complete these raises. No. 10 raise was completed in December, holing to the 100 ft. sub level, the last 20 ft. being in Silica ore. No. 13 raise was continued to a corresponding elevation, and a crosscut driven North and South from the raise in Bessemer ore which was 35 ft. wide. The contract which was drifting from No. 9 raise on the 100 ft. sub, are now headed to hole to the crosscut driven by No. 13, and after holing here, will continue to drift to the West in the high grade ore which has been shown up by the crosscut. The drift on this sub is now in ore averaging 50% iron.

No. 14 raise was started the last of the year, and for the first few feet was in lean ore. It then passed into high grade Bessemer ore averaging 54% iron.

The last of February a hole was drilled to the South from a point 700 ft. South of the shaft where the main haulage drift turned to the West. This hole showed ore at a depth of 113 ft., the ore being about 55 ft. in

width. In June a contract started driving a drift here to develop this ore, and advanced 75 ft. in slate; in July 15 ft. in slate and jasper, and then started curving to the East in ore. They drifted 94 ft. in ore to the East, the last 25 ft. of the drift being in Silica ore. They then came back and drifted 60 ft. to the West, the drift being in high grade ore for 20 ft., then lean ore and finally in jasper. Work was continued here during August and part of September, there being two crosscuts driven to the South, one at the West end for 20 ft. through a dike, then in lean ore; one near the East end of the main drift 25 ft. to the South, 8 ft. in good ore and the balance in dike and jasper. At the extreme East end of the main drift, a crosscut was driven 20 ft. to the S.E. until it reached the same dike as was shown up in the other two crosscuts. This crosscut was in jasper, however, and there was no ore found on the dike. Work at this point was then abandoned, and it was decided to bring a diamond drill here and drill to the South to determine if any ore would be found on the dike which runs E and W through the ore body on both the Chase Lease and the Excelsior Iron Co. land. A hole was drilled here 137 ft. in depth, which showed 15 ft. of 51% ore from 110 to 125 ft. No further drifting has been done in this location, however, as it was desired to push the work on the Chase Lease as rapidly as possible on account of the royalties that are accruing on the Moore and Chase leases.

2nd LEVEL.

On Jan. 1st 1913, the main haulage drift on the 2nd level was in 1650 ft. from the shaft, measured along the line of the drift, and was 230 ft. over the boundary line on the Chase Lease. The drift on the Chase Lease was in jasper. In January the main drift advanced 75 ft., the last 10 ft. of which was in Silica ore. In Feb. it advanced 80 ft., and a crosscut was also started to the North.

No work was done in this drift for a few weeks while the diamond drill was here, and when work was resumed, the main drift was advanced about 20 ft., and at the same time the crosscut was opened out. The cross-

cut was then continued to the North in lean ore for 30 ft., when high grade ore was encountered. The high grade ore proved to be 25 ft. wide, No. 12 diamond drill hole from surface being encountered about 10 ft. from the North side of the ore. The crosscut was continued through jasper 50 ft. further North when a curve was made to the West. A drift was driven to the West for 60 ft., part of the time in lean ore averaging about 48% iron. Work was then abandoned at this point on account of diamond drilling here, and no further drifting has since been done to the West. Work was resumed in this part of the mine in July, the drift being driven East from this crosscut to develop the ore shown up in No. 2 underground diamond drill hole. This drift was advanced a total distance of 155 ft., finding considerable low grade and some 56% non-Bessemer ore at the point where ore was indicated by the drilling. When the drift was stopped, the breast was in jasper.

In October and November the main haulage drift was continued to the West and North a distance of 115 ft., the greater part of the distance in Silica ore. It was driven to develop the ore shown up by No. 10 underground drill hole, which had been drilled to the Southwest from the drift near the footwall. It was hoped that the ore shown up by No. 10 diamond drill hole would continue to the West, but as rock was encountered here, work at this point was temporarily abandoned. The main haulage drift will probably later be continued to the West; this depends on finding on the 1st level the eastward extension of the ore shown up in diamond drill holes 4 and 96 on Lease 24. These two holes are located about 1000 ft. West of the breast of the 2nd level drift.

During the past year the main haulage drift advanced 250 ft. further to the West. No. 2 crosscut was driven 120 ft. to the North, and from the end of this crosscut, 230 ft. of drifting has been done, 60 ft. to the West and 170 ft. to the East, a total of 600 ft. of drifting being done during the year on the Chase Lease.

In December a new contract started working in the main haulage drift at a point 20 ft. West of No. 2 crosscut, this point being 1800 ft.

from the shaft, starting a raise to the 1st level. This raise will hole to the 1st level at a point about 100 ft. East of the jasper which cut off the ore. It will tend to prove up the ore between these levels and also will provide better ventilation. At the close of the year this raise was up 31 ft. in Silica ore.

On the Excelsior Iron Co. land a crosscut was driven to the North at a point 1230 ft. from the shaft to develop the ore which had been encountered in the main haulage drift. This crosscut was started in Feb., and was driven 140 ft. to the North. The greater part of the distance it was in ore, some of it being high grade and some low grade. Near the North end of the crosscut they passed through some jasper, beyond which they struck a small seam of high grade ore, which had been found in this locality by underground drill holes. From the end of the crosscut, drifts were started both to the East and to the West in this ore. The East drift has been driven a distance of 330 ft., the first 200 ft. being in high grade ore, the balance in Silica ore. The West drift was in Bessemer ore for 60 ft., when jasper was encountered, and the drift was turned to the S.W. following the jasper. After advancing 70 ft. along the jasper, in Silica ore, they struck high grade ore on the South side of the drift, and turned due South in Bessemer ore for 85 ft., when work was stopped here. There was a total of 695 ft. of drifting done at this point during the past year.

At the point where the main haulage drift had turned to the S.W., this being about 730 ft. South of the shaft, some lean ore had been shown up by the drift. As the East drift from No. 1 crosscut was within 140 ft. of this point, it was thought possible that this lean ore would extend across and connect with the ore in the drift near the footwall. A drift was driven in this lean ore for 30 ft., when it struck jasper and work was abandoned here. The lean ore here was very high in phosphorous, and very undesirable for dumping on the Silica ore pile.

At the close of 1912 a raise had been started on the Excelsior Iron Co. land in ore. This raise was planned to go through to the 1st

level to provide ventilation and prove up this ground. It was extremely wet and was only completed with great difficulty. At an elevation of 100 ft. they cut out for a sub level, and then continued the raise which holed to the 1st level in April.

Two other raises were started, one 25 ft. West of this raise, the other 50 ft. West, the former being on the Excelsior Iron Co. land, and the latter on the Chase Lease. As both of these raises were very wet, it was decided to stop work here in the hopes that this ground would later drain so as to render this work less difficult.

An exploring raise was put up in the East drift from No. 1 crosscut on the Excelsior Iron Co. land to determine the height of the 20 ft. seam of ore which had been shown up in this drift. The ore was shown to extend 35 ft. above the level at this point, and it was decided to mine out the ore here by the shrinkage stope method. This work was started in Oct., and a total of eighteen raises have been put up and chutes built preliminary to actual mining. A block of high grade ore settled off on the timber, and after completing the raises, it was decided to take out this block of ore, remove the lagging from the timber and put down heavy poles. On completing this work, mining was started, and at the end of the year work had been completed at both ends of the stope. In the center of the stope the ore seems to extend to a considerable height, and it will probably require another month or more to mine all of the ore. This lense of ore does not extend up to the 1st level, and only a few thousand tons will be available on the 2nd level. By this method of mining it will be possible to obtain all the ore here at a much lower cost than would be possible if it were mined by sub levels.

In November it was decided that it was advisable to outline the ore midway between the 1st and 2nd levels, and accordingly a new contract started working on the sub which had been opened out 100 ft. above the 2nd level in the raise which had been put through for ventilation. This contract drove a crosscut 80 ft. to the North before striking rock. They then started drifting to the West following the rock. The last of the

month another contract was brought to this sub level and started a drift to the West near the hanging wall. These two contracts will now continue outlining the ore at a point midway between the two levels. At the close of the year, the footwall drift had just passed the boundary line of the Chase Lease; the hanging wall drift was within 15 ft. of the boundary line. At the close of the year a total of 285 ft. of drifting had been done on this sub level. The crosscut which was driven at a point 65 ft. East of the line of the Chase Lease, showed the ore to be 100 ft. in width; at the line of the Lease, however, the ore has a width of only 50 ft. The probabilities are that the ore grows narrower to the West, which would make the body conform with the width of 35 ft. on the 1st level. On the 2nd level the ore is about 100 ft. in width, so that from the 100 ft. level down to the 2nd, the main part of the ore body will probably be found of this width. Above the 100 ft. sub the ore on the Chase Lease will probably be only about 35 ft. wide, and in the small ore body on the Excelsior Iron Co. land about 100 ft. wide.

MORRIS-LLOYD DRIFT.

In July 1912 a drift was started on the 800 ft. level of the Morris shaft towards the line of the Lloyd shaft. On Jan. 1st, 1913 this drift was in 693 ft. East of the Morris shaft, the breast being 477 ft. West and 200 ft. South of the line of the Lloyd shaft. The drift advanced 184 ft. in January, 161 ft. in February, 180 ft. in March and 145 ft. in April. It reached the line of the Lloyd shaft on April 22nd, which completed this connecting drift. The working force here was increased and the work of cutting the plat for the 4th level of the Lloyd as well as starting a drift to the new ore body on Section 6 was continued throughout the year. This work, however, will be reported under the 4th level of the Lloyd Mine. All rock from this work has been hoisted through the Morris shaft.

For the year 1913 there was a total of 6,778 ft. of ore and rock drifting done at the Morris Mine. There was 657 ft. of rock drifting exclusive of the Morris-Lloyd drift, where there was 670 ft. of rock drift-

ing done, making a total of 1327 ft. of rock drifting for the year. On the 1st and 2nd levels there was a total of 5,451 ft. of ore raising and drifting done.

DIAMOND DRILLING.

Two underground drill holes were drilled in 1912, on the 2nd level. In Feb. 1913 the diamond drill was brought to the 2nd level and hole No. 3 drilled North to the footwall at a point 1450 ft. S.W. of the shaft. This hole crosscut the formation North of the main haulage drift, striking the footwall at a depth of 135 ft. It showed 20 ft. of lean ore averaging 48% iron between 90 and 110 ft.

The drill was then moved to a point 1700 ft. S.W. of the shaft opposite to No. 2 underground drill hole. Hole No. 4 was drilled to the South from the main haulage drift into the hanging. The first 15 ft. was in 57% ore, the balance in jasper, the hole being stopped at a depth of 103 ft. on account of caving, which occured at a depth of 85 ft., where the hole passed through a small vug.

The drill was then moved to the 1st level and Hole No. 5 was drilled to the North from the breast of the crosscut 10 ft. East of the Chase Lease boundary line. This hole reached the footwall at a depth of 85 ft., and showed a small amount of enriched material near the footwall.

Hole No. 6 was then drilled at a point 550 ft. due South of the shaft. This hole passed through 86 ft. of slate, then jasper to 115 ft., with ore from 115 to 170 ft., 25 ft. of which averaged 62% iron, the balance about 55% iron. The hole was stopped at a depth of 185 ft. in jasper.

The drill was then moved to the 2nd level where hole No. 7 was drilled to the South into the hanging directly opposite to hole No. 3 which had been drilled North to the footwall. This hole was drilled 121 ft. in jasper, and as no ore was encountered, the hole was stopped. This hole was completed in March, no further drilling being done in the mine until May, when the drill was brought to the 2nd level and hole No. 8 was drilled South sixty degrees West from the breast of the West drift

from No. 2 crosscut, this point being about 1800 ft. from the shaft. The hole was drilled to a depth of 210 ft. and showed several narrow seams of lean ore in the jasper.

Hole No. 9 was then drilled North from the same station to the footwall, showing 41 ft. of rich jasper from 43% to 48% iron. The hole was stopped in slate at a depth of 51 ft.

Hole No. 10 was then drilled from this same station, South thirty degrees West. This hole was stopped at a depth of 140 ft. in jasper. It showed ore from 65 to 130 ft., averaging from 47.20 to 60.70 iron, the best run of ore being 15 ft. of 57.50 iron, .050 phos. The bottom of this hole was 100 ft. nearer the line of the main drift than hole No. 8, and it showed up sufficient ore to warrant the continuation of the main crosscut.

No further drilling was done until Sept. 30, when hole No. 11 was drilled on the 1st level South ten degrees East at a point 700 ft. South of the shaft. The ore shown up by No. 6 drill hole had been developed by drifts and crosscuts, and hole No. 11 was drilled in order to find if the ore shown up in the ore body on the Excelsior Iron Co. land continued to the East along the dike which ran through the center of this ore body. This hole found 15 ft. of 51% ore at a depth of 110 ft. on the dike. The hole was then stopped at a depth of 137 ft. in jasper.

The drill was then moved to the 2nd level where hole No. 12 was drilled from a point 1600 ft. S.W. of the shaft North from the main haulage drift to the footwall, this point being midway between No. 2 and 3 drill holes. The hole was stopped at a depth of 175 ft. From 120 to 140 ft. showed 20 ft. of Silica ore averaging 48.50 iron, .060 phos. The drill was then moved to the 4th or 800 ft. level of the Lloyd. After completing a hole here, the drill was moved to the 1st level of the Morris to the breast of the main haulage drift, 1700 ft. S.W. of the shaft.

