No. 136 - Electric Tram Plant.

1918	$ 8778.29	$ .072
1917	1543.29	.023
Increase	$ 7235.00	$ .049

7 new tram-cars cost $4064.65 in 1918. Balance is labor and supplies for wiring the first level.

No. 137 - Telephones and Safety Devices.

1918	$ 1212.03	$ .010
1917	149.14	.002
Increase	$ 1062.89	$ .008

Supplies and equipment for first aid room cost $40, mine telephones $105, and safety-gates, lights on levels, and protection of belts and openings, in shaft-house, $885.

MINING EXPENSE.

No. 150 - Air-Pipes.

1918	$ 3817.67	$ .032
1917	2098.62	.031
Increase	$ 1719.05	$ .001

Higher wages, higher cost of pipe, and more pipe used caused the increase in 1918.

No. 151 - Compressors.

1918	$ 17203.91	$ .142
1917	10483.30	.152
Increase	$ 6720.61	
Decrease		$ .010

The increase is due to a 29.1% average increase in wages and 50% increase in cost of electric power in 1918 over 1917. Air was purchased from the Section 16 Mine in February.

No. 152 - Hoisting.

1918	$ 14072.52	$ .116
1917	6092.89	.089
Increase	$ 7979.63	$ .027

Higher wages, higher rate for power, and more ore hoisted are the causes of the increase in 1918.

No. 153 - Pumping.

1918	$ 1590.60	$ .013
1917	1366.49	.020
Increase	$ 224.11	
Decrease		$ .007

An electric pump was started on the 2nd level in December 1918. In 1917 pumping was done by compressed air.

No. 154 - Sinking and Shaft Repairs.

1918	$ 5566.24	$ .046
1917		
Increase	$ 5566.24	$ .046

Sinking No. 1 shaft was started December 1st, 1918.

No. 155 - Rock Drifting.

1918	$ 11682.73	$ .096
1917	9797.37	.142
Increase	$ 1885.36	
Decrease		$ .046

In 1918 920 ft. of rock-drifting cost $12.70 per foot. In 1917 533 ft. cost $18.38 per foot. In 1918 drifting was on sub-levels and in 1917 much of it was on the main levels.

No. 156 - Breaking Ore.

1918	$ 126374.59	$ 1.041
1917	51622.94	.751
Increase	$ 74751.65	$ .290

Wages increased 29.1% in 1918 over 1917 and powder-cost increased 2.76¢ per pound. Production was greater in 1918.

No. 157 - Tramming.

1918	$ 27088.79	$ .223
1917	14853.00	.216
Increase	$ 12235.79	$ .007

Higher wages, higher cost of electric-power and more ore trammed caused the increase in 1918.

No. 158 - Filling.

1918	$ 4620.37	$ .038
1917	13.00	.000
Increase	$ 4607.37	$ .038

Rock from the shaft and much from development work was dumped underground in stopes in 1918.

No. 159 - Timbering.

1918	$ 44113.77	$ .364
1917	12039.32	.175
Increase	$ 32074.45	$ .189

Higher wages, higher prices for timber and more timber used caused the increase in 1918.

No. 160 - Captain and Bosses.

1918	$ 6689.69	$ .055
1917	3773.19	.055
Increase	$ 2916.50	$ .000

The increase is due to higher wages and to two temporary bosses put on in December.

No. 161 - Dry-House.

1918	$ 4641.63	$ .038
1917	2806.24	.041
Increase	$ 1835.39	
Decrease		$ .003

The increase is due to higher wages and higher cost of coal.

No. 162 - Top Landing and Tramming.

1918	$ 7631.43	$ .063
1917	4662.75	.068
Increase	$ 2968.68	
Decrease		$ .005

The increase is due to higher wages, higher cost of power, and more ore trammed.

No. 163 - Stocking Ore.

1918	$ 4029.79	$ .033
1917	1425.65	.021
Increase	$ 2604.14	$ .012

The length of trestles was extended in 1918. In 1917 the cost of material was covered by E and A. 299.

No. 164 - Sorting Ore.

1918	$ 1855.89	$ .016
1917	468.00	.007
Increase	$ 1387.89	$ .009

Two rock-pickers were employed on the stock-piles in 1918.

RECAPITULATION.

	Year 1918 Total	Per Ton	Year 1917 Total	Per Ton	Increase Total	Per Ton	Decrease Total	Per Ton
General Expense	18563.86	.153	7112.89	.104	11450.97	.049		
Maintenance	29269.67	.241	13565.55	.197	15704.12	.044		
Mining Expense	280979.62	2.316	121502.76	1.768	159476.86	.548		
Cost of Production	328813.15	2.710	142186.20	2.069	186631.95	.641		

HOLMES MINE.

HOLMES MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1918.

GRADE	IRON	PHOS.	SILICA
Holmes Bess. Lump,	63.23	.028	6.31
Holmes Bessemer,	61.49	.034	7.76
Holmes Crushed,	61.85	.069	7.64
Junction Bessemer,	62.27	.035	5.97
Junction,	56.65	.110	8.82

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1918.

GRADE	Mine		Lake Erie	
	IRON	PHOS.	IRON	PHOS.
Holmes Bess. Lump,	63.19	.028	63.06	.028
Holmes Bessemer,	61.51	.035	61.34	.037
Holmes Crushed,(Holmes Crushed,) All Mixed Junction, (				

ORE STATEMENT - DECEMBER 31ST, 1918.

	BESSEMER LUMP	BESSEMER CRUSHED	HOLMES CRUSHED	JUNCTION BESS.	JUNCTION	TOTAL	TOTAL LAST YEAR
On hand Jan. 1st, 1918,	2,966	4,076	0	678	7,328	15,048	0
Output for Year,	27,045	51,326	17,989	1,878	21,017	119,255	66,529
Stockpile Overrun,		2,081				2,081	2,244
Total,	30,011	57,483	17,989	2,556	28,345	136,384	68,773
Shipments,	28,723	51,391	13,497	1,662	22,684	117,957	53,725
Balance on Hand,	1,288	6,092	4,492	894	5,661	18,427	15,048
Increase in Output-76%						52,563	
Increase in Ore on Hand,						3,379	

1918 - 2-8 Hour Shifts
1917 - 2-8 Hour Shifts - Began operating March 14th, 1917.

HOLMES MINE

SHIPMENTS FOR YEAR - 1918.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Holmes Bessemer Lump,	19,771	8,952	28,723	8,957
Holmes Bessemer Crushed,	26,942	24,449	51,391	28,860
Holmes Crushed,	13,497		13,497	673
Junction Bessemer,	1,662		1,662	2,898
Junction,	10,465	12,219	22,684	12,337
Total,	72,337	45,620	117,957	53,725
Total for last Year,	31,001	22,724	53,725	
Increase - 119%			64,232	

HOLMES MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 8.	10 Mos. 1 9 1 7.	INCREASE.	DECREASE.
PRODUCT	121,336	68,773	52,563	
General Expense	.153	.104	.049	
Maintenance	.241	.197	.044	
Mining Expense	2.316	1.768	.548	
Cost of Production	2.710	2.069	.641	
Exploratory	.049		.049	
DEPRECIATION.				
Original Purchase	.002	.002		
Plant	.036		.036	
Equipment	.001	.002		.001
Construction	.464	.500		.036
Total Depreciation	.503	.504		.001
Taxes	.119	.100	.019	
Central Office	.103	.077	.026	
Supply Inventory	.032		.032	
Miscellaneous	.001	.055		.054
Sundry Expense	.031	.019	.012	
Total Cost on Stockpile	3.548	2.824	.724	
Loading & Shipping	.094	.066	.028	
Total Cost on Cars	3.642	2.890	.752	
No.Days Operating	298	236	62	
No.Shifts and Hours	2-8hr	2-8hr		
Avg.Daily Product	407	291	116	
COST OF PRODUCTION.				
Labor	1.826	1.398	.428	
Supplies	.884	.671	.213	
Total	2.710	2.069	.641	

HOLMES MINE.

COMPARATIVE WAGES AND PRODUCT.

	1 9 1 8.	1 9 1 7.	INCREASE.	DECREASE.
PRODUCT	121,336	68,773	52,563	
No.Shifts and Hours	2-8hr	2-8hr		
AVERAGE NUMBER MEN WORKING				
Surface	44	23	21	
Underground	112	58	54	
Total	156	81	75	
AVERAGE WAGES PER DAY				
Surface	4.32	3.38	.94-27.8%	
Underground	5.06	4.57	.49-10.7%	
Total	4.85	4.18	.67-16 %	
WAGES PER MONTH OF 25 DAYS				
Surface	108.00	84.50	23.50	
Underground	126.50	114.25	12.25	
Total	121.25	104.50	16.75	
PRODUCT PER MAN PER DAY				
Surface	8.90	9.02		.12
Underground	3.67	3.93		.26
Total	2.60	2.74		.14
LABOR COST PER TON				
Surface	.486	.374	.112	
Underground	1.381	1.017	.364	
Total	1.867	1.391	.476	
AVG.PRODUCT BRK'G & TRM'G	4.79	5.56		.77
" WAGES CONTRACT MINERS	5.22	4.19	1.03-24 %	
" " " TRAMMERS	0	3.59		
" " " LABOR	5.22	4.11	1.11-27 %	
TOTAL NUMBER OF DAYS				
Surface	13,625¼	7,628¼	5,997	
Underground	33,109½	17,485¾	15,623¾	
Total	46,734¾	25,114	21,620¾	
AMOUNT FOR LABOR				
Surface	58,913.39	25,753.15	33,160.24	
Underground	167,549.86	69,966.43	97,583.43	
Total	226,463.25	95,719.58	130,743.67	

Proportion Surface to Underground Men:
1918 - 1 to 2.55
1917 - 1 to 2.5

HOLMES MINE.