No. 14 hole was drilled North to the footwall and was stopped at a depth of 170 ft. in slate, no ore being shown up. There was, however, a small band of enriched material found near the footwall.

Hole No. 15 was then drilled from the same station North, fifty degrees West, and was stopped at a depth of 58 ft. in jasper. On completing this hole the drill was removed from the mine. Holes No. 14 and 15 were drilled in an endeavor to find an extension of the main ore body on the Chase Lease.

A total of eleven holes were drilled at the Morris during the past year, the total number of feet drilled being 1583, 942 ft. on the 2nd level and 641 ft. on the 1st level. On the 1st level hole No. 6 showed up sufficient ore to warrant a drift, and this ore has been outlined by drifts and crosscuts. It proved disappointing, and it is doubtful whether sufficient ore will ever be mined here to warrant the expense of development. No merchantable ore was shown up in the other holes, but they have proved of great assistance in planning development work on this level. On the 2nd level the holes drilled showed a considerable amount of lean ore, with some small runs of high grade ore. They have also proved of great assistance in laying out the drifts on this level; they have also enabled fairly accurate estimates to be made of the ore above the 2nd level.

Under Opening and Equipping, Morris Mine, E and A No. 204, the following construction work has been done during the past year.

Account No. 10-c, Motor Tracks, which account was kept open to the 1st of August, showed an expenditure of $2811.15. This represented the cost of motor haulage tracks on the extensions to the 1st and 2nd level drifts and in the Morris-Lloyd drift. It also covers the expense of installing tracks on the 4th or 800 ft. level of the Lloyd Mine, and the extension of this track in the drift to the new ore body on Section 6, there being an actual length of 647 ft. of drift included in the charges under this account. The motor haulage tracks have been extended to the point where ore was encountered on the 1st level of the Morris Mine. On the 2nd level the entire level is equipped with motor haulage tracks, including the main haulage drifts and both No. 1 and 2 crosscuts. The

work of extending the tracks on the 1st level of the Morris was started in November, and it is planned to have the motors in operation on this level in February. Electric haulage was started on the 2nd level about the 10th of May 1913.

Under Account No. 10-i, Main Air Lines, from January to June inclusive, when this account was closed, there was $719.86 expended for carrying the permanent air lines in on the 1st and 2nd levels, and also in the Morris-Lloyd drift. On the 1st level there is a 4 in. line extending all the way into the breast, a distance of 1700 ft. from the shaft. From tees placed in this line, are one inch air lines going up into the raises. On the 2nd level the 4 in. line has been carried to the breast of the main haulage drift, also into No. 2 crosscut, while in No. 1 crosscut a 2½ in. line has been carried in from the main 4 in. line. The latter part of the year a 6 in. line was put in from the Morris shaft through the Morris-Lloyd drift over to the Lloyd shaft, replacing the 4 in. line which had been put in when the drift was driven. This 6 in. line will eventually carry all the air from the compressors to the Lloyd Mine and to the new ore body on Section 6, and the line now in use on surface will be removed.

Under account No. 10½, Ventilation in Mine, a total of $127.03 was expended during the past year, this covering the cost of some 10 in. spiral riveted pipe which was used in the Morris-Lloyd drift. The good progress made in this drift has only been possible through artificial ventilation and electric haulage, as this drift is now in over 4000 ft. from the Morris shaft. In the neighborhood of 1000 ft. of this pipe has been used since the last charge in this account, but as the mine went on an operating basis on May 1st, the later charges for pipe were taken up directly in the operating accounts.

Account No. 42, Docks, Trestles and Pockets. Under this account there has been charges of $3392.91 during the year. This covers the cost of stockpile plank, laying of same and the erection of about 250 ft. of trestle on the North stockpile grounds at the Morris Mine, to take care

of the ore hoisted during the winter of 1913 and 1914.

Under Account No. 77, Receivers and Air Pipes, there was expended $284.71 during the past year. This covered the cost incurred in locating a receiver and piping it for the air entering the Morris Mine. The two receivers had originally been located on the South side of the stockpile grounds between the Morris and Lloyd shaft. The air to the Morris did not reach the receivers, going directly to the shaft through the tunnel from the compressor. One of the two receivers were moved to the Morris timber yard, and a pipe line was laid on surface from the Morris engine house to it. From the receiver a 6 in. line was carried back through the timber tunnel to the shaft. Since making this change, there has been very little water in the air underground at the drill machines.

Under account No. 81, Electric Haulage, which appears under the Morris-Lloyd division of E and A, there has been expended $14,700.14 during the past year. This covered the cost of a motor generator set and erection of same, the cost of carrying the wires from the engine house into the mine and into the drifts; the cost of two electric haulage locomotives and twenty motor tram cars. The electric haulage tracks have been carried through the Morris-Lloyd drift to the Lloyd shaft and in the drift to the new ore body on Section 6. The cost of wiring, with the material used in these drifts, is included in the expenditures for the year.

E and A No. 262, covered the cost of a new compressor for the Lloyd Mine. The 1700 ft. Ingersoll Rand compressor located in the Morris engine house, was not of sufficient capacity to furnish air at 75 lbs. pressure to both the Morris and Lloyd mines, and the purchase of a new compressor was authorized in the spring. It was decided to erect an addition to the Morris engine house for housing the new compressor, as it was desired on account of economy in operation to have both compressors located in the same building. The addition was started in May and completed in July. The foundations for the new compressor were installed in July, and the work of erection started. All the wiring and panels necessary for the compressor, as also the re-arrangement of switchboards in the engine house, was completed in August.

MORRIS MINE.

In the trial run made of the compressor in Sept., it was found that it was not working properly. Some changes were made, the base of the compressor being strengthened by the installation of heavy distance pieces between the cylinders. In the meantime the necessary safety devices were installed and the concrete floors were finished. In October the compressor was started, but after operating only a few hours, one of the valves broke, a broken piece dropping into the low pressure cylinder bending the piston rod. An erector was sent from the Nordberg Factory to make repairs, and the compressor was not operated again until the last of November.

In the meantime piping had been completed so that this compressor would furnish air for the Morris-Lloyd mines, while the piping from the Ingersoll-Rand compressor was arranged so that it could furnish air to the Cliffs Shaft mine. The compressor has been operated fairly constantly since, although there has been several delays due to minor accidents. The compressor seems to be of too light a construction, a number of breakages being due to vibration. It is furnishing air at about 78 lbs. pressure, and since it has gone into operation, there has been a noticeable improvement in the air pressure at the different working places in the mine.

MAINTENANCE OF EQUIPMENT.

There has only been one large item the past year under maintenance. This appears on the cost sheet under account No. 132, Pumping Machinery, and was due to the breaking of the large spur gear on the 1000 gallon permanent pumps located on the 2nd level of the Morris Mine. In February the gear on No. 1 pump which has been in continual operation since the pumps went into commission, was broken. It was repaired for use again, and a new herringbone gear was ordered. Early in Feb. it broke again, was repaired and operated for three days. It again broke, was repaired and operated for one week when a new break developed which put it entirely out of commission. The new herringbone gear was received the last of Feb., and was installed early in March. The other pump was operated, using the spur gears until in August, by which time these gears had become badly worn and new herringbone gears were received and the old ones discarded.

MORRIS MINE.

Up to this time the electric recording instruments had been located in the Morris engine house on surface, both pumps operating from one panel, one set of transformers, and only one set of recording instruments. A separate panel was ordered for each pump with the necessary instruments, and this equipment was moved underground and set up, one for each pump. A total charge of $2696.10 was incurred in this account due to breaking of the spur gears and the purchase of new equipment.

SURFACE, MORRIS-LLOYD MINES.

The surface work is reported under the heading of the combined mines, as many of the buildings and much of the equipment are for common use, also since the properties are combined on the cost sheets.

In Jan. 1913, five bents were erected on the East stocking trestle at the Lloyd, as it was necessary to make new stocking ground for the Silica ore. In April six more bents were erected, and in May one, at which time the limit of the East trestle was reached; no further extension being possible on account of the public highway and the L. S. & I. Ry. tracks. This completed the construction work at the Lloyd Mine under E and A No. 204. During the shipping season fifteen bents were torn down on the East stocking trestle at the Lloyd to permit of loading the Bessemer and Silica ore here. This portion of the trestle was rebuilt the last of October, and early in November. Two carloads, or about 30,000 ft. of stockpile plank was laid on the East stocking ground at the Lloyd, as this work had not been completed at the time the bents were erected.

In Nov. seven bents were erected on the North stockpile grounds at the Morris. Stockpile plank have been laid over this area, and on the trestle built the previous year the planked area has been widened 20 ft. on each side of the trestles. In 1912 only enough plank were laid to take care of the output. In November the old trestle at the Morris Mine was repaired, as it had settled over 18 in., and this was anticipated, as the trestle was built on filled ground.

The ground improvement work at the mine during 1913 has been

charged directly into "Operating," account No. 125, "Tracks and Yards." During the past year over $1200.00 has been expended in this work; it is now nearly completed, and the work remaining to be done will only cost a small amount. In May the plants for the grounds around the mine buildings were received. The planting extends on three sides of the mine office, framing in the building, and on the slope in front of the office. It also outlined the road to the office as well as the road which passes in front of the office. Only a small grass area has been made near the building on the top of the slope; the balance of the lot will be allowed to grow wild, and it is planned to transplant into this area a number of native plants. It already contains a number of blue berry bushes. In May the road to the office, 300 ft. in length, was graded and the side slopes sodded. In June the work of building the stone wall enclosing the whole group of mine buildings was started, and it was completed in July. Gates have been made for the five entrances to the enclosed area; they have been fitted, but will not be hung until in the spring of 1914. The stone wall has proven a success and adds greatly to the appearance of the buildings. The ground around the laboratory has been graded, but not seeded. Trees have been planted in front of the dry house and vines planted near the building. One of the two tile drains necessary to carry the excess water off at the mine during the time of the spring thaw, also following very heavy rains, has been put in, with a catch basin and outlet into the swamp; the other one will be put in as early as possible in the spring. The remaining work will be completed in the spring of 1914.

A drive shed large enough to shelter three rigs and horses, has been built on the West side of the barn. This was badly needed, as heretofore, horses had been compelled to stand out in the open, exposed to the wind. As soon as the weather will permit, the work of putting siding on the barn will be started, and on completing this work, both the barn and drive shed will be painted.

FATAL ACCIDENT.

One fatal accident occured in the district during 1913. On

April 8th, John Wisuri, a Finn miner was killed on the 1st level of the Lloyd Mine by a fall og ground. Wisuri and his partner were working under timber, when a large piece of ground settled down on the timber of the main drift set, rolled or slid over on the side set, crushing it down, resulting in the death of Wisuri. All necessary precautions had been taken, and the accident was one of those due to the hazard of the mining industry.

SAFETY.

A number of safety devices have been installed during the past year. The moving machinery in the laboratory has been enclosed to prevent accidents. A number of guards, railings and platforms have been installed on the top trams at both the Morris and the Lloyd mines, in addition to those built in 1912. It was thought that they would decrease the danger of accidents here.

The last week of October the U.S. Mine Rescue Car No. 8, was set on a siding at the mine, and for one week the "First Aid" and mine rescue crews were trained by the government men. The men at the mine are impressed with the efforts being made by the Company to decrease accidents, and it is undoubtedly having a moral effect in making the men more careful themselves.

LOCATION.

In April and May the streets and alleys of the location were cleaned up, and throughout the entire summer and fall the garbage was removed from the alleys once every week.

Several cess pools at some of the first or oldest lot of houses were filled, and new ones were made during the past year. In February a number of the water pipes froze, and were thawed out by electricity. In the summer ground was teamed in and banked over the water lines, as the ground over the pipes had settled in some cases nearly a foot.

The park space in the road running East from the school house in the location, was seeded, and in the fall the wire fence enclosing this space was removed, as a good sod has formed here.

GENERAL WELFARE.

Twice a week train service was started in May. It was continued until in the fall, when it was reduced to once a week. The results have proven disappointing from a money standpoint, as the service has not paid for itself. During the summer it was patronized by a limited number of women and children, but the majority continued to walk. Once a week service on Saturdays has been continued into the winter, but thus far very few have taken advantage of it. It may be that if some shelter were provided at the railroad tracks,that more people would use it, but under present conditions very few are willing to stand in the cold and wait for the trains.

A rural free delivery route including West Ishpeming, North Lake and the Chase Mine locations, went into operation in the spring. About 120 boxes were erected on the route, and it is stated that the mail to this territory has more than doubled. Nearly every patron now takes a daily paper. It has tended to make the people more contented, and has proven a great help in keeping the people in the locations.

The awarding of prizes in 1912, for the best kept premises, window box gardening, vegetable gardens and vine planting, for the same amounts as such awards have been made in Gwinn, showed results the past year. Three times as many people endeavored to win prizes, and as a result, the appearance of the whole location improved. Some excellent results were obtained, lawns were graded, walks laid out and some shrubbery planted, also flower borders were made. The interest is increasing, and another year better results will be shown through an increased number of tenants competing for the prizes.

MORRIS MINE.

AVERAGE MINE ANALYSIS OF OUTPUT FOR 1913.

GRADE	IRON	PHOS.	SILICA
Morris Bessemer	59.99	.050	
Morris	57.89	.074	
Morris Silica	51.42	.061	17.93

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR 1913.