TIMBER STATEMENT FOR YEAR ENDING DECEMBER 31, 1918.

KIND.	LINEAL FEET.	AVG.PRICE PER FOOT.	AMOUNT 1 9 1 8.	AMOUNT 1 9 1 7.
4" to 6" Stulls	24,056	.02	481.12	
6" to 8" "	74,888	.03	2239.74	789.30
8" to 10" "	38,992	.04¾	1807.04	538.18
10" to 12" "	30,784	.06¾	2112.00	634.90
12" to 14" "	10,176	.09¼	937.36	227.36
Total - 1918	178,896	.0423	7577.26	
Total - 1917	61,184	.035		2189.74
	LINEAL FEET.	PER 100'.		
5' Lagging	406,725	.52	2316.51	819.87
7' "	107,400	.55	590.70	912.33
Total Lagging (1)	514,125	.56	2907.21	1732.20
Poles	222,236	.98	2194.62	410.35
Total - 1918	736,361	.69	5101.83	
Total - 1917	343,157	.62		2142.55

Product	121,336	68,773
Feet Timber per ton of Ore	1.474	.889
Feet Lagging per ton of Ore (1)	4.24	4.36
" " per foot of Timber	2.90	4.90
Cost per ton for Timber	.0624	.0319
" Lagging	.0239	.0251
" Poles	.0188	.0059
" Timber, Lagging & Poles	.1044	.0629
Equivalent of Stull timber to Board Measure	325,199	107,543
Ft.Bd.Measure per ton of Ore	2.68	1.56
Total Cost for Timber, Lagging & Poles - 1918		12679.09
" 1917		4332.29

HOLMES MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICES.	AMOUNT 1 9 1 8.	AMOUNT 1 9 1 7.
50% Powder 1½"x8" L.F.	90,650	.206	18679.21	8192.43
60% " 1½"x8" L.F.	27,950	.235	6586.55	181.50
80% " Gelatine	4,500	.378	1705.50	8373.93
Total Powder	123,100	.2191	26971.26	8373.93
Fuse	277,300	.7.40	2065.13	795.17
Caps	54,000	13.50	732.67	252.42
Sundries			26.12	29.77
Electric	250		21.75	
Connecting Wire	25		12.31	
Total Fuse,Etc.			2857.98	1077.36
Total Explosives			29829.24	9451.29
Product			121,336	68,773
Pounds Powder per ton Ore			1.01	.638
Cost per ton for Powder			.222	.121
" " Fuse, Caps,Etc.			.024	.016
" " All Explosives			.246	.137
Avg.Price per lb. for Powder			.2191	.1911

Increase cost per ton for powder caused principally by more ore being broken in shrinkage stopes than was hoisted.

NEGAUNEE MINE - 1918.

During the year 1918 the Negaunee Mine operated on single shifts of eight hours from 7 A. M. to 5 P. M., one hour being given for the noon luncheon. More ore is broken during the day than can be hoisted on this shift so night hoisting was continued throughout the year. The product for the year was 516,161 tons or 27,596 tons less than 1917. This was due to the shortage of men, the effect of which was felt from April 1st to the end of the year. During the first three months our product was well above the average, the January product being the largest in the history of the mine, being 50,916 tons of ore.

The work for the year consisted in regular mining and development work. The mining was distributed over several areas, the main product coming from the ore body directly above the 10th level, extending from #74 raise West to #100 raise. The rest of the product came from the Northwest end of the mine along the Railroad pillar near the Maas boundary; on the foot under the 6½ level; North of No. 2 shaft; on the South foot wall above the old 8th level, and in the West end of the mine under the hanging above the 10th level.

The development consisted in the completion of #3 shaft from the 10th to the 12th levels; the opening of the 11th level with the installation of pocket and plat at this point; the development of the 11th level including the starting of a new auxillary pump station at this elevation and in starting the connecting drift between the Negaunee and Athens Mines.

UNDERGROUND

Following is a brief description of the work on the various sub levels and levels where work was done throughout the year.

945' SUB LEVEL - NORTH OF #2 SHAFT.

During the year 1918 the few remaining pillars to the Southeast of the dike between #2 and #5 raises were taken out. The material here was lean. In the Southwest end of the sub level at #9 and #10 raises an area about 100 feet by 75 feet was mined. This area was cut off to the Northwest by an old stope, to the Southwest by jasper, and to the Southeast by a large dike.

930' SUB LEVEL - NORTH OF #2 SHAFT.

At the beginning of the year the main traveling way had been opened from 1-A raise to #6 and development started to the Southeast. During the year this development continued to the Southeast and Northwest, also to the North and West of raises #9, 10 and 11. The ore to the Northwest and Southeast of raises #2 and #6 was lean, while that at #9, 10 and 11 was of a good quality. At the latter place the development to the Northwest was cut off by old stopes. Mining was completed on this sub level in September.

918' SUB LEVEL - NORTH OF #2 SHAFT (OLD 400 LEVEL).

The ore to the Southeast of the dike which had been lean on the sub levels above was entirely cut off at this elevation. The development from the North drift beyond the large dike was in a crushed area making mining difficult. This is the territory where mining was conducted years ago by square set rooms and stopes above the 3rd level. Mining was completed on this sub level in December. This sub level is the old 400 Level and is connected with #2 shaft.

900' SUB LEVEL - NORTH OF #2 SHAFT.

In September this sub level was opened at #12 and #13 raises which extend from the 825' sub level to the 918' sub level. The development here is to the Northwest, to mine the ore left on the foot wall and between the rooms above the 3rd level. About 75 feet Northwest from #12 raise is a large dike which extends to the Northeast and Southwest. To the Southeast of this dike the ore is lean. To the Northwest development is still in progress. The formation is badly broken due to the 3rd level rooms.

In December six gangs were employed here developing and repairing. Old drifts driven by Captain Anderson ten years or more ago had been encountered. These are being timbered where possible. Many of these drifts were originally driven without timber. On December 19th a settlement occurred to the Southeast of the dike in which four men were caught, one being instantly killed, the other three being entombed for 63½ hours before being rescued.

880' SUB LEVEL - NORTH OF #2 SHAFT.

In November a new sub level was opened at this elevation at #12 raise.

In December development was continued to the Northwest in lean material to the large dike. This development is in the foot jasper under the square set rooms. To the Southwest of #13 raise a drift was driven in the foot and holed to an old square set room from the 3rd level.

6½ LEVEL - AMERICAN MINING COMPANY'S PILLAR.

The remaining pillars at the elevation of the 6th level were mined during the year. This is in the extreme Northwest end of the mine.

On the North foot wall, pillars between #36 and 36D raises were taken out, finishing the sub level started here a year ago.

700' SUB LEVEL - AMERICAN MINING COMPANY'S PILLAR.

At the first of the year there was nothing but a small development drift here. During the year a sub level was opened and completely mined. The area covered being comparatively small, about 140 feet in length by 70 feet in width.

690' SUB LEVEL.

Work at this elevation was in the American Mining Company's pillar; on the North foot wall; and in the South end of the mine.

AMERICAN MINING COMPANY'S PILLAR.

A small sub level was opened at this elevation in the Northwest end of the mine, extending from the foot to the hanging. The development and mining were completed during the year.

ON THE NORTH FOOT.

This is the area that was left to support the old 6½ level between raises #36 and 40. It was opened and entirely mined in 1918 with the exception of a small development drift.

SOUTH END OF THE MINE.

In the South end of the mine in the hanging between 17C and 17F raises pillars left here a year ago were mined.

683' SUB LEVEL - AMERICAN MINING COMPANY'S PILLAR.

Here work was started in October. In December the development was still in progress, five contracts being employed. The area outlined here is

somewhat larger in size than the sub level above at this point. The work is being conducted from 56C and 56D raises.

On the North foot wall in the pillar below the 6½ level between #41 and #37 raises an area 150 feet in length and 100 feet in width was developed and mined during the year.

673' SUB LEVEL.

AMERICAN MINING COMPANY'S PILLAR.

One gang started developing in December at 56D raise to the Northeast.

SOUTH FOOT WALL.

Development in this area started in 1917 from 12D on to the 640' sub level. Early this year a raise was put up from this sub level on the foot and development started at an elevation of 674. This arrangement required the transferring of the ore at the 640' sub. Raises 19D and 19F were put up from the 9th level main foot wall drift in May which were carried up to the 674' sub. Work during the year consisted in outlining the ore. The development to the east of 19F raise showed practically nothing; while from 19D a small area of merchantable ore was found to the Southwest. This is now being mined. In December, two gangs were employed here stoping on the foot.

Under the hanging between 17C and 17H raises to the North of the dike a sub level was opened and completely mined during the year. The size of the sub level being 200 feet in length by 80 feet in width.

653' SUB LEVEL.

AMERICAN MINING COMPANY.

A traveling way between the Maas and Negaunee Mines was opened at this elevation in September.

NORTH FOOT WALL.

In the pillar under the 6½ level development is now under way between #42 and #39 raises. Four gangs were employed, three on the foot and one on the hanging.

SOUTH END OF THE MINE.

Here North of the dike between 17C and 17H raises, a small sub level

was opened and completely mined under the hanging. Immediately above and to the East of 18B and 18C raises, old square set rooms were encountered filled with cave material. As I have mentioned during the year this was supposed to be virgin ground, no record of mining being shown here on any of the old maps. The area on this sub level is increasing as we recede from the hanging.

653' SUB LEVEL.

In the South end of the mine between 17C & 17H raises North of the dike a sub level was opened and completely mined under the hanging. The area to the East, mentioned under the 663' sub level, was so badly crushed that no attempt was made to get into this area at this elevation.

640' SUB LEVEL.

On the North foot wall adjoining the American Mining Company's pillar the area between #45 and #54 raises was opened and mined during the year. The area due South of #31 raise encountered caved material including sand, rock and broken ore. This sub level is below the old 646' sub above which, several years ago, 40 feet of ore was dropped to protect against sand runs.

In the South end of the mine between 17C and 17H raises, a new sub level was started in November. Six gangs are developing to the East between 18B and 18C raises. Two gangs are developing to the East in the old square set rooms. The area is badly crushed, but good ore is being found in the broken pillars.

630' SUB LEVEL.

On the North foot between raises #53 and #47 a sub level was started in July. In December three gangs were developing to the foot, one gang is mining, while another is developing to the South. At #31 raise two gangs are mining pillars North of the large dike which extends through this area to the Southwest and Northeast.

NINTH LEVEL.

On the South foot two raises 19D and 19F were put up to the 673' sub level in May. The main level drift to the North of 12C raise was extended 50 feet and raises #18A, 18B and 18C were put up from this drift.

In the Northwest end of the mine in December a drift was driven from

the main level drift which parallels the American Mining Company's boundary to the Southeast. It intercepts the raise from the 10th level. This drift will act as a traveling way.

595' SUB LEVEL.

NORTH FOOT.

In December at #30 raise one contract has developed between #30 and #28 raises to take the ore left to the Southeast of the dike.

SOUTH SIDE OF MINE.

In the South end of the mine at #158 raise, in July a drift was driven East and holed to the 9th level for a traveling road. From this raise a gang is now drifting South in ore for exploratory purposes.

At #128 raise located North of the winze to the 11th and 12th levels, in October a test raise was put up to the elevation of the 596 from the 545' sub level. Development here showed a small area of ore in the hanging to the North of the dike. This is now being developed.

580' SUB LEVEL.

At #165 raise the small remaining pillars left last year to the Northwest of the dike were removed.

565' SUB LEVEL.

Most of the mining in this large sub level was completed in 1917. This extended from #74 to 94 raises. During the present year, the mining was extended West to #99 raise. The ore between the large dike on the North and the jasper to the South was removed. Two development drifts were driven into the American Mining Company's supporting pillar to outline the ore in that direction.

Immediately to the Southeast of this large sub level between #165 and #199 raises and Northwest of the large dike which runs through the mine in a Northeasterly and Southwesterly direction, the remaining pillars were mined. Here the main sub level connects with the ore found in a roll in the hanging.

At #127 raise development was started to the West towards the hanging. This has been stopped awaiting the mining of the 595' sub level in this same area.

555' SUB LEVEL.

This large sub level was partially developed last year between #76

and #94 raises. Development continued to the #100 raise to the West and the whole sub level was mined with the exception of small pillars between #96 and #100 raises. In this section of the mine the territory to the East of #86 raise is extremely heavy requiring extensive retimbering. To the West of #96 the graund is considerably firmer.

545' SUB LEVEL.

The main sub level at this elevation between #76 and #97 raises was opened during the year. From #76 and #89 the mining has been completed. From #89 raise to #93 raise there are few remaining pillars. From #93 to #97 raises the area is now being developed. To the Southwest at #166 raise, three gangs are developing between the main sub level and the former development in the roll in the hanging. At #174 raise a connecting drift was driven to raise #173 and mining started. A test raise here proved that the real hanging is about 25 feet above the elevation of this sub level. Mining has been stopped pending development from the Northeast.

At #128 raise in the Southeast end of the mine developments are being carried North of the dike; West to the hanging; and East to the foot. From the West drift a contract is now drifting to the North. This has been extended about 60 feet and is still in good ore. The development from #128 raise to the East and West is about 200 feet in each direction or 400 feet in all.

530' SUB LEVEL.

Between #78 and #81 raises to the Southeast of the Northeast-Southwest dike, all available ore has been developed and mined. Between #83 and 88 raises, five gangs are now developing; while between #112 and #116 raises, five gangs are developing. Here we are now placing our raises at 60-foot intervals instead of 30-foot and making the pillars for mining short and thick instead of long and narrow. By adopting this scheme it was necessary to drive an extra main level drift, but we hope by this method to cut down on the expense of retimbering.

TENTH LEVEL.

In December in the Northwest end of the mine along the American Min-

ing Company's pillar two gangs were raising at #58 and #59 raises. In the center of the ore body between #90 and #91 raises a new raise was being put up to the 530' sub level to take the place of a raise, which is crushing. Between raises #89 and #90 one gang repaired.

During the year from #119 raise, the main level drift was extended 60 feet to the Northwest and raise #120 put up to the sub levels above. In the South end of the mine North of the winze, three raises were put up to the hanging, namely, #127, 128 and 129. A little crushing of the 10th level due to the mining directly above it is now being experienced. Withing a few months raises from the 11th level will tap this territory. It is hoped that no excessive crushing will develop before this time.

ELEVENTH LEVEL.

The main level foot wall drift connecting the winze and #3 shaft was driven practically 1153 feet during the year. The 11th level plat opened, pocket cut and the pocket and plat concreted. The plat required 105 yards of concrete while 305 yards were used in the pocket and for bearers. That part of the plat which was not concreted with forms was coated with cement applied by means of the cement gun. To the South of the shaft 160 feet of tail track has been completed and an additional 230 feet beyond this has been driven to the Southwest for the Negaunee-Athens connecting drift.

The main foot wall drift North from the winze was extended 320 feet and at a point 200 feet North of the winze a crosscut was extended to the Northwest 125 feet. This encountered ore immediately after passing through the dike; at 460 feet North of the winze, a third crosscut has been started to the Northwest. These drifts will serve as a main level drifts in the 11th level development.

UNDERGROUND IN GENERAL

The territory which has given the largest product for the past two years is gradually getting smaller as mining approaches the 10th level. This has had a tendency to cut down somewhat on our product, however, during the year the developments in the South end of the mine above the 9th level and in the Northwest end of the mine in the Railroad pillar have opened territories

which gradually are increasing in size so that more contracts can be added monthly. The area on the North foot wall below the old 6½ level is gradually getting smaller as it approaches the bottom of the trough, and the area North of #2 shaft is not any larger than a year ago. Here about 10 or 12 contract only can be employed, however, the mine is in excellent shape for a large product which will be secured during the coming year if men are available. The mining in the main ore body has now reached a point where weight is being shown on the 10th level requiring considerable retimbering there. The 11th level development is being pushed as rapidly as possible and by April first raises from this level will be extended into the crushed area above the 10th. When ore from this territory can be handled from the 11th level most of the expense of retimbering on the 10th level will be eliminated.

The territory above the 10th level, West and North of the winze, under the hanging is being developed. The hanging is very irregular and pockety so development work is slow. From this territory came practically all of our Bessemer product, which during the last year was very much less than the previous year. During the coming year the development of the 11th level will be continued; new pump station cut and equipped and the connecting drift to the Athens completed.

WATER.

The average number of gallons pumped throughout the year was 57,-843,428 gallons per month or an average of 1,327 gallons per minute. On March 1st a settlement of the surface occurred over the Maas workings which increased the flow considerable to the Maas Mine, practically more than doubled it. The Maas pumps were unable to handle this quantity of water so during the year a considerable quantity of Maas water was handled by the Negaunee pumps, during the installation of an auxillary pump at the Maas Mine. This water came from the 2nd level Maas to the 10th level Negaunee which is at the same elevation. A pump being installed on the Maas side of the line to throw the water into Negaunee drifts. Since the cave on the Maas surface there seems to be a slight slackening of the water on the Negaunee side of the line. This is probably

caused by the break in the hanging wall on the Maas side. Contours of rock surface show a considerable depression just North of the Railroad pillar on the Maas side of the line. Surface drainage would naturally follow this contour leading the water into the Maas workings rather than into the Negaunee. This has been the first break through to surface of the Maas hanging.

On the 10th level foot wall drift at the bottom of the winze from the 9th level, concrete supports were placed on the sides of the drift so that a bulkhead could be quickly erected to dam water coming from the Northeast end of the mine or from the Maas workings if desired. This bulkhead will make a dam six feet high and will hold a considerable quantity of water. The water from this end of the mine can be turned into the Maas in case of trouble with the Negaunee pumps.

METHOD OF MINING.

Most of the mining throughout the year was by the top slicing method which has been employed in this mine whereever possible for the past several years. These slices average about 11 feet in thickness, it being necessary to make the slices this depth in order to avoid cutting timber from the crushed sub levels above. On account of the tremendous timbering cost due to crushing, an innovation has been started which we hope will prove beneficial in this mine. The results to date seems to indicate this. The main drifts on the 11th level are spaced at 112 feet, raises are being planned at 60-foot intervals. These are alternately of one or two compartment, the latter permitting an ore chute and a combination timber and traveling road. The development on the sub level is to the foot and hanging of these chutes, 55 feet being advanced in each direction. This cuts up the sub level into blocks 60 by 55 feet or in short chunky pillars. Under the old development, drifts on the sub levels extended towards the foot and hanging 100 feet, while the distance between raises was only 30 feet. This left a long narrow pillar which crushed down much more readily than the present chunky pillar. We hope by the new method to save considerable retimbering. By having two compartment raises, timber can reach any contract necessary by means of the tugger hoist. Formerly, at times, it was very expensive to keep traveling

and timber roads open between raises.

LOW PHOSPHORUS ORE.

I have mentioned above that the Bessemer product was considerably less during the past year than for some years back. This ore at the Negaunee Mine has come from a roll under the hanging in the West end of the mine. Mining in this area has reached a point where it had to stop until the completion of the work further to the East. The development is being carried under the hanging and during this coming year a considerable quantity of ore should be mined there. The ore analyses in the developed area, however, do not indicate as large a percentage of low phosphorus ore as we had expected, consequantly, the estimate of Bessemer ore for the coming year is considerably less than in former years.