	Mine		Lake Erie	
GRADE	IRON	PHOS.	IRON	PHOS.
Morris Bessemer	All Mixed			
Morris	No Shipments			
Morris Silica	All Mixed			

ORE STATEMENT - DECEMBER 31ST, 1913.

	MORRIS BESSEMER	MORRIS	MORRIS SILICA	TOTAL	TOTAL LAST YEAR
On hand Jan. 1st,1913.	904	60	2,877	3,841	
Output for year	20,223	3,913	13,106	37,242	5,370
Total	21,127	3,973	15,983	41,083	5,370
Shipments	14,092	1,060	3,242	18,394	1,529
Balance on hand	7,035	2,913	12,741	22,689	3,841

1913 - 2-8hr shifts during 1913.
1912 - 2-8hr.shifts from Aug.10th to Dec. 31st.

SHIPMENTS FOR 1913.

	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Morris Bessemer	14,092		14,092	1,286
Morris	1,060		1,060	243
Morris Silica	3,242		3,242	
Total	18,394		18,394	1,529
Total Last Year	1,529		1,529	
Increase 1103 %			16,865	

MORRIS-LLOYD MINE.

CONSOLIDATED ORE STATEMENT - DECEMBER 31ST, 1913.

	MORRIS BESS.	MORRIS	MORRIS SILICA	NO.LAKE BESS.	NORTH LAKE	N O.LAKE SILICA	TOTAL	TOTAL LAST YEAR
On hand Jan.1,1913.	904	60	2,877	12,633	9,180	117,535	143,189	43,937
Output for year	20,223	3,913	13,106	41,352	20,833	76,653	176,080	145,005
Total	21,127	3,973	15,983	53,985	30,013	194,188	319,269	188,942
Shipments	14,092	1,060	3,242	44,604	17,916	73,226	154,140	45,753
Balance on hand	7,035	2,913	12,741	9,381	12,097	120,962	165,129	143,189
Increase in Output 21%							31,085	
" in Ore on Hand							21,940	

CONSOLIDATED STATEMENT OF SHIPMENTS FOR 1913.

	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Morris Bessemer	14,092		14,092	1,286
Morris	1,060		1,060	243
Morris Silica	3,242		3,242	
North Lake Bessemer	26,775	17,829	44,604	21,557
North Lake	4,781	13,135	17,916	12,647
North Lake Silica	41,171	32,055	73,226	10,020
Total Last Year	91,121	63,019	154,140	45,753
Increase 237%			108,387	

MORRIS - LLOYD MINE.

COMPARATIVE MINING COST FOR THE YEAR 1913.

	1 9 1 3	1 9 1 2	INCREASE	DECREASE
PRODUCT	176,080	139,635	34,445	
General Expense	.067	.074		.007
Maintenance	.077	.046	.031	
Mining Expense	1.122	1.002	.120	
Cost of Production	1.266	1.122	.144	
Exploratory	.108		.108	
DEPRECIATION				
Equipment	.006	.002	.004	
New Construction	.258	.250	.008	
Total Depreciation	.264	.252	.012	
Taxes	.035	.062		.027
Central Office	.063	.063		
Ore produced in development (opening mine)	.039		.039	
Sundry Expense	.085		.085	
Cost of Stockpile	1.860	1.499	.361	
Loading and shipping	.042	.010	.032	
Total cost on cars	1.902	1.509	.393	
Number days operating	300	298	2	
Number shifts and hours	2-8hr	2-10-hr 2-8 -hr		
Average daily product	587	469	118	
COST OF PRODUCTION				
Labor	.867	.809	.058	
Supplies	.399	.313	.086	
Total	1.266	1.122	.134	

MORRIS - LLOYD MINE.

STATEMENT OF COMPARATIVE WAGES.

	1913	1912	INCREASE
SURFACE.			
Total Number of days	11,198-3/4	7,354-3/4	3,844
Average Rate	2.48	2.33	.15
Amount	27,722.41	17,157.26	10,565.15
UNDERGROUND.			
Total Number of days	45,502	33,037½	12,464½
Average rate	2.90	2.73	.17
Amount	132,125.25	90,440.01	41,685.24
Total Days	56,700-3/4	40,392¼	16,308½
Average Rate	2.82	2.68	.14
Total Amount	159,847.66	107,597.27	52,250.39
Labor cost per ton	.908	.771	.137

No.Shifts and hours 1913 - 2-8hr; 1912 - 2-10hr, 2-8hr.

Increased wages per day
Surface .15 ----- 6.44%
Underground .17 -----,6.23%
Total .14 ----- 5.22%

When Morris started to operate May 1,1912, it consolidated with Lloyd Mine, from which time operations are called Morris-Lloyd.

MORRIS - LLOYD MINE.

STATEMENT OF AVERAGE WAGES AND PRODUCT.

PRODUCT '13 176,080 TONS	SURFACE		UNDERGROUND		TOTAL.	
PRODUCT '12 139,635 TONS	1913	1912	1913	1912	1913	1912.
Avg.no.men working	36	24	146	105	182	129
" wages per day	2.48	2.33	2.90	2.73	2.82	2.68
" " per month 25 days	62.00	58.25	72.50	68.25	70.50	67.00
" product per man per day	15.74	18.99	3.87	4.23	3.10	3.46
Labor cost per ton	.157	.123	.751	.648	.908	.771
Diff.in labor cost per ton	+.034	-.057	+.103	-.246	+.137	-.303
Avg.product breakg. and tramming			5.70	5.84		
" wages for MinersmContr.			2.97	2.74		
Total Avrg.wages for contract			2.97	2.74		

			Tons	%
Tons per man per day	Surface	Decrease	3.25	17.1
" " "	Underground	"	.36	8.5
" " "	Suf.& Undg.	"	.36	10.4

Proportion Surface to Underground men (1913 1 to 4.05
(1912 1 to 4.37
(1911 1 to 4.06

MORRIS - LLOYD MINE.

TIMBER STATEMENT FOR YEAR ENDING DECEMBER 31,1913.

KIND	LINEAL FEET	AVG.PRICE PER FOOT	AMOUNT 1913	AMOUNT 1912
6" to 8" Timber	83,542	.02	1,657.90	809.62
8" to 10" "	31,345	.0422	1,317.17	934.92
10" to 12" "	17,784	.06	1,075.03	1,182.69
12" to 14" "	8,066	.0838	667.83	417.54
Total 1913	140,737	.0335	4,717.93	
Total 1912	82,348	.0406		3,344.77

	LINEAL FEET	PER 100'	1913	1912
5" Lagging (561 cords)	476,850	.475	2,264.00	1,350.70
7" "	20,160	.55	110.88	83.31
8" "	156,990	.544	854.18	1,506.09
Poles	46,904	.95	447.17	349.19
Total 1913	700,904	.525	3,676.23	
Total 1912	605,724	.543	8,394.16	3,289.29

	1913	1912
Feet of timber per ton of ore	.799	.590
Feet of lagging per ton of ore	3.71	4.07
Feet of lagging per foot of timber	4.64	6.90
Cost per ton for timber,lagging and poles	.048	.047
Equivalent of stull timber to board measure	243,390	159,107
Feet Board Measure per ton of ore	1.38	1.14
Total product	176,080	139,635
Total cost of timber and lagging,1913		8,394.16
Total cost of timber and lagging,1912		6,634.06
Total cost of timber and lagging,1911		6,001.30

MORRIS - LLOYD MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND	QUANTITY	AVERAGE PRICES	AMOUNT 1913	AMOUNT 1912
40% Powder	87,950	.092	8,098.50	5,035.41
50% "	18,920	.10	1,892.00	4,960.07
60% "				1,823.87
80% " Giant	2,138	.13½	300.69	2,153.02
Total Powder	109,008	.0944	10,291.19	13,972.37
Fuse	220,100	3.84	847.66	951.57
Caps	45,280	6.37	284.97	318.78
Cap Crimpers	36	.25	9,15	5.00
Fuse Lighters	400	.0025	1.00	
Electric Exploders	250	3.00	.75	18.18
Powder Thawers				5.16
Connecting Wire	16	.27	4.38	16.59
Tamping Bags	4,000	1.07	5.28	2.74
Total fuse,etc.			1,153.19	1,318.02
Grand Total			11,444.38	15,290.39
Product			176,080	139,635
Pounds Powder per ton Ore			.619	.974
Cost per ton for Powder			.058	.100
Cost per ton fuse,caps,etc.,			.007	.009
Cost per ton all explosives			.065	.109
Avg.Price per lb. powder			.0944	.1027

CHASE MINE.

The Chase Mine is located on the N.E.¼ of Section 3, T47-R28. This quarter section with the N.W. quarter section is under lease from the Barnes Land Company, Lease No. 32. Work was originally started on this property Dec. 5th, 1909. Sinking, equipping and developing was continued until Oct. 7th, 1911, at which time the mine was closed down. It was re-opened about one year later on Sept. 20th, 1912, and active work was resumed underground the last of October. A full force was secured the last of November and some ore was mined during December. It was decided to put the mine on an operating basis on Jan. 1st, 1913, and it has been operated on double shift throughout the past year.

PRODUCT FOR YEAR.

Chase 1st Class,	53,312 tons,
Chase 2nd Class,	1,431 "
Total Ore,	54,743 "
Rock,	6,101 "
Total Hoist,	60,844 "

SHIPMENTS FOR YEAR.

	TONS.	BALANCE IN STOCK.
From pocket,	29.005	8,237
From stockpile,	23,925	
Total Shipments,	52,930	

The total output of the mine to date is 61,167 tons. Owing to both jasper and dikes which were encountered in the ore body, the grade of the product has been lower than was indicated by the analysis from the drill holes. On Jan. 1st, 1913, the ore in stock, 6,424 tons, averaged 56.63 iron, .233 phos. The average of the 52,930 tons shipped during the year was 57.20 iron, .290 phos. The average of the 8,237 tons in stock Dec. 31st, 1913 is 56.29 iron,.307 phos.

CHASE MINE.

ORE ESTIMATE.

	1st CLASS.	2nd CLASS.	TOTAL TONS.
Above 2nd level,	40,500	19,400	59,900
Below 2nd level,	8,300	8,300	16,600
Total,	48,800	27,700	76,500
Less 10% for rock,	4,800	2,700	7,500
Total Available Ore,	44,000	25,000	69,000
Add for ore left in pillars to support capping,			14,400
Total Ore in Sight,			83,400

The developed ore, plus that which has already been mined, totals 144,561 tons. There is, however, a possibility of some additional ore being developed between the 2nd and 3rd levels, as well as the possibility of discovering ore in the territory lying between the Chase and Dexter mines. The last previous estimate of ore in the mine was that of the Geological Department, made in January 1911, which showed a total of 413,000 tons of ore, 350,000 tons of which was 1st class, averaging 61.15 iron,.355 phos. It is evident that the original estimates based on the diamond drilling were entirely too high, both in tonnage and analysis.

If the estimate of Mr. Bradt of the ore in the old Dexter Mine, from 250,000 to 300,000 tons be accepted as correct, it is evident that by unwatering the Dexter and mining the ore through the Chase shaft, that there will eventually be obtained a product equal to or greater than the original estimates for the Chase Mine. It is doubtful, however, whether there are anywhere near 250,000 tons in sight, but the prospects for ore here warrants pumping out the mine and exploring with diamond drill.

Based on the ore now in sight, mining will be completed in 1914 unless new ore bodies are discovered.

Practically no ore has been developed during the past year on the 1st level. This level is only 150 ft. below surface, and the back of nearly all of the drifts is within 25 ft. of the quicksand. This is as close as it is deemed safe to carry mining operations, so that the only ore available on the level, is that obtained from the drifts and crosscuts.

The developments on the 2nd level during the early part of the year were disappointing as the main haulage drift to the West showed the ore to

be only 10 ft. in width. For a time it was thought that the ore had pinched out entirely, but after diamond drilling, and later drifting to the S.W. towards the old Dexter, the ore was again encountered and a fair size body was opened here the latter part of the year. Some lean ore has also been developed during the year to the East of the main crosscut to the shaft. It would appear that the main ore body has the form of a wedge, with the large end on the 1st level, narrowing to form the bottom of the wedge just below the 2nd level.

In December it was decided that the extension of the ore body which was developed the last of the year on the 2nd level, warranted the continuation of the 3rd level drift into this territory. The drift is advancing at a good rate, and within a few months will reach the territory where there is a possibility of developing some ore on this level.

There has been two systems of mining used in taking out the ore. At the East end of the 1st level the ore is cut off by jasper which pitches at a flat angle to the West. This part of the ore body has been mined in the same manner as that used at the Cliffs Shaft Mine, viz., the room and pillar system. Further to the West the ore extended down to the 2nd level, and it was mined here by the shrinkage stope method. Owing to the small width of the ore body, it has been possible to remove practically all of the ore where shrinkage stope mining was used, except that near the 1st level where the ore was 50 ft. wide, it was necessary to leave some pillars.

Development work has been continued throughout the year along with mining. The main shrinkage stope was not completed until after the close of the shipping season, so that the greater part of the ore broken in this stope was not hoisted during the past year. It is estimated that this stope contains about 20,000 tons of broken ore. The combination of these two conditions resulted in high operating costs. To avoid the cost of loading from stockpile, it was decided to leave the ore in the main shrinkage stope until the shipping season of 1914. This resulted in a decided decrease in the product for November and December, as practically

no ore was drawn from this stope, and at the same time the amount of rock increased, owing to starting the drift on the 3rd level.