MAIN LINE CARS.

I mentioned in my last years' report that we had adopted the M.C.B. bearings for our underground main level cars on account of the continual trouble we were having with our Hyatt roller bearing trucks. During the past year, with the 7" Hyatt roller bearings, we have had less trouble than for some years previous with the 6", but still the cost of maintenance of these bearings has been excessive. The new assemblage of the 7" seems to stand up considerably better than the old 6" assemblage. While the roller bearing trucks have not held up as we had hoped they would at the same time, with cars equipped with these bearings nearly twice the trainload can be hauled as with the MC.B. bearings. We are experimenting now with assembling the broken bearings ourselves. If this can be worked out satisfactorily it may cut down considerably on the roller bearing maintenance expense, and make them more profitable to use than the M.C.B. bearings.

Where we had considerable trouble with springs on these cars, during the past year this has been eliminated by the adoption of a heavier spring.

SHAFT.

At the end of last year the drift from the bottom of the winze had holed to the shaft site at the 12th level and a raise had been extended through to the bottom of the shaft below the 10th level. In January, the 11th level

plat, 100 feet below the 10th level, was cut and the 11th level pocket placed in position. In February practically all of the month was employed on the 11th level storage pocket. In March, stripping of the shaft was completed from the 11th to the 12th levels and plans were made to cut out the pentice below the 10th level. The pentice was removed in April and timbering completed to the 12th and a chute put in on the 12th level under the skip compartment to serve as a clean-out for the skip pit. In May the shaft was completed in the cage and pipe compartments to the 12th level. In June, this work was completed in the skip compartment and during July hoisting started from the 11th level. At the 11th level plat the formation has a tendency to slab off any large chunks. In order to make this secure, concrete was extended from the pocket around the shaft to support the brow. In November forms were placed in position and a concrete arch constructed over the pocket and 5 feet back from the brow of the shaft over to the plat. The ground immediately adjoining this concrete arch was treated with the cement gun to prevent slacking.

PUMPHOUSE.

With the development of the 11th level it was necessary to provide means to handle the water which will naturally seek this level from the workings above. It was decided to install an auxillary pump at the shaft with sufficient capacity to handle practically the same volume as the pumps on the 10th level are now handling. A pumphouse and sump have been planned, a pump purchased and the cutting of the excavation is now in progress. The location of the proposed pumphouse is just to the North of #3 shaft. A connecting drift will be driven from the 11th level station to the 10th level pumphouse. The discharge will carry the water to the 10th level sump. The cleanout drift below the suction is at an elevation of 42 feet below the 11th level. Here mud from the sumps will be handled directly to the skips or cage. Two plunger pumps of 1,000 gallons each will be installed at this station.

In December at a point 15 feet North of the shaft a drift was driven 60 feet to the West to the location of the proposed pump room. At 120 feet and 185 feet, respectively, to the North of the shaft slopes have been started below

the 11th level for a sump to supply these pumps. The development of this pump station will be carried on as rapidly as possible.

FATAL ACCIDENT.

On December 19th, at 3:30 P.M., William Medlin was instantly killed by a fall of ground while working on the 900' sub level North of #2 shaft. Medlin ans his partner, Aino Ekeluoma, were drilling the breast of their drift preparatory to blasting, when without warning, a considerable area over their working place crushed down, killing Medlin instantly. Medlin's partner, Ekeluoma, was standing only a few feet distant, was not knocked down by the fall and managed to escape with two other miners who were working nearby, into an old drift, opening under a large dike. Subsequent falls entombed them where they had taken refuge. Medlin's working place had been inspected by the shiftboss only a short time before the accident and no signs of "working" were noticeable at that time. After the settlement occurred it was not known whether all the four men were buried beneath the fall or if they had managed to escape. A rescuing party was immediately set to work and after 63½ hours, three of the men were rescued alive and Medlin's body recovered underneath the ore. Two of the men, William and Sylvester Arbelius, escaped without injury. Ekeluoma received a sprained leg while trying to extricate it after it had been caught beneath a piece of lagging and chunks of ore. Medlin was a married man 35 years of age, living in Ishpeming.

SURFACE.

ENCLOSING HEADFRAME.

Last winter the headframe was enclosed from the landing platform to the top sheaves around the skip compartment and dumps. Shiplap was employed which was covered with composition roofing. Since this has been completed practically no extra time has been spent in keeping the dumps in good shape during the winter weather, while before, continual trouble was had during the extremely cold periods causing delays in hoisting. There is also a considerable saving of steam as there is very little freezing in the dumps.

NEW TOP TRAM.

During the month of January the new top tram system was put in com-

mission; this is of a type similar to that employed at the Stephenson and Maas Mines of the Company. The driving engine consists of a rubber lined 8' sheave which is geared to a motor. The tram has worked satisfactorily throughout the year with the exception of the rubber lining on the sheaves which has had to be replaced. At the other Mines the original rubber lining is still in use. At this installation, however, the sheave does not seem to be perfectly true, which is probably the cause of the cutting out of the lining. There is considerably harder use at this plant than any other installation of the Company.

MAKING OF AUGER STEEL.

During the early part of the year, there was a great shortage of Auger Steel among the mines of the Company. The kind which had been in use at most of the mines was F.J.A.B. steel which is imported from Sweden. During the lack of shipping facilities, the only steel available was of inferior grade, manufactured by the Ingersoll-Rand Company. The cost of this was also excessive. On the Gogebic Range, The Newport, Oliver Company and Montreal Company, were making their own steel by hammering it out with a steam hammer and twisting it. Investigation was made of the process they employed, and an experimental apparatus was rigged up at the Negaunee Mine. It was found that in order to make the steel properly a steam hammer would have to be installed with large forming blocks, and a pyrometer used, where the absolute temperature was known so that proper tempering would result. A pyrometer was purchased and the experiment tried out at the Cliff-Shaft Mine. It was found that in order to get satisfactory results a proper furnace would have to be built and a more suitable hammer employed. A few pieces of steel made in this experiment have been employed at the Negaunee Mine for several months and work satisfactorily, however, during the summer another consignment of the F.J.A.B. steel was received, so that since then there has not been the pressing necessity for steel there was earlier in the year. I believe auger steel can be made by the Company at a price considerably lower than that which we have to pay for the imported material.

STOCKING TRESTLE.

New ties were installed on the steel stocking trestles throughout their

entire length. This being the first renewal since the trestles were erected.

FIRES.

On June 11th at 1:30 P.M. a fire occurred at #2 headframe. A hard wind was blowing from the West. A short time after it was discovered the whole East side of the headframe was in flames. The material in the headframe was as dry as tinder and fire soon reached the collar of the shaft. Efforts to put it out by means of chemical apparatus by the Company employees and City Fire Department failed, so that a hose line 2,000 feet long had to be laid before the fire was gotten under control. Men working in the East end of the mine North of #2 shaft were taken from their working places as a little smoke entered this section of the mine. After the fire this headframe was blasted down and a small headframe erected as the shaft is still being used as a timber shaft to supply the East end of the mine. The small electric hoist which had been used here was removed to the Angeline Mine in May and timber is now being lowered without an engine. A counterweight being employed to bring back the empty cage.

GARDENS.

All employees who desired garden plots were given pieces of land by the Company the same as a year ago. These patches were large enough to provide their families with plenty of vegtables for their winter supply.

PRODUCTION

Month	Bessemer	Negaunee	Total	Rock
January	13,176	37,740	50,916	920
February	9,952	33,341	43,293	1,300
March	9,048	35,489	44,537	1,716
April	7,763	31,496	39,259	1,328
May	9,038	34,631	43,669	1,872
June	8,726	30,208	38,934	1,492
July	7,222	39,082	46,304	1,772
August	8,449	35,806	44,255	2,236
September	6,233	32,643	38,876	2,744
October	6,922	37,950	44,872	2,532
November	5,712	27,624	33,336	1,500
December	5,620	32,290	37,910	2,400
Total	97,861	408,300	506,161	21,812
Stock pile overrun		10,000	10,000	
	97,861	418,300	516,161	
Transferred from	15,533 to	15,533		
Total	82,328	433,833	516,161	21,812

ANALYSIS OF PRODUCTION

Production of 1918	516,161 tons,	
" 1917	543,757	
Increase 1917	27,596	
Cost of production 1918	$760,135.17 - cost per ton	1.472
" " " 1917	604,367.46 " " "	1.111
Increase 1918	155,767.71 " " "	.361

During the year 1918 the mine worked one eight-hour shift for 298 days. The average number of men employed during the year was 347, for a total of 103,370 days. In 1917 an average of 360 men were employed for a total of 109,223 days. A decrease in labor in 1918 of 13 men and 5853 days.

The average tons per man underground in 1918 was 6.01 or an increase of .07 tons per man over 1917, when the average tons per man was 5.94. The total tons per man in 1918 was 4.86 while in 1917, the total tons per man was 4.81; an increase of .05 tons per man.

There were three increases in wages affecting the 1918 cost; April 16, 1918, August 1st, 1918, and October 1st, 1918.

The total increase this year over last year is $1.10 per day, or 29.10%. (Over the year 1916 the increase is $1.83 per day or 60%). The actual amount paid due to increase in wages this year over last year is $113,707.00; which based on the production mined equals $.22 per ton.

In 1918 the totsl supply cost was $246,897.18 against $190,730.36, or an increase of $56,166.82 which, based on the production equals an increase of $.108 per ton.

The increase of $.22 per ton for labor account of increases in wages and the increase of $.108 per ton for supplies totals an increase of $.328 per ton. This increase deducted from $1.472 - 1918 cost per ton equals $1.144 per ton, which shows that if conditions were the same during the two years the cost per ton in 1918 would be $.033 more than 1917 cost. This difference would have been eliminated if there had been no shortage of labor.

The Mine worked the entire year with a shortage of men due to many

going into the U. S. service. Taking into consideration the unsettled condition of affairs, the scarcity of labor, especially skilled miners, the years' production did not drop very much below that of 1917.

GENERAL EXPENSE

No. 26 Insurance	1918 Amount	1,016.42 - cost per ton	$.002
	1917	46.87	.000
	Increase	969.55	.002

This increase due to a debit memo from Cleveland Office charged in Dec. $969.81.

No. 27 Engineering	1918	3,230.05	.006
	1917	3,010.58	.006
	Increase	219.47	

This increase due to increase in wages.

No. 28 Analysis	1918	17,233.23	.033
	1917	13,841.33	.025
	Increase	3,391.90	.008

This includes operating laboratory and sampling. In 1918 the total operating cost for the laboratory was $14,987.19 and the total number of determinations was 129,628. In 1917 the cost was $12,019.44 and the determinations 130,432. An increase in expenditure of $2,967.75 and a decrease in determinations of 804.

Cost per determination in 1918	$.11562
" " " " 1917	.09215
Increase	.02347

Due to increased cost of labor and supplies.

Sampling at the mine increased $1,208.35 in 1918. This is due to increased wages entirely.

No. 30 Personal Injury Expense	1918	9,810.37	.019
	1917	8,750.50	.016
	Increase	1,059.87	.003

This increase includes deferred payment for injury to Frank Carilli, injured Sept. 1917 and died November 1918. Also deferred payments account of William Medlyn fatally injured Dec. 19, 1918, $3000.10. Serious accident to Henry Pekkola infected hand $350.00.

No. 30a Mine Office

1918 Amount	$19,482.35	cost per ton	.038
1917 "	14,533.44		.027
Increase	4,948.91		.011

	Sub Division Direct Charges		Central Office
1918	$7,572.61		$11,909.74
1917	8,816.26		5,717.18
Decrease	1,243.65	Increase	6,192.56

Decrease in direct charges due to wages of clerks at mine transferred to Central Office payroll in May 1918. Increase in Central Office charge due to transfer of clerks wages and the Company's donation to Marquette Co. War Relief Association.

Total General Expense

1918 Amount	50,772.42	cost per ton	.098
1917	40,182.72		.074
Increase	10,589.70		.024

Accounted for in 26-27-28-30.

MAINTENANCE

No. 125 Tracks and Yards

1918 Amount	4,515.02	Cost per ton	.009
1917	2,098.16		.004
Increase	2,416.86		.005

Increase due to invoice from L.S.&I.Ry. Co. for $1788.26 charged in Dec. 1918. This invoice covered cost of track maintenance for year 1918, complying with 1918 government ruling.

No. 126 Docks Trestles and Pockets	1918	Amount	$2,530.60	cost per ton .005
	1917		1,861.82	.003
	Increase		668.78	.002

This increase due to extending rock trestle and renewing ties on steel stocking trestle.

No. 127 Buildings	1918	1,405.99	.003
	1917	2,761.80	.005
	Decrease	1,355.81	.002

Newconcrete top tram transfer house erected in 1917.

No. 128 Shop Machinery	1918	83.85	.000
	1917	282.19	.001
	Decrease	198.34	.001

Decrease due to fewer repair parts for shop machinery purchased in 1918.

No. 129 Boiler Plant	1918	381.99	.001
	1917	726.13	.001
	Decrease	344.14	

One new hot water tank and one smoke stake erected in 1917. Small repairs made in 1918.

No. 130 Hoisting Machinery	1918	3,714.11	.007
	1917	3,041.09	.005
	Increase	673.02	.002

Sub Division	Wire Rope	Machinery repairs
1918	$1,703.23	$2,010.88
1917	528.72	2,512.37
Increase	1,174.51	Decrease 501.49

Increase inwire rope.

1917 New rope put on North skip only.

1918 New rope put on North skip South skip and new cage rope.

The new cage rope put on to enable the cage to go to new 11th level. Old rope not scrapped.

Decrease in Machinery repairs. In 1917 a new frame on cage hoist was installed, also two brake magnets. Ordinary repairs made in 1918.

No. 131 Compressors & Power Drills

1918	Amount	$211.44	Cost per ton .000
1917		1,509.28	.003
Decrease		1,297.84	.003

Sub Division

	Repairing Compressor		Power Drills
1918	$211.44		0
1917	380.04		$1,129.24
Decrease	178.60	Decrease	1,129.24

Six auger drills and 1 B.C.R.W. 430 Ingersoll-Rand charged in 1917. No drills purchased in 1918.

No. 132 Pumping Machinery

1918	5,321.08	.010
1917	1,588.75	.003
Increase	3,732.33	.007

This increase due to 1500 ft. of armored lead cable installed in 1918, as an emergency cable for the electric pumps - $3400.00.

No. 133 Top Tram Engine & Cars

1918	6,707.79	.013
1917	4,165.72	.008
Increase	2,542.07	.005

Sub Division

	General Repairs		Wire Rope
1918	5,840.65		618.03
1917	2,050.37		2,115.35
Increase	3,790.28	Decrease	1,497.32

Increase in general repairs due to machinery for new transfer purchased and installed in 1918 -$3400.00

Decrease in wire rope due to two 5500'

5/8" wire rope put on in 1918. Four put on during 1917.

No. 134 Skip and Skip Roads

1918	Amount $3,453.28	Cost per ton	.007
1917	1,921.30		.003
Increase	1,531.98		.004

This increase due to rebuilding 2 skips in 1918. New runners.

No. 135 Underground Tracks and Cars

1918	3,847.99		.007
1917	3,251.83		.006
Increase	596.16		.001

This increase due to increase in cost of 12# rail-also 20 sets of 10" roller bearings trucks charged in 1918.

No. 136 Electric Tram Plant

1918	34,002.91		.066
1917	23,294.45		.043
Increase	10,708.46		.023

	Sub Division			
	Eng.&Dynamo	Locomotives	Wiring	M.L.Tracks
1918	1,375.66	7,494.01	3,996.83	14,147.67
1917	79.98	4,015.02	3,026.07	11,218.96
	1,295.68	3,478.99	970.76	2,928.71

	Main Line Cars
1918	6,988.74
1917	4,954.42
	2,034.32

Increase in Engine & Dynamo due to new armature for haulage generator charged in 1918 - cost $1200.00.

Increase in Locomotives due to one new 10-ton locomotive purchased and used on the new 11th level - cost $3115.00.

Increase in Wiring due to equiping new 11th level with trolley wire and other wiring supplies.

Increase in Main Line Tracks due to increased amount of 30# rail used account of more

developing work done than in 1918.

Increase in Main Line Cars due to 5 new Motor cars added to underground equipment in 1918 - cost $2400.00.

No. 137 Telephone & Safety Devices	1918	Amount	$315.90	Cost per ton	.001
	1917		452.85		.001
	Decrease		136.95		

Less in safety appliances installed in 1918.

No. 140 Fire Expense & Damage	1918	80.03	.000
	1917	00.00	
	Increase	80.03	

This charge occured account of fire in our old #2 shaft house.

Total Maintenance	1918	66,571.98	.129
	1917	46,955.37	.086
	Increase	19,616.61	.043

MINING EXPENSE

No. 150 Air Pipes	1918	6,229.30	.012
	1917	6,259.15	.012
	Decrease	29.85	

1917 cost was unusually large account of extensions to 4" line put in on 12th level for new development.

No. 151 Compressors	1918	15,163.03	.029
	1917	10,920.59	.020
	Increase	4,242.44	.009

	1918	1917
Air made by Negaunee Comp.	331476750	343334250
Air purchased from Maas Mine	112500000	112191000
Total Cu. ft.	443,976750	455525250

		1918	1917
	Cost of operating Neg. Comp.	13,574.47	9,120.59
	Amt. Charged by Maas Mine	1,800.00	1,800.00
	Total	15,374.47	10,920.59
	Cost per cubic foot	.0346	.024

The increase in cost per cubic foot due to increase in wages; also the cost of electric power was increased from 1¢ to 1½¢ per K.W. in July 1918.

No. 152 Hoisting	1918 Amount	$30,492.02	Cost per ton	.059
	1917	21,821.87		.040
	Increase	8,670.15		.019

This increase due to increased wages and increased price of electric power.

No. 153 Pumping	1918	46,575.72	.090
	1917	32,684.87	.060
		13,890.85	.030

Sub Division

	1918	1917
Operating Elec. Pumps	$46,365.94	$32,529.80
Cleaning Sump	209.78	155.07
	$46,575.72	$32,684.87
Total gals. water pumped	694121136	676485880
Gals. Water pumped per Min.	1327	1287

The increase in amount of water pumped due to some of the Maas mine water pumped through Negaunee Mine, while installation of electric pump at Maas Mine was taking place.

Increase in cost due to increased wages and increased price of electric power.

No. 154 Sinking & Shaft Repairs	1918	16,878.27	.033
	1917	9,726.46	.018
	Increase	7,151.81	.015

This increase is due to the development of the 11th level. The shaft was completed to the 11th level, the plat was finished and 11th level pocket installed during 1918.

No. 155 Rock Drifting

1918	Amount	$30,139.82	Cost per ton	.058
1917		20,346.20		.037
Increase		9,793.62		.021

SUB DIVISION

	Drifting	Per Ft.	Raising	Per ft.
1918	3578	5.17	658	3.32
1917	2854	4.54	582	2.24
Inc.	724	Inc. .63	Inc. 76	Inc.1.08

Of the 3578 ft. drifting in 1918, 2205 ft. was main level drifting on the 11th and 12th levels.