1st LEVEL.

The main haulage drift on the 1st level struck rock the last of December 1912, and in January was continued 20 ft. further to the West in jasper. As there was no change of ground, it was decided to abandon work at this point.

The East drift which had also struck rock the last of December, in January was turned to the N.E. and was driven 30 ft. in mixed ore and dike. The product in this drift was not high grade enough to go on the ore pile, and when they reached the main dike work was abandoned here. The two contracts which had been driving these main drifts, were combined to form one contract, and they started outlining the ore at the East end of the 1st level by drifts and crosscuts. This work was continued through February and March, at which time the ore at the East end of the mine had been divided into 25 ft. pillars and 10 ft. drifts and crosscuts. Near the East end of the deposit a crosscut was driven 25 ft. to the South in jasper when a small seam of hard blue steel ore was encountered which proved to be 7 ft. wide. A drift was driven 20 ft. to the East until this ore pinched out. A drift was then driven 55 ft. to the West in ore, at which point it holed to the drift which had been driven to the S.E. from the main crosscut to the shaft. Some ore was stoped from the back of this drift at this time, and again in August a contract was brought here, timbered this drift and continued back stoping until they reached an elevation of 35 ft. above the 1st level. The rock was about 60 ft. thick above the level at this point, so that it was considered safe to remove this ore to a height of 35 ft. above the 1st level. At this point the ore had pinched down to 5 ft. in width, and as some water was coming in the back, work was abandoned here.

In May a contract started mining the floors at the East end of the deposit, the ore being trammed out on the sub 36 ft. below the 1st level and dumped into a raise from the 2nd level. The jasper cut off the ore

about 15 ft. from the point where jasper was encountered in the main East drift on the 1st level. From this point to the West, the ore gradually increased in thickness. They widened all of the drifts, which had been driven to develop the deposit to 15 ft. in width, reducing the pillars to 20 ft. They also removed the ore floors down to the jasper. Some of the pillars had a length of nearly 50 ft., and stopes were driven through them to the East and West at a point about 25 ft. under the 1st level. Work has been continued throughout the year, and is now nearly completed. About 8000 tons of the 14,000 tons of ore reported as left in pillars is found at this end of the mine. A total of 9000 tons of ore was mined here during the year.

The second outlet raise which was up 40 ft. in jasper on Jan. 1st, 1913, was continued, holing to surface in April. A permanent ladderway was installed for a traveling road, and all necessary safety devices were also put in at the collar of the raise on surface.

In March the main crosscut from the shaft was continued to the North 40 ft. in rock, when ore was encountered. It proved to be about 8 ft. wide and a drift was driven to the West 17 ft. and to the East 8 ft. in this ore. By this time the shrinkage stope had been opened on the 2nd level beneath this point, and it was decided that it would be cheaper to take this ore out from the shrinkage stope than by drifting on the 1st level.

The latter part of the year a contract a contract came to the 1st level from the 2nd and outlined the ore at the West end of the 1st level by crosscuts. This work was done to determine the width of the ore and divide it up into pillars preliminary to mining the floors here. Shrinkage stopes from the 2nd were cut off by jasper nearly 50 ft. below the 1st in this territory. Further to the West at the extreme limit of the ore body, the ore continued all the way through to the 1st. From this point back to the crosscut from the shaft, a distance of 200 ft., the ore in the shrinkage stope did not extend through to the 1st level in the small seam of ore which was found North of the jasper in the drift driven North in March.

In the main East drift from the crosscut to the shaft, the ore came through from the 2nd to the 1st level for a distance of about 50 ft.

From this point on to the East limits, a distance of 160 ft., the ore is cut off by the jasper. In order to operate the shrinkage stopes, it was necessary to put through several raises in ore to the 1st level, these raises being used for traveling roads and air lines. Five of these raises were put up during the year.

At the East end of the mine about eighty five percent of the available ore has been removed during the past year. The work of removing the ore at the West end has already been started, and as this ore is shown up by a diamond drill hole to be only 14 ft. in thickness at the point where the hole penetrated it, it is expected that only a small tonnage will be available here. Owing to the fact that it is not possible to work more than two contracts here, it will require several months to complete work on this level. The grade of all the ore on the 1st level is uniformly higher than on the 2nd level. It is much more free from rock, which is the controlling factor in the grade of the ore.

2nd LEVEL.

On Jan. 1st, 1913, the West drift on the 2nd level was in 150 ft. from the crosscut to the shaft. This drift was continued in ore for 45 ft. when a crosscut was started to the South. This crosscut advanced 15 ft. in ore when jasper was encountered and the drift was continued 10 ft. to the South in jasper. Work to the West in the main drift was discontinued temporarily, and this contract with two others started putting up raises in the West drift preparatory to opening a shrinkage stope. In February when six of these raises had been put up and chutes built, the drift was continued to the West, advancing 45 ft. during the month of February, 11 ft. in rock and 34 ft. in ore. In March the drift advanced 75 ft. in ore when jasper was encountered in the breast and the drift was turned more to the Southwest. The jasper proved to be only a small bunch, and in April the drift advanced 86 ft. to the West, 77 ft. in ore, the last 9 ft. being in rock. From the diamond drilling which had been done from surface prior to the opening of the mine, it was evident that the West end of the ore body had been reached. The drift was turned to

the S.W., as the drilling had indicated that ore might be found in this direction. The drift advanced to the S.W. 30 ft. in mixed ore and jasper. The contract was then moved back into the main East-West drift, where they drove two crosscuts to the South to prove up the width of the ore. The first crosscut showed the ore to be 20 ft. wide, and the second only 15 ft. They also drove a crosscut 20 ft. to the North in lean ore. Work in this part of the mine was temporarily abandoned at this time and the contract moved back in the drift where they worked with other contracts in opening the shrinkage stopes.

In June the diamond drill was brought to the mine and a hole drilled to the S.W. from the breast of the crosscut which had been driven to the South near the West end of the main drift. This drill hole showed some good ore and some lean ore, but was mainly in jasper. The indications, however, were favorable enough to warrant drifting, and the main drift was continued to the South for 35 ft., being in ore for the greater part of the distance. Jasper was encountered in the breast and drifts were then started to the East and West following the ore. The West drift was in mixed ore and dike for 20 ft., when the jasper which had been on the left side disappeared and the drift turned to the Southwest. It was continued 110 ft. to the S.W., 100 ft. in ore and the last 10 ft. in rock. Forty feet back of the breast a drift was driven 25 ft. to the East in ore. Fifty feet from the breast a drift was driven 45 ft. West in ore when rock was encountered. Another short drift was driven to the West 80 ft. from the breast, but struck rock after advancing 10 ft. The East drift along the jasper 110 ft. back from the breast, at the close of the year had been driven 70 ft., 60 ft. in ore and 10 ft. in jasper. The main drift to the S.W. was also continued 10 ft. further into the jasper.

The work as outlined above, covers all the extensions of the main West drift on the 2nd level during the past year. The drift was advanced approximately 400 ft. in ore during the year, exclusive of the other drifts which were driven to prove up the width of this ore. In the neighborhood of 200 ft. of ore drifting was done in addition to the advance of the main

drift, there was also about 60 ft. of rock drifting done here. From the large number of raises which have been put up in the main East-West drift, it has been proven that the first 200 ft. of ore drifting here developed only a small tonnage of ore between the 2nd and 1st levels. The work of opening a shrinkage stope in the S.W. extension of this drift, indicates that a considerable tonnage may be developed between the 2nd and 1st levels in this territory.

At the East end of the mine a drift had been started to the East of the main crosscut to the shaft in December 1912, and Jan. 1st, 1913 was in 50 ft. to the East. Twelve feet of ore had been shown up, the ore being found near No. 17 drill hole from surface, which showed ore at this elevation. The drift advanced 64 ft. in January in jasper, and was gradually turned to the North so as to crosscut the formation here. In Feb. the drift advanced 66 ft., the last 10 ft. being in the main dike on the North side of the ore formation. Two small seams of ore between dikes were shown up during this month, but the ore only averaged 52% iron, and as there was no facilities for stocking this grade, work was stopped here.

In May a drift was started to the East along the South side of the deposit in the ore which had been encountered near No. 17 diamond drill hole. This drift was in very hard blue steel ore, this being the same ore which had been developed on the 1st level at a point directly above. In May this drift advanced 40 ft., and in June 12 ft., when jasper was encountered in the breast and work was abandoned here. On starting this drift the ore was 10 ft. wide, with eighteen inches of jasper in the center. The ore on the North side was finally replaced by jasper, so that the ore in the breast was only 5 ft. in width. No further work was done at this place until in December, when a contract came here to put up a raise on the North side of this drift in the hard blue ore. This raise followed up along the jasper in ore for 35 ft. when it holed to the shrinkage stope which had been opened in the ore near No. 17 drill hole. The contract then returned to the main level, and continued the drift, and after drifting 5 ft. in jasper they struck ore again, in which they

drifted for 12 ft. On the last of the month they started a raise 15 ft. East of the first raise they had put up, and at the close of the year this raise was up 10 ft. in ore. It is planned to put this raise through to the sub level which was opened 36 ft. below the 1st level, then return to the 2nd level and continue the drift to the East until the limits of the ore are reached, putting up as many more raises as is possible, after which a shrinkage stope will be opened and all of the ore here mined out.

In August a contract started drifting to the East opposite the main drift to the West, the drift for a few cuts being in mixed ore and jasper. Good ore was then encountered and it was followed for 45 ft. to the N.E. At this point rock was encountered and the drift was turned to the East, and after advancing 40 ft., holed to the crosscut which had been driven in rock early in the year. Four raises were put up in this drift, and the shrinkage stope which was opened here as part of the main East-West stope, permitted of the mining of all the ore that it was possible to obtain from this territory.

The developments in the shrinkage stope West of the crosscut from the shaft, indicated a possibility of the ore extending to the 2nd level North of the main West drift on the 2nd level. A contract was brought down from the shrinkage stope and a crosscut driven 25 ft. to the North at a point 60 ft. West of the main crosscut from the shaft. After passing through a dike, which was three feet thick, lean ore and jasper was encountered in the drift which averaged about 48% iron. As there was no change in ground after advancing 23 ft., it was decided that the ore did not extend down to the 2nd level.

The last of January it was decided that the shrinkage stope system of mining might be used to advantage at the Chase Mine, as it was thought that practically all of the ore between the 1st and 2nd level could be removed at a lower cost than would be possible with any other system of mining. The 1st stope was opened near No. 17 diamond drill hole to the East of the main crosscut from the shaft, this ore being near the South side of the ore deposit. Three raises were put up, the first

two being in ore and the third striking ore after raising 10 ft. in jasper. A stope was opened extending East and West, its width in the bottom was about 16 ft., at the top just below the 1st level it was 20 ft. in width. The stope was only 45 ft. in length when first started, but as it gained in elevation the ore was found to extend to the East over the jasper, and from an elevation of 50 ft. up to the 1st level, it was 80 ft. in length. The first work in this stope was done during the last week of January. Two contracts worked here and completed mining all the ore up to the 1st level the last of June. The ore in this stope averaged above 60% iron, and was entirely free from dike and jasper. It is estimated that about 10,000 tons of ore was broken here. The ore was drawn from this stope during the summer, and was used to improve the grade of the ore which was obtained from other parts of the mine.

In February it was decided that the main West drift on this level had advanced far enough so that it was possible to open a shrinkage stope to the West of the crosscut from the shaft. Raises were accordingly started 20 ft. center to center in this drift and a stope was opened about 100 ft. in length. The ore was only drift wide on the 2nd, and at the point where the stope was opened it was widened to 14 ft. There were two dikes running East and West in the stope which was impossible to avoid breaking; they varied from a trace to three inches in thickness, and reduced the grade of the ore in this stope to 55%. At the West end of this stope, when they reached an elevation of 50 ft., a drift was driven between the two dikes, following the ore to the West. The work done here indicated that it would be possible to extend the stope further to the West. Three contracts were brought to this territory in the 2nd level main West drift, and 12 raises were put up; later on these raises were connected and a connection made to the shrinkage stope which already had been opened to a point 50 ft. above the level. The work at the East end of the stope indicated that more raises should be put up to the East to remove all of the ore. After a drift had been driven to the East in this territory, six more raises were put up, making a total of twenty three raises over

a length of 375 ft. Several of these raises were extended through to the 1st level to provide traveling roads for the men in going to and from the stopes. They also improved the ventilation, and the air lines were taken through them down from the 1st level.

At the East end of the stope the ore was found to extend through to the 1st level over an area 120 ft. in length. In an area 120 ft. in length, immediately to the West, the ore was cut off by jasper at a point about 40 ft. below the 1st level. In an area 40 ft. in length immediately to the West of this, the ore was found to extend all the way through to the 1st level. In the remaining 95 ft. at the West end of the stope the ore was found to be badly mixed with dikes and jasper, and it is doubtful whether it will be possible to obtain much ore from this territory. At a point about 40 ft. above the 2nd level, the ore had widened out to the North, and it was impossible to mine it all in the stope. Crosscuts were started to the North following the dike which formed the North footwall of the ore, and six crosscuts 20 ft. wide with 20 ft. pillars between, were eventually driven to the North of the main shrinkage stope. From four to six contracts worked in this stope throughout the past year, and at the close of December all the ore had been mined in the stope except at the West end where there is 100 ft. of ground where the ore is badly mixed with rock. Mining of the ore here will shortly be started again.

The greater part of the product obtained during the year came from the excess ore which was necessary to draw off from this large stope. The East 120 ft. of the stope is comparitively free from rock, and is filled with high grade ore which will average about 59% iron. The next 120 ft. of the stope which only extends 50 ft. above the 2nd level, contains ore which is mixed with dike; this ore will only average 55% iron. The next 40 ft. of the stope where the ore extends through to the 1st level, is filled with high grade ore which will average 57% iron; the remaining 95 ft. of the stope contains ore badly mixed with rock, and will only average 53% iron. It is estimated that this stope

contains 20,000 tons of broken ore. This ore will be hoisted during the shipping season of 1914. The cost of tramming, hoisting and loading in cars are the only costs which will have to be taken up against this ore, which should not total more than 25¢ per ton.

Since completing this work early in December, these contracts have been moved to the S.W. extension of the main ore body, and are now putting up a number of raises preparatory to opening a shrinkage stope in this territory. There is apparently a bar of barren ground about 150 ft. in length between the old and the new shrinkage stope, in which it will not be possible to obtain any ore, unless it be found a considerable distance above the 2nd level. An exploring raise has been started, which it is planned to push up through this ground, and by crosscutting at various elevations, to determine if there is any ore in this territory.

64 ft. SUB ABOVE 2nd.

In order to explore the ground between the 1st and 2nd levels, a raise was started in Jan. at the East side of the crosscut from the shaft. This was continued in ore through to the 1st level, holing in February. At a point 64 ft. above the 2nd level, a sub level was opened and a drift driven 120 ft. to the East. This drift was stopped within 50 ft. of the East limit of the ore on the 1st level, the last 40 ft. of the drift being in jasper with ore in the back. The contract then put up three raises which holed to the 1st level, and then started removing the floors on the 1st level. The ore from these floors came down through chutes to the sub and was trammed on the sub and dumped into the raise from the 2nd level. Later on when the shrinkage stope reached the elevation of the sub level, the ore was dumped into the stope. At the point where they are now mining the 1st level floors, the ore falls directly into the stope.

At a point 190 ft. West of the crosscut to the shaft where the ore came through to the 1st level, a drift was driven to the East at a point 30 ft. below the 1st level. The ore on the South side of the deposit in this drift is about 25 ft. South of the shrinkage stope. There

is a diamond drill hole from surface about 100 ft. East of this point, which showed ore only 14 ft. below the 1st level. It is probable that jasper will be encountered in this drift within a short time. This sub is being opened here in order to permit of mining the floors on the 1st level to the West of the crosscut to the shaft.

3rd LEVEL.

In December it was decided to continue the 3rd level drift to the West, as the floors developed in the S.W. extension of the 2nd level were of sufficient area to indicate the probability of this ore extending some distance below the level, if not entirely to the 3rd level, and with a probable tonnage sufficient to justify the expense of the drift. Two drill holes which had crosscut the formation from the breast of the 3rd level drift at a point 200 ft. North of the shaft, had passed through a dike 40 ft. wide, and it was thought that by turning the drift to the West it would be possible to drive it in the dike. The drift was gradually turned to the West, and after advancing about 40 ft. in dike, low grade ore and jasper was encountered in which the drift has been continued. At the close of the month it had advanced 123 ft. to the West, and at the present rate of progress should sometime in March reach the territory where it is possible ore may exist. No. 17 diamond drill hole which is located East of the crosscut to the shaft, showed that the ore extended 30 ft. below the 2nd; although the area shown on the 2nd level at this point is small, it is sufficient to justify a raise, from which to mine this ore.

The main West drift on the 2nd level showed the ore to be only drift wide, and from the shrinkage stope work done above this drift, it is thought that the ore is wedge shaped, the bottom of the wedge being only a short distance below the 2nd level. It is improbable therefore that any ore can be mined or will be found in the 400 ft. of ground immediately West of the crosscut from the shaft. As stated before, the chances in this territory seem to be confined to the ore which was developed the last of the year to the South of the main ore body, and to the chances further to the West towards the old Dexter Mine.

CHASE MINE.

During the year 1913 there was a total of 702 ft. of rock drifting done on the various levels, and 338 ft. of rock raising; 1676 ft. of ore drifting and 1088 ft. of ore raising, a grand total of 1040 ft. of rock drifting and raising, and 2764 ft. of ore drifting and raising.

UNDERGROUND DIAMOND DRILLING.

When the main West drift on the 2nd level encountered rock in May, it was thought advisable to bring a diamond drill to the mine and drill a number of holes in an effort to locate ore. A drill was brought to the 2nd level on June 3rd, and a hole drilled South fourteen degrees West at the extreme West end of the 2nd level. This hole was stopped in slate at a depth of 175 ft. It showed 25 ft. of ore which averaged 59.28 iron, and the results were encouraging enough to warrant the extension of the 2nd level drift, from which a considerable tonnage of ore has since been developed. On completing this hole another one was drilled to the South 50 ft. East of the first hole. This hole was drilled to a depth of 101 ft. in jasper when it was stopped. The third hole was drilled to the N.W. from the West end of the 2nd level and was stopped at a depth of 67 ft. It showed 28 ft. of ore formation, beyond which it passed into the main dike on the North side of the deposit.

Hole No. 4 was drilled to the North at a point 100 ft. East of No. 3. This hole showed 32 ft. of ore formation, then passed into the main dike, being stopped at a depth of 72 ft.

Hole No. 5 was drilled to the South at a point 120 ft. East of hole No. 2, it being the 3rd crosscut hole drilled to the South. This hole was stopped at a depth of 62 ft., and showed nothing but soft ore jasper.

Hole No. 6 was drilled to the North to the main dike from the same station as hole No. 5. It showed some lean ore averaging about 48% iron, the total width of the ore formation at this point being 55 ft. This hole was stopped at a depth of 72 ft. in the main dike on the North side of the deposit.

The drill was then moved to the 3rd level where hole No. 7 was drilled due North from the breast of the 3rd level drift at a point 200

ft. North of the shaft. This hole was in dike for 58 ft., hard ore jasper from 58 to 95 ft., 95 ft. to 110 ft. showed 49.64 iron, from 110 to 152 ft. soft ore jasper, and from 152 to 168 ft. in the main dike on the North side of the deposit.

Hole No. 8 was then drilled North thirty six degrees West from the same station, the bottom of this hole being 120 ft. West of hole No. 7. This hole showed 82 ft. of dike, from 82 to 165 ft. soft ore jasper, 165 to 185 ft., 20 ft. of 45.60 ore, 4 ft. of jasper to 189 ft., then 12 ft. in the main dike on the North side of the deposit, a total depth of 191 ft.

The drill was then brought back to the 2nd level and hole No. 9, a vertical hole was drilled near the breast of the West drift on the 2nd level. This hole showed mixed ore and jasper, with some runs of good ore down to a depth of 59 ft. From 59 to 58 ft., the hole was in quartzite, and was stopped on account of caving.

Hole No. 10 was then drilled from the same station, dipping fifty degrees to the North. This hole showed considerable lean ore averaging about 50% iron, and was stopped at a depth of 59 ft. in soft ore jasper.

The drill was then moved about 50 ft. to the North, and No. 11, an incline hole drilled, dipping sixty degrees to the South. This hole showed ore from 1 to 14 ft., and another run of 9 ft. from 52 to 61 ft., and was finally stopped at a depth of 81 ft. in jasper. All the formation shown up here was very rich, but no continuous uniform ore body was disclosed.

The drill was then moved 100 ft. to the East to the same station from where No. 4 hole was drilled, and an incline hole dipping eighty five degrees to the North was drilled. This hole was drilled to a depth of 138 ft., or about 30 ft. beneath the 3rd level. It showed a rich ore formation for the entire distance, but no high grade ore was disclosed. On completion of this hole it was decided that no further drilling was necessary at this time, and the drill was moved to North Lake.

Through the drilling done, it was possible to eliminate a considerable territory on the 2nd level, where it would have been necessary to

drift in order to definitely prove whether ore might be found. The drilling also disclosed the fact that it was very improbable that any merchantable ore would be found by the 3rd level drift below the 2nd level in the line of the downward extension of the main ore body opened on the 1st level, also the 2nd. Through the drilling, however, the main drift on the 2nd level was continued to the S.W. where a fair size ore body has been opened up. As this body has a width of 50 ft. at one point, it is thought probable that it may extend down to the 3rd level, and drifting is now under way to reach this territory.

A total of twelve holes were drilled, with a total footage of 1264 ft., 30 ft. of high grade ore averaging 59% was shown up, with 85 ft. of low grade ore averaging 51.23 iron.

In February a Gould electric driven plunger pump was set up in the permanent pump house on the 3rd level. This pump has a capacity of 400 gallons per minute, 400 ft. head. By leaving the Alberger centrifugal pump in the bottom of the shaft and operating both pumps at one time, it was possible tp pump eighty percent of the mine water on day shift. A pumpman was employed on day shift only, and on night shift the Gould pump is run from an hour to an hour and a half by the shift boss. The pumpman in addition to taking care of the pumps, does all of the underground piping and takes care of the electric signal system and underground telephones, also the underground and surface lights. There has been a gradual increase in the amount of water made by the mine. In January 1913 it made eighty gallons per minute, in June eighty six and in December ninety one gallons.

MAINTENANCE OF EQUIPMENT.

In June during a high wind storm the smoke stack of the heating plant was blown down. It was found badly rusted and it was impossible to repair it, so that a new stack had to be ordered and erected at once.

On June 28th, during a severe electric storm, the lightning came into the engine house, puncturing four coils of the compressor motor.

It required eleven hours to make repairs on this motor. This storm, with storms which had previously damaged the lightning arrestor, made it necessary to purchase a new one, which was installed and charged out in Sept.

In August a small electric pump was purchased for use in pumping water to the tank which supplies water for the entire mine. Water is used in the shops, dry, boiler plant and for the intercooler of the compressor.

The last of October trouble developed on the coils of the compressor motor. Two of the coils became grounded on the frame, charging all the steel around the mine including the air pipes, making conditions unsafe for the men. It required ten hours to locate this trouble and make repairs.

On Nov. 3rd trouble developed on the hoist motor, the insulation breaking down on one coil, which required two hours to repair. Again on Nov. 5th trouble developed on this same motor, and it required ten hours to make repairs. On Nov. 8th the insulation broke down on a number of coils, and it was necessary to remove the stator in order to make repairs, which required sixteen hours to complete. The series of troubles which had developed on this motor, made it necessary to order a complete new series of windings for the stator of this motor.

On Nov. 6th, a coil grounded in the stator of the compressor motor, which required five and one half hours to locate and repair. A complete new set of coils were ordered for this motor. On Dec. 26th, which by custom is a holiday, these two motors were taken down and a complete new set of windings for the stator of the hoist motor was installed, also about twenty five coils on the compressor motor. This work required three days to complete, there being no work done at the mine on Dec. 27th, which otherwise would have been an operating day. The various delays in Nov. on account of accidents to these motors, did not make it necessary to close down the mine.

In order to load the ore in stock, it was necessary to tear down

one bent of the stocking trestle. In September when all the ore had been removed, work was started on the trestle. To permit of picking rock from the ore, it was decided to make two grades of ore; this required two trestles branching from the permanent trestle. Material was received and framed in Sept., and five bents for the low grade and four for the high grade were erected in October.

SURFACE.

Until in November of the past year, only one regular surface man has been employed at the Chase Mine. Two men are now employed picking rock on the stockpiles, as it is impossible to do this work thoroughly with one man since two grades of ore are hoisted.

In April and May the alleys and streets of the location were cleaned up, also the surface around the mine.

The second outlet raise holed to surface in May, and the ground around the collar of the raise was then leveled off, the raise covered and a fence built around it.

Some stockpile plank were laid in April, and again in October, when preparations were being made for stocking two grades of ore. Some of the stocking ground had been leveled off when the mine was opened, so that the main expense was the cost of the plank and laying same. Eight new trestle bents were erected in addition to the old one which had been torn down to permit of loading the ore; these nine bents will permit of stocking two grades of ore hoisted during the stocking season of 1914.

At the close of the shipping season it was decided to try to break all of the lump ore as it was stocked so as to avoid the very heavy cost of crushing at the South Jackson crusher. After one weeks trial it was abandoned, as it was impossible to prevent some chunks from being covered. The ore from the big shrinkage stope runs over sixty percent lump, the ore from drifts and raises about ten percent lump, and the ore from the new shrinkage stope just being opened, about thirty percent.

EXPLORATIONS.

On Jan. 11th, 1913, an option was taken from Sophia Peterson and others on the N.W.¼ of the S.W.¼ and the South half of the S.W.¼ of Section 2, T47, - R28. This parcel of land fills out the South half of Section 2, the balance already being under lease from Moore and Chase.