No. 156 Breaking Ore

1918	Amount	$306,379.59	Cost per ton	.594
1917		248,513.51		.457
Increase		57,866.08		.137

This increase due to increase in wages and cost of supplies.

EXPLOSIVES.

	1918	1917
Total lbs. of powder	203,900	199,000
Average price per lb.	.1971	.165
Total amount	40,188.46	32,743.20
Fuse, caps, etc.	6,733.85	6,064.70
Grand Total	46,922.31	38,807.90
Lbs. powder per ton of ore	.395	.366
Cost per ton for powder	.0779	.060
" " " all explosives	.0909	.071

This increase in explosives is due to the main sub level in the mine being cut off on the East end where ore was broken with little powder,

while in the West end of this sub, the ore is extremely hard, requiring considerably more powder.

No. 157 Tramming,

1918	Amount	$46,448.80	Cost per ton	.090
1917		38,061.72		.070
Increase		8,387.08		.020

SUB DIVISION

	1918	1917
Tramming	39,826.38	31,457.24
Skip Tender & Bellman	3,882.64	3,356.38
Clean Skip Pit	2,739.78	3,248.10

The principal increase is in wages. A crew of 4 to 6 trammers were employed during the entire year transfering ore from the 900' workings to the 9th level.

No. 158 Filling,

1918	Amount	$5,408.04	Cost per ton	.010
1917		3,519.24		.006
Increase		1,888.80		.004

Considerable more filling was necessary in the mining operations on the 900' sub level in 1918.

No. 159 Timbering,

1918	Amount	$104,423.31	Cost per ton	.202
1917		97,306.60		.179
Increase		7,116.71		.023

	1918	1917
Timber cost	10,821.95	12,074.13
Lagging and Poles	10,582.01	10,063.38
	21,403.96	22,137.51
Ft. Timber per ton of ore	.454	.588
Cost per ton for timber lagging and poles	.0415	.0407

The decrease in timber in 1918 is explained as follows. The heaviest place on timber in the mine has been in the large sub level running from

#70 raise West to #89 raise. This sub level has been gradually cut off on the Eastern side, so that it is much smaller this year than in previous years.

We are also spacing our new raises at 60-foot centers instead of 30-foot, shortening up the length of the drift from the top of the raise, so as to make our pillars shorter and wider, rather than longer and narrower. This seems to have done away with considerable retimbering.

Five little tugger hoists were installed in the mine during 1918 at a cost of $310.00 each.

No. 160 Captain and Bosses,

1918	Amount	$17,250.68	Cost per ton	.034
1917		13,356.44		.025
Increase		3,356.44		.009

This increase due to increase in wages. Also one additional shiftboss put on the new 11th level in December.

No. 161 Dry House,

1918	Amount	8,363.80	Cost per ton	.016
1917		7,002.49		.013
Increase		1,361.31		.003

Increase due to increase in wages and increase cost of 3/4 coal.

No. 161 Top Land & Tramming,

1918	Amount	7,665.43	Cost per ton	.015
1917		6,137.35		.011
Increase		1,528.08		.004

Due to increase in wages.

No. 163 Stocking Ore,

1918	Amount	000.00	Cost per ton	.000
1917		331.61		.001
Decrease		331.61		.001

No. 164 Sorting Ore,

1918	Amount	$363.46	Cost per ton	.001
1917		346.38		.001
Increase		17.08		

No. 166 Cave In,

1918	Amount	884.50	Cost per ton	.002
1917		0.00		.000
Increase		884.50		.002

Increase due to small cave underground in December 1918.

No. 171 Ventilation,

1918	Amount	0.00	Cost per ton	.000
1917		769.89		.001
Decrease		769.89		.001

In 1917 ventilation system was installed and used on the 11th and 12th level developments.

Flooding Lands Rental,

1918	Amount	$125.00		
1917		125.00		

Total Mining Expense,

1918	Amount	$642,790.77	Cost per ton	1.245
1917		517,229.37		.951
Increase		125,561.40		.294

DELAYS - ELECTRICAL.

February 22nd	Washington's birthday. No work on account of shortage of electric current.
March 2nd	30 minutes delay, no current.
June 14th	5½ hrs. delay account of main electric cable on 10th level burning out.
19th	1 hr. delay account of electric current being off and 3 cars off main line.
November 25th	2½ hrs. delay, no current.
December 17th	1 hr. delay, hoist out of commission.

DELAYS - NON ELECTRICAL.

January 14th 2½ hrs. delay account of top tram motor out of commission due to steam heater valve bursting.

17th 1 hr. 45 min. delay account top tram plant out of commission. Spider and base of South side wrecked at 2 o'clock. North side oil switch at 3:15.

April 13th 1½ hrs. - haulage cable grounded in shaft.

16th & 17th About 70 men home on account of sickness.

July 1st 5½ hrs. delay night shift account of North skip rope breaking 80 ft. from skip. Full skip at 9th level.

November 7th Worked stopped at 2:00 P. M. at all mines. False report that armistice was signed.

11th Armistice signed, mines did not work on this day.

ESTIMATE OF PROBABLE ORE IN NEGAUNEE MINE DECEMBER 31, 1918.

Original tonnage in area above 500' contour from 100' sections		9,907,812 tons.
Total ore mined to December 31, 1918 (excluding American Mining Co.) (American Mining Co. 53,316 tons)		7,107,383 "
Balance left in mine December 31, 1918		2,800,429 tons.

GRADED AS FOLLOWS:

Bessemer Ore	Trade name.	
Developed	Negaunee Bessemer	280,043 tons.
Non-Bessemer Ore	Negaunee	2,520,386 "
Total Bessemer and Non-Bessemer		2,800,429 tons.

ASSUMPTION:

12 cu. ft. equals one ton. 10% deduction for rock.
10% " " loss in mining.

Percentage of Bessemer 10

Area 9th level 400,750 sq. ft.

ESTIMATED ANALYSES.

		IRON	PHOS.	SILICA	MANG.	ALUM.	LIME.	MAG.	SUL.	LOSS BY IGNITION	MOIST
Negaunee Bessemer Soft Hematite	Natural	53.55	.053	6.20	.239	2.09	.567	.270	.009	1.82	12.22
Negaunee Soft Hematite	Natural	52.00	.073	7.75	.240	2.38	.788	.348	.010	2.67	11.86

NEGAUNEE MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1918.

GRADE	IRON	PHOS.	SILICA
Negaunee Bessemer,	61.17	.057	6.28
Negaunee,	59.00	.082	7.77

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1918.

	Mine		Lake Erie		
GRADE	IRON	PHOS.	IRON	PHOS.	MOIST.
Negaunee Bessemer,	61.32	.057	61.05	.058	12.37
Negaunee Special,	61.12	.057	61.19		11.60
Negaunee,	58.74	.081	58.39		12.72

ORE STATEMENT - DECEMBER 31ST, 1918.

	NEGAUNEE BESSEMER	NEGAUNEE	TOTAL	TOTAL LAST YEAR
On hand Jan. 1st, 1918,	50,090	32,140	82,230	129,489
Output for Year,	82,328	423,833	506,161	531,757
Stockpile Overrun,		10,000	10,000	12,000
Total,	132,418	465,973	598,391	673,246
Shipments,	123,798	404,906	528,704	591,016
Balance on Hand,	8,620	61,067	69,687	82,230
Decrease in Output - 5%			27,596	
Decrease in ore on hand,			12,543	

1918 - 1-8 Hour Shift

1917 - 1-8 Hour Shift

NEGAUNEE MINE.

NEGAUNEE MINE

SHIPMENTS FOR THE YEAR 1918.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR	
Negaunee Bessemer,	38,396	85,402	123,798	157,533	
Negaunee,	251,941	152,965	404,906	433,483	
Total,	290,337	238,367	528,704	591,016	
Total last Year,	321,749	269,267	591,016		
Decrease - 11%			62,312		

NEGAUNEE MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 8.	1 9 1 7.	INCREASE.	DECREASE.
PRODUCT	516,161	543,757		27,596
General Expense	.098	.074	.024	
Maintenance	.129	.086	.043	
Mining Expense	1.245	.951	.294	
Cost of Production	1.472	1.111	.361	
DEPRECIATION.				
Plant Account	.030	.030		
Equipment		.001		.001
Total Depreciation	.030	.031		.001
Taxes	.231	.180	.051	
Central Office	.044	.042	.002	
Supply Inventory	.010		.010	
Miscellaneous	.014			.014
Cost on Stockpile	1.773	1.364	.409	
Loading & Shipping	.041	.025	.016	
Administrative	.010	.009	.001	
Total Cost on Cars	1.824	1.398	.426	
No.Days Operating	298	303		5
No.Shifts and Hours	1-8hr	1-8hr		
Avg.Daily Product	1732	1794		62
COST OF PRODUCTION				
Labor	.970	.751	.219	
Supplies	.502	.360	.142	
Total	1.472	1.111	.361	

NEGAUNEE MINE.

COMPARATIVE WAGES AND PRODUCT.

	1 9 1 8.	1 9 1 7.	INCREASE.	DECREASE.
PRODUCT	516,161	543,757		27,596
No.Shifts and Hours	1-8hr	1-8hr		
AVERAGE NUMBER MEN WORKING				
Surface	56	58		2
Underground	285	301		16
Total	341	359		18
AVERAGE WAGES PER DAY				
Surface	4.20	3.26	.94-28.5%	
Underground	5.02	3.88	1.14-30%	
Total	4.88	3.78	1.10-29.1%	
WAGES PER MONTH OF 25 DAYS				
Surface	105.00	81.50	23.50	
Underground	125.50	97.00	28.50	
Total	122.00	94.25	27.75	
PRODUCT PER MAN PERDAY				
Surface	29.74	30.79		1.05
Underground	6.00	5.94	.06	
Total	4.99	4.98	.01	
LABOR COST PER TON				
Surface	.141	.106	.035	
Underground	.837	.653	.184	
Total	.978	.759	.219	
AVG. PRODUCT BRK'G & TRM'G	8.88	10.14		1.26
" WAGES CONTRACT MINERS	5.27	4.10	1.17-28.5%	
" " " TRAMMERS	0	0		
" " " LABOR	5.27	4.10	1.17	
TOTAL NUMBER OF DAYS				
Surface	17,353¾	17,657½		303¾
Underground	86,016¾	91,565¾		5,549
Total	103,370½	109,223¼		5,852¾
AMOUNT FOR LABOR				
Surface	72,847.76	57,642.42	15,205.34	
Underground	431,999.74	354,953.74	77,046.00	
Total	504,847.50	412,596.16	92,251.34	

Proportion Surface to Underground Men:

1918 - 1 to 5.10
1917 - 1 to 5.20
1916 - 1 to 5.63
1915 - 1 to 5.05
1914 - 1 to 4.69
1913 - 1 to 4.51
1912 - 1 to 2.68

NEGAUNEE MINE.

TIMBER STATEMENT FOR THE YEAR ENDING DECEMBER 31, 1918.

KIND.	LINEAL FEET.	AVG.PRICE PER FOOT.	AMOUNT 1 9 1 8.	AMOUNT 1 9 1 7.
4" to 6" Timber	[illegible]			12.24
6" to 8" "	90,068	.0288	2597.44	2689.52
8" to 10" "	93,041	.0497	4625.42	4423.07
10" to 12" "	37,412	.0657	2459.14	4258.87
12" to 14" "	13,712	.083	1139.95	690.43
Total - 1918	234,233	.0462	10821.95	
Total - 1917	319,747	.0378		12074.13
	LINEAL FEET	PER 100'		
7' Lagging	1,180,638	.6062	7156.64	6459.17
Poles	332,997	1.029	3425.37	3604.21
Total - 1918	1,513,635	.699	10582.01	
Total - 1917	1,567,771	.6419		10063.38

Product	516,161	543,757
Feet timber per ton of ore	.4538	.588
Feet Lagging " "	2.2873	2.178
Feet Lagging per foot of Timber	5.0404	3.74
Cost per ton for Timber	.0210	.0222
" Lagging	.0139	.0119
" Poles	.0066	.0066
" Timber, Lagging & Poles	.0415	.0407
Equivalent of stull timber to Board Measure	422,328	574,798
Ft.Bd.Measure per ton of ore	.8182	1.057
Total Cost for timber, Lagging & Poles 1918		21403.96
" 1917		22137.51
" 1916		21510.67
" 1915		19783.21
" 1914		13236.64
" 1913		12327.95
" 1912		12191.04
" 1911		15137.84

NEGAUNEE MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICES.	AMOUNT 1 9 1 8.	AMOUNT 1 9 1 7.
35% Powder	50	.1766	8.83	
40% "	173,400	.1823	31614.08	29888.90
60% "	30,450	.2813	8565.55	2854.30
Total Powder	203,900	.1971	40188.46	32743.20
Fuse	613,800	7.43	4559.31	3966.33
#6 Caps	116,400	14.29	1663.86	1383.64
#8 Caps	500	20.40	10.20	297.64
Cap Crimpers	142	.564	80.16	61.72
Electric Exploders	362	7.655	27.71	11.19
Connecting Wire	110½	.453	50.05	50.62
Tamping Bags	70,900	2.15	152.11	159.99
Powder Bags	168	1.123	188.82	133.57
Leading Wire	250	6.52	1.63	
Total Fuse,Etc.			6733.85	6064.70
Total Explosives			46922.31	38807.90
Product			516,161	543,757
Pounds Powder per ton Ore			.395	.366
Cost per ton for Powder			.0779	.060
" Fuse,Etc.			.013	.011
" All Explosives			.0909	.071
Avg.Price per lb.for Powder			.1971	.165

NEGAUNEE MINE.

MAAS MINE - 1918.

During the year 1918 the Maas Mine operated on a partial double shift. The night crew was not large at any time during the year, but it was thought advisable to break ore on two shifts along the American Mining Company's pillar and on the development above the 4th level. This scheme was started in June 1917. Hoisting throughout the year was on both day and night shifts. The product for the year was 307,436 tons, practically the same as for the year before. This included a slight overrun. The grades show practically 25% Bessemer in 1918 as compared with 18% in 1917. This Bessemer is practically all coming from the 4th level under the hanging and is averaging better than we have had heretofore. During the coming year we hope to make at least as large a percentage of Bessemer as last year, with possibly an increase. The total production in the mine was somewhat disappointing, however, the year started out well, January having the largest product in the history of the mine. February was also good, but in March a sand cave occurred which broke through to surface. With this came an increased flow of water and the filling of the 4th level. This cut down the product for the next two months and from that time on to the ehd of the year there was a labor shortage due principally to the drafting of many of our men and other war conditions, there being a shortage of labor throughout the whole district.

There were large shipments from the stockpiles during the year. On December 31st there remained in stock 63,227 tons, consisting of 53,327 tons of Maas and 9,900 of Bessemer. This is about 44,000 tons less than we had in stock a year ago.

There were practically no changes in the surface equipment during the year.

Development work was continued above the 4th level on the South side near the Negaunee Mine. A change in our mining method in the territory below the 3rd level made it necessary for us to abandon considerable development work

which has been in progress for the past two years, however, most of this will be useful later. The work at the shaft was carried on without interruption throughout the year except two months in the Spring, when it was necessary to abandon work due to water which got into the 4th level workings at the time of the surface cave. It is hoped that the shaft will be completed early this coming year.

UNDERGROUND

Following is a brief description of the work on the various sub levels and levels where work was done throughout the year.

730' SUB LEVEL.

The pillars remaining at this elevation where mined early in the year at #41 raise near the Northeast boundary of the Roman Catholic Cemetery tract. The sub level was completed in March.

720' SUB LEVEL.

Mining immediately to the South of #41 and #42 raises was conducted until the middle of the year when work was stopped on account of the caving of these raises, Latter in the year ore was found at this elevation South of the dike which runs through this territory in a Northwesterly-Southeasterly direction. Raise, #61, was put up from the 575' sub, and mining is now in progress. Two contracts are developing here.

FIRST LEVEL.

The work here was in the extreme Eastern end of the mine in the Roman Catholic Cemetery tract and American Mining Company's strip. The operations extended over the entire area. The only ore remaining is between the old #41 raise and the new #61 raise North and South of the dike.

695' SUB LEVEL.

Here work was under the Cemetery tract and in the Railroad pillar. The pillars on the extreme East foot wall were removed early in the year. Latter ore was found in a roll in the hanging. A triangular piece about 100 feet in length by 60 feet wide was opened next to the Negaunee boundary. Work has been abandoned for the present near #61 raise awaiting the completion of mining above

on the first level.

On March 1st a settlement of the hanging occurred which extended through to surface where a large cave appeared. A small amount of sand entered the mine and appeared mostly at #51 raise on this sub level. This interferred somewhat with the mining in this area. A few pillars were temporarily left and afterwards mined from the 675' sub level. This end of the mine from that date has been extremely wet and the mine is making practically double the amount of water it pumped before.

675' SUB LEVEL.

During 1917 a foot wall drift connecting the foot wall raises was driven. Early this year the development of the East end of the sub level from the foot to the hanging was started and mining is still under way in the Roman Catholic Cemetery tract and the Railroad pillar. In the extreme South end in the Railroad pillar a small pocket of ore was found South of the dike, latter developments to the South of #61 raise also found ore to the South of this same dike. Mining in this latter place is awaiting mining above.

655' SUB LEVEL.

The development of this sub level along the foot wall in the East end of the mine was started in 1917 from #43 to #47 raises. This was continued early this year to the East to the Negaunee boundary and West to #40 raise. In driving to the East it was found that #50 raise which had been opened without cribbing had developed into a large stope from 40 to 50 feet in diameter. Raises #51 and #52 had also arched together making it necessary to abandon all three. To the West at raises #40, #41, and #42 it was found that large stopes were also developing. It was deemed advisable to fill these openings as rapidly as possible as they made mining in this vicinity extremely hazardous on account of the possibility of their caving and drawing. At the same time if a sand run occurred while they were open it would be absolutely impossible to reach them in future mining. Five new raises were planned to reach this area from the second level hanging wall drift. Raises #61, #63 and #68 have reached this elevation and are now being used in the development of the sub level from the

hanging towards the foot.

623' SUB LEVEL.

A new traveling road was opened opposite #43 raise to connect with the 575' sub level. This was necessitated by the caving of #42 raise.

596' SUB LEVEL.

This old sub level had its main drift reopened in 1917. Mining here was conducted throughout 1918. Most of the pillars West of old #40 raise being mined. This sub level between #59 raise and the West end of the deposit which is 100 feet beyond #69 raise will be completed early this coming year. No mining can be done to the East until the sub level above has been mined.

575' SUB LEVEL.

The only work on this sub level during 1918 was development. A traveling road was driven from a point between raises #59 and #60 to the Northwest for a distance of 80 feet, connecting with the 610' sub level by a raise. Raises #61 and #63 were continued from this sub level to the 720' and 655' sub levels, respectively. Between #40 raise and 100 feet West of #69 raise development drifts for mining were driven to the foot, the hanging, and to the Western extension of the sub level.