Standpiping near the North line of the N.W.¼ of the S.W.¼ was started on April 2nd by the Company, and continued throughout the balance of the year. Three vertical and four incline holes, a total of seven, have been put down and drilled a short distance into the ledge. Six of these holes were drilled in the center line of the Forty near the North side, and the contact of the quartzite and hard ore formation was finally determined. Drilling at this point was finished the last of November and the drill was then moved over to the East line of the Forty, where an incline hole is now being drilled. This hole struck ledge at 198 ft., and at the close of the year was down to a depth of 303 ft., at which point it reached the contact of the quartzite and hard ore jasper. The last hole drilled in the center line of the Forty, was continued into the hard ore jasper, no ore being shown up here. The hole now being drilled on the East line, will be continued in the hard ore jasper until it reaches the North line of the Forty. On completing this hole, it is planned to move the drill to the West line of the Forty, where one or more incline holes will be put down to determine the hard ore contact here.

From the drilling done to date, it is evident that the North line of the N.W.¼ of the S.W.¼, which is the North line of the option, is practically on the line of the contact of the quartzite and the hard ore jasper. As no enrichment was found on the center line of the Forty, it is improbable that there is any ore on this option.

There was a total of 1355 ft. of standpiping done and 420 ft. of drilling on this option during the past year.

W. M. Graff

CHASE MINE.

AVERAGE MINE ANALYSIS OF OUTPUT FOR 1913.

GRADE	IRON	PHOS.	
Chase	57.04	.301	
Chase #2	53.84	.405	

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR 1913.

	Mine		Lake Erie	
	IRON	PHOS.	IRON	PHOS.
Chase	57.18	.288	57.41	

ORE STATEMENT - DECEMBER 31ST, 1913.

	CHASE NO.1	CHASE NO.2	TOTAL	TOTAL LAST YEAR
On hand Jan.1,1913,	6,424	0	6,424	1,935
Output for year	53,312	1,431	54,743	4,489
Total	59,736	1,431	61,167	6,424
Shipments	52,930	0	52,930	0
Balance on hand	6,806	1,431	8,237	6,424

1913 - 2-8hr shifts during year.
1912 - Idle to October 22nd.
2-8hr shifts balance of year.

SHIPMENTS FOR 1913.

GRADE	POCKET	STOCKPILE	TOTAL.
Chase No. 1	29,005	23,925	52,930
Chase No. 2	0	0	0
Total	29,005	23,925	52,930

CHASE MINE.

COMPARATIVE MINING COST FOR THE YEAR.

	1913	1912
PRODUCT	54,743	4,489
General Expense	.087	
Maintenance	.102	
Mining Expense	1.396	
Cost of Production	1.585	
Exploratory	.053	
DEPRECIATION		
Plant	1.548	
Equipment (barn)	.001	
Total Depreciation	1.549	
Taxes	.014	
Central Office	.076	
Sundry Expense	.080	
COST ON STOCKPILE	3,357	
Loading and shipping	.181	
Total cost on cars	3.538	
No.days operating	300	
No.shifts and hours	2-8hr	
Average daily product	182	
COST OF PRODUCTION		
Labor	1.054	
Supplies	.531	
Total	1.585	

Mine commenced operating basis Jan.1,1913.
Tonnage as shown for 1912 is ore mined in development.

CHASE MINE.

CHASE MINE.

STATEMENT OF COMPARATIVE WAGES.

	1913	1912	INCREASE	DECREASE
SURFACE				
Total number of days	4,553			
Average rate	2.47			
Amount	11,252.33			
UNDERGROUND				
Total number of days	16,355-3/4			
Average rate	2.83			
Amount	46,309.41			
Total days	20,908-3/4			
Average rate	2.75			
Total amount	57,561.74			
Labor cost per ton	1.052			

STATEMENT OF AVERAGE WAGES AND PRODUCT.

PRODUCT '13 54,743 TONS	SURFACE		UNDERGROUND		TOTAL	
PRODUCT '12 -----Tons	1913	1912	1913	1912	1913	1912
Avg.no.men working	15		52		67	
Avg.wages per day	2.47		2.83		2.75	
Avg.wages per month 25 days	61.75		70.75		68.75	
Avg.Product per man per day	12.02		3.35		2.62	
Labor cost per ton	.206		.846		1.052	
Avg.product breaking & tramming			4.33			
Avg.wages for miners Cont.			2.83			
Total avg.wages cont.			2.83			

CHASE MINE.

TIMBER STATEMENT FOR YEAR ENDING DEC.31,1913.

KIND	LINEAL FEET	AVG.PRICE PER FOOT.	AMOUNT 1913	AMOUNT 1912
6" to 8" Timber	10,713	.02	214.26	
8" to 10" "	1,652	.047	77.91	
10" to 12" "	2,290	.063	145.56	
12" to 14" "	2,394	.08	196.89	
Total 1913	17,049	.039	634.62	

	LINEAL FEET	PER 100'	1913	1912
5" Lagging (7 cords)	6,020	.49	28.00	
8" "	680	.53	3.62	
Poles	310	1.05	3.25	
Total 1913	7,010	.497	34.87	

	1913	1912
Feet of timber per ton of ore	.311	
Feet Lagging per ton of ore	.122	
Feet lagging per foot of timber	.393	
Cost per ton for Timber,lagging, and poles	.0122	
Equivalent of stull timber to board measure	34,972	
Feet Board Measure per ton of ore	.639	
Total Product	54,743	
Total Cost of timber and lagging,1913	669.49	

CHASE MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND	QUANTITY	AVERAGE PRICES	1913 AMOUNT	1912 AMOUNT
40% Powder	700	.09	63.00	None
50% "	44,843	.10	4884.30	
80%	33,362	.135	4,503.93	
Total Powder	78,905	.120	9,451.23	
Fuse	166,986	3.84	641.80	
C aps	27,610	6.37	175.23	
Cap Crimpers	24	.25	5.70	
Tamping Bags	500	.00132	.66	
Connecting Wire	8	.31	2.49	
Total fuse,etc.			825.88	
Grand total			10,277.11	
Product			54,743	
Pounds Powder per ton ore			1.44	
Cost per ton of powder			.173	
Cost per ton fuse,caps,etc.			.015	
Cost per ton all explosives			.188	
Avg.price per lb.for powder			.12	

NEGAUNEE MINE.

NEW CONSTRUCTION NO. 3 SHAFT E. & A. NO. 193.

COMPRESSOR - Acct. No. 77a-c.

On account of the Maas Mine compressor being unable to furnish sufficient air to supply the requirements at the Negaunee Mine it was decided to install a new compressor as authorized in the E. & A. No. 193. In June the floor in the Northwest portion of the engine house was removed and the large excavation commenced for the foundation of a compressor. These foundations were quite extensive and extended to a depth of about 7 feet below the original floor line. On the end of the month the forms had been constructed and about one hundred yards of concrete placed in position. After waiting a short time for the concrete to set sufficiently the compressor was brought into the building and set up over the anchor bolts. On the 24th an erector from the Nordberg Company arrived and commenced the work of lining up the machine. On August 18th the machine had been lined up and all the necessary electric connections completed. The compressor is a new type, being driven by a synchronous motor. On the 19th an attempt was made to start the machine but it was impossible to get the motor up to a sufficient speed to interlock it. The Westinghouse people were notified and sent one of their men to the mine to determine the trouble. He worked several days, going over the wiring, found nothing wrong but was unable to start the machine. On the 30th a second Westinghouse man went over the entire work. He in turn was unable to locate any trouble. On Sept. 11th a representative from the Nordberg people, who built the compressor, found that the valves had not been set properly. Inside of two hours he started the machine. From this time until the end of the month the compressor was shut down at intervals to make adjustments. During October the machine continued to work but not to the satisfaction of Mr. McClure. In the early part of November a representative from the Nordberg Company found a serious

defect in the valve action. There are certain ports in the valves which were not sufficiently large. The machine was shut down and upon removing the valves it was found that several of them had cracked. It was fortunate that the trouble was discovered before broken parts of steel entered the cylinders. The piston rod was found to be slightly bent. Extra valves were obtained from a similar compressor which had been ordered for the Athens Mine. During the first week in November the delay was serious for the compressor only worked for small intervals while adjustments were being made. For the last three weeks in November and during the month of December a very marked improvement has been noticed in the working of the machine. In addition to changing the valves other defects were remedied. As far as can be told at the present time the machine is working very satisfactorily.

Receivers - 77d.

No receiver has been placed on the new line. I have called Mr. McClure's attention to the fact that the air as received in the mine often contains a large amount of water. Temporarily this is being removed by opening a small valve in the bottom of the main air pipe in the shaft at the 10th level. It is my opinion that a receiver should be installed.

PUMP HOUSE AND SUMP - No. 10f.

Pump House.

In 1912 it was stated that a certain amount of work had been done on the excavation of two large chambers on the 10th level to serve as pump houses. The completed dimensions of two chambers are: 20 feet in width, 40 feet in length, and 13 feet in height in the center. In addition there is one chamber for a centrifugal pump 10 feet wide, 27 feet long, and 13 feet high, and another 9 by 13 by 11 feet high for two small centrifugal pumps which will force water into the suction. On the beginning of the present year the first large excavation had been completed and a considerable amount done in two other chambers. On Jan. 23d carpenters from the surface were sent underground to commence the building of the forms for concrete. The

thickness of the side walls and also the roof would average about 1 foot. A mixer was set up on the 10th level and the gravel sent down from the surface and stored in a bin. On account of commencing this work in cold weather the expense was increased due to the difficulty of obtaining the gravel and thawing it before making concrete. The side walls were built up in sections of 5 feet in height, being made of plank properly braced on the inside to prevent buckling. The filling of the side walls was comparatively simple as the concrete could be handled in wheelbarrows run up a small incline. While concreting was being continued in the first chamber the excavation for the second was carried on. In this way it was possible to continually keep busy the crew of men employed on the work. When the laborers were not handling concrete they were used in tramming rock to the shaft. The construction of the roof was difficult and expensive due to the fact that it was necessary to handle the concrete several times before it could be placed behind the forms. The roof is arch shape, the forms used being the same as those which were ordered for the plats at the shaft. At intervals of 3 feet in the back holes about 18 inches deep were drilled. Into these holes split eye-bolts were firmly driven. From these eye-bolts a network of wire rope was suspended. The purpose of this wire rope was to reinforce the flat arch which would form the roof. In order to strengthen the part of the roof which connected with the vertical side walls, 1 inch square reinforcing was put into the vertical walls at intervals of 2 feet. In the early part of March the first large pump chamber was completed and in April the second large chamber and also the third smaller one were also finished. In the latter part of April the carpenters were started on the construction of the forms for the pump foundations. Previous to the construction of these foundations I had not been instructed that it would be necessary to excavate in the floor for flywheels. I did not like the idea of blasting in the pump chambers until the concrete had had sufficient time to thoroughly set. Many holes were drilled and only a very small amount of powder used at each blast. In order to protect the walls from material

being thrown against them, the holes were covered with small evergreen trees. The blasting was completed without damaging the concrete in any way. Early in June the foundations were all completed. In the latter part of the month our men commenced the work of sending down the heavy parts of the pumps and setting them up over the anchor bolts. This work was continued during July and on Aug. 11th an erector from the Prescott Company arrived and commenced to line up the pumps. A certain amount of moisture collected on the walls and in places there was a small amount of water continually dripping. A stove was set up in each pump chamber, the pipe running to the discharge which extends from the 10th level to the surface. The current in the shaft was downcast and much trouble was experienced in making the stoves draw. After the current was changed in the pipe it was found that the stoves dried the larger amount of moisture from the walls. There was still a certain amount coming through and it was necessary over a part of each chamber to put up a sheet iron roof. After the sheet iron was in place the motors were taken underground. On Sept. 13th the erector completed his work and left the mine. In the latter part of October the mechanical department commenced to get ready to do the electrical work in connection with the pumps. This electrical work continued during the month of November and also December when I understand that it is practically completed. There is still a very large amount of heavy piping to be done. The pumps should be in commission sometime in February.

Sump.

On the 10th level map will be shown the location and general dimensions of the sump. It will be noticed that this is practically a square and consists of four parallel drifts separated by pillars of 20 feet in width. The length of each of these drifts is 100 feet. The square is connected on the ends by two drifts. The total length of the drifts amounts to 520 feet. In order to commence this sump a small drift was cut out from the winze which extends to a point below the 10th level. The drifts will average 9 feet in width by 9 feet in height. This work was started in April but, due to

continual trouble on account of low air pressure, it was impossible to hoist the rock as rapidly as it could be broken. This greatly delayed the progress. In October the drifting was completed.

On the East side of the sump a small drift has been driven East for a distance of 20 feet. From the breast of this drift a raise was started in October to extend to the 9th level. This raise was completed in November. When necessary a hole will be knocked through from the raise to the 9th level. The raise will then serve as a passageway for the water from the 9th level to the sump. From the Northeast corner of the sump an incline drift was started in October and connected with the 10th level in November. The length of this drift is 85 feet. The object of it is to make it possible to clean the coarse material out of the settling basin in the sump. At a point about 30 feet to the West of the incline drift a dam made of concrete was put in. Directly opposite the small raise which extends to the 9th level a tee-shaped dam was completed in December. On the upper part of the tee there are two openings which make it possible to either deflect the water into the settling basin or to send it direct to the pumps. The plan is to cause all of the water under natural conditions to first flow into the settling basin. Here the velocity will be greatly reduced and the coarse material will naturally settle out. When the basin is practically full of coarse material the water will be deflected away from it, going directly to the pumps. By operating a small car in the incline drift the settling basin can be cleaned. All of the concrete work in connection with the dams in the sump should have been completed in December. The mechanical department found that it was necessary to make certain changes in the excavations which had been made for the small centrifugal pumps which will force the water into the suction. The drift for the suction had to be increased in width and the hole below the sump where the foot valves will be located had to be shifted. The work of putting in the last bulkhead which would seal the sump from the winze was therefore stopped. If this bulkhead was in position it would be difficult to get the rock out of the sump. It was therefore stopped

until the changes which the mechanical department wanted done were first completed.

Discharge for Mine Water - No. 8c-2.

In the original estimate, Superintendent's Division, $1300.00 was figured as the cost for putting in 1300 feet of spiral riveted pipe on the surface. Under Acct. 45, Master Carpenter's Division, $1600.00 was estimated for launder. It was found advisable not to put in the launder but to extend the pipe line for a total length of 2,750 feet from the shaft and discharge the water into an open ditch to the South of the new L. S. & I. spur to No. 3 Shaft. For this reason account No. 8c-2 and No. 45 have been combined. During August we commenced at the shaft and put in 2750 feet of 14 inch spiral riveted pipe. This pipe runs East and West parallel with the new spur of the L. S. & I. to No. 3 Shaft. On the East end the water discharges near the bottom of a box 4 by 4 by 4 feet high. The overflow is near the top of this box. By discharging under water the siphon action in the pipe is made use of. This will probably make a saving equivalent to 30 feet in the height to which the water is raised in the shaft collar. Commencing at the overflow on the end of the discharge a ditch 1750 feet in length was started and completed in December. The water discharges into the old Negaunee Mine creek. This account is closed. All other new construction accounts are also completed.

GENERAL WORK.

STEEL STOCKING TRESTLE.

During the winter months the West side of the steel stocking trestle was practically filled with ore. As this trestle was something entirely new and radically different from the old method of stocking ore, it was watched most carefully to see if there was any defect in its design or construction. When the plan was being discussed it was suggested by some that the weight of ore accumulating around the reinforced concrete piers might have a tendency to shift them. In stocking we were particularly

careful to keep the ore at the same height on each side of the piers. This could easily be done without any inconvenience. It was also suggested that in loading with the steam shovel, after half of the pile had been removed, that there would be some danger of a large slide of ore damaging the columns. During the shipping season no precautions were taken to prevent slides of ore against the piers. Small slides did occur but the piers are so tremendously strong that they were not effected. No defect has been found in either the design or the construction of the trestle. It has now been in use since August 1912 and has been proven to be perfectly practical in every respect. No trouble was experienced in working around the piers with the steam shovel. If the shovel had been provided with sufficient car service it would have been shown that a larger amount of ore could be loaded in a day than in places where the ore is stocked from wooden trestles. In the latter part of June we received word that there was trouble on the L. S. & I. dock and that it was necessary to commence to stock ore. While there was a delay at other mines, where the wooden trestles had been dismantled preparatory to loading with the steam shovels, there was none at the Negaunee for it is possible to stock at any time.

GRADING FOR STOCKPILES.

At odd times during the summer when the surface crew was not busy on other work they were used in grading additional ground on the East trestle. Sufficient sollar plank was not ordered to cover this East trestle for the reason that I was informed that the old stockpile at No. 2 Shaft would be shipped during the season. There would have been sufficient plank under this stockpile to complete the sollar on the East trestle. Late in the season the shipping department had to change its plans as it was found impossible to ship but a small part of the old stockpile. For this reason a large amount of additional plank had to be purchased.

SHAFT HOUSE.

In March a weakness in the large plate girders on the North and

South sides at the top of the shaft house was discovered. It was found that the pull of the ropes was causing these to buckle toward the engine house. Work was immediately started by boiler makers from Ishpeming to strengthen these weak members. No further trouble is anticipated and, in future shaft houses, this defect will be altered.

It was found that pieces of ore in running from the chutes either into the cars or the pockets had a tendency to bound off and fall to the ground below. There was some danger of these chunks striking men. For this reason directly opposite each chute large pieces of quarter inch plate have been placed in a vertical position. This will safeguard men who are working below.

SKIPS.

The measuring pockets underground could not be constructed in such a way so that it was impossible to overload them. For this reason when very wet ore was being handled at times the small pockets were overloaded. It was found that if the skip was full the hoist was not powerful enough to bring it to the surface. It was decided to reduce the capacity of the skip in order to avoid the possibility of overloading the hoist and burning out the motor. In November the height of each skip was decreased 2 feet by putting in false bottoms. If the measuring pockets are now overloaded the excess material will go to the bottom of the shaft.

CAGE.

In December new catches were placed on the cage. Considerable difficulty has been experienced with the old jaw-type catches. At a meeting of the Central Safety Committee it was decided that catches containing spikes were much more practical and the danger of their failing to work was very slight. For this reason it was recommended that at all mines the new type of catch be installed.

CASING SHAFT.

The original material used as casing to separate the skips from

the cage compartment was expanded Toncan metal. This came in widths of 20 inches. It was 10 feet in length. The sheets were riveted to small angle irons on the top and bottom of each steel set. In addition the various sheets were riveted together in the center. After the shaft had been in operation for a comparatively short time it was found that this material was not sufficiently rigid to withstand the suction action due to the rapid motion of the cage and skips. The rivets commenced to work loose and many pieces of sheeting were torn off by the cage or skips. After experimenting with several methods of reinforcing the sheeting it was finally decided that the most practical way was to spike three pieces of 2 by 4 diagonally across each skip compartment. Six inch spikes were used, being driven first through the metal and clinched after they had passed through the 2 by 4's. This work was comparatively inexpensive and could be done rapidly. Since June we have had practically no trouble with the sheeting and it is sufficiently rigid to stay in place.

The casing of the cage from the ladder and pipe compartment was not completed when the shaft was put in commission for the reason that this would have interfered with the handling of pipes and the tightening of bolts on the various lines. In July it was decided that the use of heavy wire netting would afford sufficient protection for men who might have to travel in the ladder compartment. This compartment will never be used except in cases where there is some accident to the machinery and it is impossible to use the cage. The object of the netting is simply to prevent the possibility of a man falling from the ladder into the shaft.

TOP TRAM ENGINES.

During the winter months when ore was being stocked considerable trouble was experienced with the top tram motors. From what I can learn these motors are overloaded. We have made every effort to lessen the load by putting in roller bearing sheaves. It is evident that the motors are not strong enough to do the work and they should be replaced by more powerful ones.

Twice during December the South motor burned out. When this motor is out of commission it is impossible to handle any rock. It was thought that by using roller bearing wheels that the load would be reduced. For this reason two sets were purchased from the Lake Shore Engine Works who practically guaranteed them. After these wheels had been in use for a very short time they had to be removed as there was a defect in their construction. The Lake Shore took them back so they were no expense to the mine except the labor of installing them. Since that time the Lake Shore Engine Works have investigated the matter and claim that they have located the trouble. At their own expense they sent one set of wheels which were put in commission on Dec. 3d which have been running satisfactorily up to the end of the year.

NEW TOP TRAM CAR.

The old style of top tram cars have never been perfectly satisfactory. From time to time improvements have been made. During January a new car was completed at the Negaunee Mine which is much more satisfactory than any other I have ever seen. In practically all cars the angle of the bottom is too flat. In the new car the angle was increased from 45 to 50. In most cars the doors are not sufficiently high and when they pass over the dumpjack they do not open wide enough to allow all of the material to run out. The consequence is that when the car is pulled back towards the shaft the doors fail to close and the material which has been held back in the car spills along the entire length of the trestle. It is safe to say that in practically half of the trips the doors fail to close. This means a loss of many minutes each day. By increasing the angle of the bottom and extending the height of the doors it was possible to have them open to a much greater width. The angle being steep, all of the material in the car immediately rushes out. There are a number of other small details which have been greatly improved and add to the value of the car. In February the second car was placed in commission. The catches on these cars work absolutely and do not fail to close once a week.

UNDERGROUND MOTOR CARS.

In March it was necessary to commence to rebuild practically all of the motor cars which were in use. Most of these were bought in 1904. They have become so badly worn that it is necessary to rebuild all of them. There has always been serious defects in the standard motor car. The angle of the bottom is too flat, being 45 degrees. The door is not sufficiently high to allow it to open wide enough so that the ore can run out freely. The ends are beveled instead of being vertical which greatly retards the flowing of the ore. The dumping of the car, containing sticky or wet ore, is extremely slow and difficult. The door is kept closed by two catches on the extreme end of it. In a very short time this door will buckle in the center, causing a large amount of ore to be constantly spilled along the tracks. A new car was designed at the Negaunee to rectify these serious faults. This car was built on the same general lines as top tram cars. The height of the door was considerably increased. The angle of the bottom was made steeper, being 50 degrees instead of 45. The ends were made vertical. The bottom of the door was provided with four catches which prevented the same from buckling. The old style car requires at least four men to dump it and before the ore can be made to run out much poking, barring, and pounding is necessary. With the old style car containing wet or sticky ore it will require hard work of four men to dump it inside of two or three minutes. The new cars can be dumped in a fraction of a minute by simply releasing two levers. On the end of the year with 20 new cars in use the services of only one dumper and a brakeman are required at the shaft. Formerly there were four men. The use of these cars have made a saving of two men on each shift. In addition to the saving in labor there is much time saved in the dumping of each train. When all of the old cars are replaced the labor necessary in cleaning tracks will be greatly reduced.

FREEZING OF NO. 3 SHAFT.

During the latter part of January considerable trouble was

experienced due to ice forming in all of the compartments of the shaft. Under natural conditions the current in No. 3 Shaft, during the winter months, should be upcast because the elevation of the collar is considerably higher than Nos. 1 and 2 Shafts. Due to the fact that there is a steam line in No. 2 Shaft this has always been strongly upcast. When it was found that No. 3 Shaft was freezing it was necessary to place an additional covering over Nos. 1 and 2. This helped the conditions somewhat but the current in No. 3 was still downcast due probably to the fact that the Negaunee Mine is connected with the Maas. The natural direction of the current during winter months in the Maas is upcast. The pull was sufficient to continue to make No. 3 downcast. On two occasions ice formed so rapidly in the skip roads that the skips hung up. Men had to be sent through all compartments of the shaft to chop out the ice. In the meantime heaters were placed at a point about 50 feet below the surface. These heaters changed the current and caused the ice to melt. During this period extra precautions were necessary as large masses of ice commenced to drop down the shaft. Until this ice had all disappeared it was necessary to continue to send men through the shaft to chop it out.

FREEZING OF AIR LINES.

Much trouble was experienced during January due to the main air line between the Maas and Negaunee Mines freezing. It was continually necessary to expose the pipe and thaw out the ice which completely blocked it. It was suggested that by admitting a small amount of alcohol into the pipe that the conditions would be improved. At the Maas Mine near the compressor and also at a point about 1200 feet away from No. 3 Shaft, large lubricators were attached. These lubricators were regulated so that a small amount of alcohol would be continually fed into the pipe. It was found that after the ice was once removed from the pipe that this alcohol would keep it clear. If there is a large accumulation of ice in the pipe the alcohol does little good. After using the alcohol the conditions were much improved. On March 4th, 5th, and 6th a serious delay was caused by

freezing. The weather was unusually mild and the conditions favorable for the freezing of the line. There was a total delay of 17 1/2 hours. It was necessary to dig up the pipe for a great length and build fires around it in order to remove the ice. There are a number of short turns in the main air line. The alcohol probably caused the ice to loosen. The pressure would take it down the line to one of these sharp turns where it would accumulate and finally block the pipe. Under these conditions the alcohol was of no benefit.

COAL DOCK.

In order to store coal for the heating plant at No. 3 Shaft and to handle it in future years at a small cost a dock was constructed in a line directly west of the wing in the dry where the boilers are located. By putting in a short spur from the main timber track and building a small approach to the east it was possible to construct a dock of an average height of 13 feet and of a length of 216. The railroad had a construction crew at the mine and were loading gravel to ballast their tracks. They used a certain amount of this material to build the short approach. No new timber was purchased for this dock. The legs were made out of broken trestle legs. The caps and stringers were obtained from the old stocking trestle at No. 2 Shaft. The dock is situated on a side hill and a small amount of grading was therefore necessary. The erection of the small bents was commenced in June and completed in July. In order to handle the coal at a small cost two parallel tracks were laid on the sollar plank. Going West at a point near the dry it was necessary to build a small light trestle. The coal is loaded into a tramcar and pulled up an incline to a point opposite the coal bin. The car is here at a sufficient height in order to allow the coal to run into the bin. Previous to this work it was necessary for a team to haul the coal to the boiler house. It can now be done at a nominal cost. In order to do the general mine work and to handle the coal to the heating plant two mine teams were necessary. When the new arrangement was completed it was possible to suspense with one team.

Coke is used in the furnace in the blacksmith shop for sharpening drills. This material is now bought in carload lots and is stored in a special bin at one end of the dock. This bin is entirely enclosed and the door kept locked in order to prevent people from stealing the coke.

COOLING TOWER.

There has always been a very heavy consumption of water in the engine house for cooling the motor generator set. In addition, when the compressor was put into commission there was a large increase in the volume. Mr. McClure's attention was called to this and he laid out a plan for preventing this heavy waste. To the west of the dry a pit 12 feet square and 4 feet deep was sunk. Inside of this pit a concrete well with walls 8 inches thick and 10 feet square on the inside and 5 feet in height was built. On these walls a small cooling tower was erected. The water used in the motor generator set and also the compressor will be pumped to the top of the cooling tower and used over and over again for cooling purposes. This work was started in the latter part of August and completed in September. Up to the end of the year the pump to send the water to the tower has not been put into commission.

HEATING PLANT.

A large waste in hot water from the heaters in the dry and engine house is constantly going on. Considerable economy could be made by conducting this water by gravity from the traps to a well. From this well it could be pumped into the boilers. This should mean some saving in coal. In August a concrete well 5 feet square on the inside with walls 8 inches thick and a height of 10 feet was constructed. This is located on the West side of the dry at a point a short distance from the heating plant. The water from the traps drain into this well by gravity and is pumped into the boilers. The work was completed in September. Previous to this time the water accumulated rapidly in the traps and at times the pits in which the traps are located became full of water. This was a bad condition and it was absolutely necessary

to make some change. By connecting the various traps with the well the accumulation of water in the pits is prevented and in addition we are using hot water in the boilers instead of cold.

IMPROVEMENT WORK.

On May 6th Mr. Cotter came to the mine with a small crew and started the work of planting shrubs and flowers as laid out by Mr. Manning. The large shrubs were obtained from the Beach Inn Hotel at Munising and arrived in excellent condition. These shrubs were planted around the various buildings and the border along the North and East fence. To the East of the dry a row of Maple trees have been set out. To the South of the office and to the West of the laboratory a few Spruces were planted. The area to the East of the engine house was not improved in the previous year due to the fact that there were several temporary buildings which were then in use. Since then these buildings have been moved and this area graded and sown with grass seed. To the South of the engine house there is a high bank which has always been an eyesore. A retaining wall 276 feet in length has been constructed. The base of this wall is 3 feet in width and 1 foot in thickness. The vertical part is 2 feet above the base and 8 inches wide on the top and 1 foot on the bottom. This wall was located a little to the South of the natural slope of the bank. The final slope when the base was graded was about 30 degrees. In June the face was graded and sown with Bermuda grass seed. This took a considerable length of time to sprout but finally came up in July. Between the dry and the engine house concrete steps have been constructed.

In June it was found that during heavy rains the graded bank washed badly. For this reason a small concrete gutter has been placed parallel with the top edge of the bank and for its entire length. This gutter is graded to the East and naturally prevents streams of water from flowing down the improved bank.

CAVES.

Nine runs of sand have occurred during the year. These will be described in their order.

No. 1.

On Jan. 18th, just before noon, sand commenced to come into the mine through Raises 26, 27, 28, and 29. At first only a very small amount of sand reached the main level and it was thought that it would not amount to much. The territory above became perfectly quiet in a very short time. In the afternoon another flow started and in the early part of the night shift a very large amount came in. In order to confine the sand in as small an area as possible men were put to work building bulkheads in the main drift on the 9th level. The material was exceedingly fine and on this account it was possible to handle a large amount of it with the pumps. It was shoveled in the main ditch and taken by the large stream of water to the sump. On the 19th, 20th, and 21st men were worked on an eight-hour shift in order to clean the drifts as soon as possible. On the 22nd hoisting of ore was resumed. Directly after the cave it was possible to work some of the gangs above the 6 1/2 level. In this territory we have long chutes and a number of these gangs could be kept busy.

As explained in my previous report, the reason for these caves was that the water would accumulate in a cavity which was connected by cracks or holes to the surface. When the pressure became sufficient the sand was naturally forced out. The process of undercutting a very large area in order to break down the side walls of the cavity and to cause the water to pass through the broken ground was naturally a very slow one. Work to accomplish this has been pushed with all possible energy. It was suggested that it might be possible to relieve the pressure by driving a few diamond drill holes into the cavity. If the water could be tapped and made to flow freely the danger from caves would be avoided. Although the chances of accomplishing this was thought to be small the scheme was tried. On Jan. 27th a drill was set up on the 6 1/2 level and started a hole on a course of S. 40° W.,

the vertical angle being plus 16°. The direction and elevation of this hole were planned to intersect the bottom of the old 764' sub level where trouble due to sand was first encountered. At a depth of 155 feet badly caved ground was encountered and it was necessary to stop drilling. Only a very small amount of water was found in this hole. A second hole was started on a course of S. 50° W. and a plus vertical angle of 23°. This hole was stopped in February at a depth of 146 feet in caved ground. Special tubes were procured for holding dynamite. These tubes were attached to half inch rods being pushed up to the end of the hole. Blasting was continued for several days with the hopes of causing the water to flow through the hole. The flow of water could not be increased and drilling was discontinued.

Nos. 2 and 3.

During February there were two large runs of sand which caused great delay. On the 5th, at 1 P. M., a flow started through the same raises as in the previous month. No ore could be hoisted until the morning of the 7th. This cave occurred directly after the men had returned to the mine from their lunch. There were a large number of men available for prompt work and bulkheads were built which confined the sand in a comparatively small area. A very large amount of it was shoveled into the main ditch and handled by the pumps. On Sunday and Sunday night men continued the work of cleaning the main drifts.

On the 16th, at 6:30 P. M., the second flow in February commenced. Sand continued to run at intervals until the morning of the 17th. A very large amount of material entered the main drifts. This cave was one of the most severe that has ever occurred and it was not until the night shift of the 20th that hoisting could be resumed. At this time there was still a large amount of sand in the main drift in which is located raises from No. 25 to 33. By working extra time, on the end of the month the drift was clean up to raise No. 30. During this cave there was a tremendous pressure and the sand was forced through 30 feet of caved material and entered the 646' sub level on two places, on the foot side opposite Raises 27 and 28,

and in two places on the hanging side. This was entirely unexpected as it was thought that the pressure would not be sufficient to force this material through such a thickness of broken ore. For several days after the cave a large volume of water flowed from the foot wall side opposite Raises 26 and 27.

Nos. 5, 6, 7, and 8.

On the 7th of April, at about 8 A. M., sand commenced to flow into the mine. This was election day and it took some time before men could be collected to go underground and build bulkheads to confine the sand in a limited area. No ore could be hoisted for the following twenty-four hours. Immediately after this cave the water in Raises 26, 27, and 28 ceased to flow. It was therefore realized that in a short time the chances of a second run were most probable.

At 11 P. M. on the 13th, which was Sunday, cave No. 6 commenced. Men were collected and taken underground to build bulkheads and to ditch the material in the drift in order to allow the water to drain out of it. The sand was exceedingly fine and a large part of it was shoveled into the main ditch and pumped to the surface. No ore could be hoisted on the day shift of the 14th. Although there was a large amount of sand in some of the main drifts, hoisting was resumed on the night of the 14th. Men were kept busy cleaning the tracks in order to avoid the possibility of shutting down the mine and losing a number of men. Directly after this cave a large volume of water flowed through Raises 26 to 29, inclusive. In the latter part of the month the water was greatly reduced.

On the 26th, at 10 A. M., cave No. 7 commenced. The sand was confined in one of the main drifts and we continued to hoist ore until the end of the night shift of the 26th. A large force of men were then put on the work of cleaning up. By Monday morning the 28th practically all of the sand had been removed.

The sand from the previous cave had no sooner been removed than at 5 A. M. on the 28th cave No. 8 commenced. A very large volume of fine

sand came into the workings with tremendous force. It not only came in through the raises but forced its way through small cracks on the foot and hanging side and entered the 646' sub level in four different places. It was not possible to hoist ore on either the 29th or 30th. This cave was serious and it was necessary to clean a tremendous amount of sand before mining could be resumed.

Cave No. 9.

Between 12 and 1 o'clock P. M. on the 18th, the 9th run of sand commenced. As this was Sunday night it was difficult to procure sufficient men. Before bulkheads could be put in the sand had covered a very large area. On Monday, between 12 and 1, a second flow started and on Tuesday, between 1 and 2, an additional amount came to the 9th level. During the cave of Monday a tremendous amount of sand and water came to the 9th level with great force. Near No. 2 Shaft the pumps were partly covered. It was only with the greatest difficulty that these pumps were saved. These flows brought into the mine a much larger amount of sand than has ever entered it at any previous time. For a distance of 1400 feet it varied in thickness from 1 to 5 feet in the main drifts. It was known that the mine would be idle for at least a week and for this reason only sufficient men were kept to handle the material economically. Sand was hoisted continually from the 18th until the morning of the 26th. Men underground were worked on an eight-hour shift.

After cave No. 9, for the remainder of the year no sand has entered the mine and there is every reason to think that the very extensive work which has been done on the 646' sub level in undercutting a large area has caused the water to cease to accumulate and back up in any one opening. We sincerely hope that our troubles from future runs of sand are over. These caves have had a very demoralizing effect on the men. New men naturally become alarmed when they see sand entering the mine. After each cave we have always lost a number of good men. The frequency of caves has caused the majority of the men to lose much time, and as work has been plentiful

it has been extremely difficult for the Negaunee Mine to obtain sufficient good miners. They naturally prefer to go to some other mine where such serious trouble is not encountered. Aside from the fact of being unable to either obtain or hold the best class of labor, the additional cost has been heavy. The amount which can be charged directly to sand entering the mine is small compared with the large influence it naturally has on every mining account. After caves men are nervous and it is impossible to get the proper amount of work out of them. The tonnage is greatly reduced and the cost in practically every mining account goes up. I believe that it is perfectly safe to say that during each month when a serious cave has occurred that it has meant the addition of anywhere from 25 to 40 cents per ton, while the amount which can be directly charged against "Cave In" would be from 7 to 12 cents per ton.

WATER.

The following statement shows the number of gallons pumped per minute for each month during the year:

January,	1422
February,	1385
March,	1440
April,	1451
May,	1475
June,	1506
July,	1553
August,	1590
September,	1569
October,	1540
November,	1551
December,	1527

In 1911 the average gallons per minute was 1206, while in 1912 it was 1316, or an increase of 9.1%. In 1913 the average number of gallons per minute was 1501, or an increase of 14% over 1912. Reducing the total number of gallons of water to tons it is found that in 1912 it would amount to 2,566,000, while in 1913 it would be 2,935,000, or for each ton of ore hoisted we pumped approximately 8.4 tons of water.

PRODUCTION.

Month	Bessemer	Negaunee	Total	Rock
January,	6,768	19,332	26,100	4,208
February,	4,444	15,560	20,004	4,704
March,	6,232	19,040	25,272	1,372
April,	6,665	17,969	24,634	3,576
May,	7,384	15,642	23,026	5,536
June,	8,770	19,214	27,984	1,684
July,	7,862	21,910	29,772	1,564
August,	8,577	24,682	33,259	704
September,	7,832	24,883	32,715	836
October,	8,584	29,101	37,685	1,200
November,	5,444	27,208	32,652	576
December,	4,944	30,008	34,952	524
Total,	83,506	264,549	348,055	26,484

FATAL ACCIDENTS.

On July 11th, at 8:25 A. M., Waino Tuomi was instantly killed by a fall of ground in No. 42 contract on the 646' sub level. In this contract the hanging had been reached and the work of slicing back, removing the ore to a height of only one set was in progress. Three slices had been taken out and the men were engaged in blasting the ore in the back in order to fill the open space. Tuomi and his brother were working their first shift. They had been instructed by the boss a few minutes previous to the accident to drill holes in the back directly above the timbered drift. This drift was well timbered and lagged close to the solid ore above. Without the slightest warning a large slab of ore settled on the timbers, crushing them and burying Tuomi. There was no sign that the place was taking any weight and the men were given no warning. This accident was the first to occur due to direct mining operations underground since June 17th, 1910.

On October 28th Jos. Mallett, employed as an oiler at No. 3 Shaft, was run over by one of the top tram cars on the North track of the East

trestle. Mallett had been instructed a number of times not to go out on the trestle for any reason unless he first notified the top engineer. The Bessemer grade was being dumped at a distance of only about 50 feet from the permanent trestle. Mallett evidently thought that as the distance was so short that it was unnecessary to notify the engineer. Shortly after one o'clock the South car was being spotted under the dump while the North car was being sent to the Bessemer pile. The operator was naturally watching the spotting of his car under the dump while he was running the other car slowly out to the Bessemer pile. He was unaware that Mallett was on the trestle. From several eye-witnesses, who were in the upper part of the office receiving instruction in first aid work, it was perfectly evident that Mallett did not see or hear the car approach as he never made the slightest attempt to get out of its road. The sheave which he was oiling was near the dumpstick and the car was moving slowly. The strangest part of this accident is that he failed to hear the car when it was so close to him, to notice the rope passing between his feet, or to see the sheave which he was oiling turning over. The car ran over both of his legs and he fell to the pile below and rolled down to the sollar. He was taken to the hospital where he died at about four o'clock. If this man had only seen or heard the car he could have easily jumped on the pile which was only about 10 feet below him. In all probability his mind was completely occupied with some other thought.

ELECTRIC CURRENT DELAYS.

On the night of the 14th of March, during a very severe storm, a serious delay on account of trouble on the transmission line occurred. There was no current from 10:20 to 11:25 and from 3:30 to shortly after 8 o'clock. The men could not be hoisted out of the mine and many of them walked to the surface. Shortly after 8 o'clock the turbine at the Maas was started.

On May 19th something went wrong with one of the transformers at the Maas Mine. Mr. McClure and the head electrician came to the mine as