SECOND LEVEL.

At the shaft the plat was extended to the East to make room for an auxillary pumping plant. This work was done in March and April. The pump went into commission November 1st. It handles most of the second level water.

In the foot wall drift #70 raise was extended to the 575' sub level for a timber, traveling way and water way.

In the East end the main traveling drift was extended 70 feet to permit tail room beyond a new raise near the Negaunee boundary.

Raises #67 and #68 were put up 100 and 160 feet, respectively.

SUB LEVELS BETWEEN THE SECOND AND THIRD LEVELS.

465' SUB LEVEL.

The only work here was a little development in the Cemetery tract. This was early in the year. One drift was driven towards the foot, the other to-

wards the hanging. A short development drift was driven here in February just West of the Southwest corner of the Cemetery tract.

435' SUB LEVEL.

Work at this elevation was at the Eastern end of the sub level. Three drifts were driven to the foot wall in the Cemetery tract and a stope mined Southeast of #100 raise. This latter working being under the hanging.

401' SUB LEVEL.

In the extreme Eastern end of the Cemetery tract, three development drifts were driven to the foot. These were parallel with the Railroad pillar.

The last four sub levels, namely, #465, 450, 435, and 401, were all stopped in April as no mining can be done in this area on the foot wall side for several years, i.e., before the ore above on the foot has been mined.

395' SUB LEVEL.

Mining on this sub level continued throughout the year and is now finished under the hanging from the Railroad pillar to G crosscut and to the mining limit to the North. At G crosscut and to the West, a few small pillars remain.

375' SUB LEVEL.

WEST END.

The area West of #82 raise started in 1917 was completed during the year.

EAST END.

At F crosscut a small stope was mined between 3F and 5F raises. Under the hanging in the Railroad pillar and adjoining property, mining is now in progress.

365' SUB LEVEL.

This sub level opened in 1916 and developed in 1917 was completed during the year between #82 and #93 chutes. Development work is now in progress to the South and West of #81 raise.

355' SUB LEVEL.

This sub level opened last year between #86 and #94 raises was continued to the West to #83 raise. Mining is now in progress on both foot and

hanging sides.

At G crosscut stoping is now in progress receding from the hanging South of 7G raise.

At F crosscut, two small pillars were mined during the year between 3F and 5F raises.

A development drift was extended East to the boundary from 5G raise.

345' SUB LEVEL.

At F crosscut, stoping started under the hanging last year, was continued to the North mining limit at 3F raise.

335' SUB LEVEL.

At G crosscut mining under the hanging started last year was continued. This is completed back to 8G raise.

325' SUB LEVEL.

The work here was all development at F crosscut. Drifts were driven under the hanging to the South and West preparatory to stoping.

THIRD LEVEL.

A new foot wall drift was started in September just East of #94 raise. It has been extended Easterly 160 feet and will be pushed on to the Negaunee boundary.

H and G crosscuts have been extended to the South 20 and 10 feet, respectively, and I crosscut has been started between #106 and #107 raises. It has advanced South 25 feet.

Raise #105 was put up to the 375' sub level. A timber and traveling road was also put up last month to the 355' sub level. This latter raise is about 25 feet East of #107 raise.

SUBS BETWEEN THIRD AND FOURTH LEVELS.

280' SUB LEVEL.

This sub level was developed from #504 and #506 raises under the hanging along the Negaunee boundary. Stoping is now in progress, the hanging being outlined by raises and found to vary from 10 to 15 feet above the back of this sub level. The ore here is of Bessemer grade.

270' SUB LEVEL.

A development drift is being driven to the South from 224 raise. It

has advanced to date 365 feet all in ore except a small dike and two bunches of jasper amounting to 70 feet. At 125 feet from the raise a drift has been started to the Southwest to find the hanging. At present it has advanced 50 feet in ore.

The development in this sub level is to provide a timber road to the subs between the third and fourth levels. It will also explore a large area and improve ventilation in this end of the mine.

260' SUB LEVEL.

This sub level has been opened in the South end of the mine along the Negaunee line. Raises #500 to #508 have been connected and a drift driven due South from #504 to the Negaunee line. Development here is still in progress.

240' SUB LEVEL.

This sub level was started in the South end of the mine next to the Negaunee boundary. Development and mining started along the West end under the hanging, when it was found that due to a roll the ore went to a higher elevation to the East. Exploratory raises from this sub level found the top of the ore 10 or 15 feet above the 280' sub. Mining here was at once stopped after blocking out the sub level. Recently a drift has been driven to the Northeast from #513 raise, thence by #422 raise. The breast in this drift is now about 100 feet Northeast of #422. By extending this 100 feet farther and raising 30 feet vertically, a traveling and timber road will be opened through this sub level to the 270' sub, and thence to the 3rd level by way of #224 raise. As I mentioned above this should also improve ventilation in this end of the mine. This latter development is outside the present mining limit and supporting pillars.

220' SUB LEVEL.

A small sub level 100 by 150 feet was opened under the hanging at #408 raise. This is wholly in the mining area and work here has been practically completed.

200' SUB LEVEL.

This sub level was opened last year by developing from the winze, and raises from the 4th level. After development drifts had been driven it

was decided that pillars would have to be left in this territory to support the surface. In carrying out this idea the whole territory above the 4th level had to be cut into pillars and mining areas. Many of the development drifts already driven were found to be in the supporting pillars, so they are little used for present mining. This years' development consisted in the extension to the East of three drifts from #408 crosscut to the Negaunee boundary, also a crosscut to the North to connect with #422 raise and the extension of #408 crosscut South to the Negaunee boundary. Mining was started under the hanging in one of the mining areas adjacent to the Southeast corner of the Race Course tract.

185' SUB LEVEL.

Development was continued South at #406 crosscut to the foot wall. The breast is now 365 feet South of the raise, all in ore except four small dikes which have been cut in the last 300 feet. The last dike being 15 feet in width. Mining was carried on West of #406 crosscut in the Mining area Southeast of the Race Course.

FOURTH LEVEL.

The main motor drift was extended to the South and thence East a total distance of 260 feet during the year. Three double compartment raises were put up namely, #500, #504, and #505. Raise #508 has been started.

At the shaft site the 4th level plat has been cut. Opposite the shaft on the West side, a slice was taken to provide room for the pocket.

SHAFT.

During December the sinking was completed to a point 78 feet below the 4th level and the concreting of the pocket is now in progress. The work at the shaft during the year, I have taken up in detail which will follow.

UNDERGROUND IN GENERAL

The detail of the work in the sub levels just given shows the developments that have taken place in the Mine from the 1st level down to the 4th. The surface cave on the 1st of March occurring near the Negaunee boundary made it all the more imperative to hurry the mining in and along the Railway pillar, in both the Maas and Negaunee Mines. Work here has been rushed, day and night

crews being employed. Early in the year we had considerable trouble with our foot wall raises between the 1st and 2nd levels in the East end of the mine on account of caving. Later it became practically impossible to use these and it was necessary to get new raises to this territory. As there was no space on the foot wall, it was necessary to raise from the 2nd level hanging wall drift. These new raises were cribbed. They were extended until they met the hanging wall which was at a point considerably higher than we had expected. This was due to a slight roll in the jasper. The top of the ore has been outlined, the pocket not being large.

Shortly before the sand cave in March, a settlement occurred on the 623 and 596' sub levels above the second level. In June another settlement occurred which crushed down the main 3rd level drift between #84 and #88 raises; while in December another settlement of ground occurred at the extreme Eastern end of the 3rd level. The first cave effected nothing but the sub levels, while the last two required considerable retimbering on the main level. The former cut off the product from this section of the mine for a period of two weeks or more.

The main development for the year were as follows: The extension of the 4th level main drift to the South and Southeast, new raises from this level and development above the 4th level along the South boundary where sub levels are now being opened nearly 200 feet above the level. On the 3rd level the extension of the main foot wall drift to the East and on the 2nd level in the new raises from the hanging wall side to the 1st level. The mine is gradually getting in better shape for an increased production and as soon as ore from above the 4th level can be handled directly to the shaft, the cost of production should decrease considerably as all of the ore from this territory now has to be rehandled.

Since March 1st the water coming into the Maas is practically double that which was pumped before that time. I have taken up the subject of water and new pump station under separate headings, also the development at the main hoisting shaft between the 3rd and 4th levels.

MAAS MINE SURFACE CAVE.

As I have already mentioned a cave occurred March 1st. This is the

first that has broken through to surface at the Maas. At noon of that day a hole about 200 feet in diameter occurred just to the North and West of the Northwest corner of the Roman Catholic Cemetery. This was directly over the point where the greatest bulk of water in the mine has been coming for the past few years. It was directly over the lowest point in the ledge as the ledge contours show. The air blast caused by this cave was considerable, but on account of its occurring at noon few men were in the mine, most of them being either at the shaft plat or in the dry. An examination showed that a little sand had come into the mine on the first sub level below the first level near the American Mining Company's strip. The area immediately to the West of this had given considerable trouble on account of settlements for the past year or more, so it was thought advisable to continue operations on the upper sub levels. Openings here were blasted in and preparations were made to get into these pillars by raising from the lower sub level where travelling roads were in better condition. The water flow from the cave remained normal until about five o'clock in the afternoon when it started to slack off. It remained this way for a little over 24 hours when an increased flow started and by March the 3rd, the quantity was about double the normal flow. Practically all of this water came in on the first and second levels. A pump was placed on the 2nd level and a quantity of water was pumped over to the Negaunee Mine as the flow was such that the plunger pump at the Maas had to run continuously and the centrifugal pump was forced to run 12 hours out of 24. About four o'clock on the morning of the 11th, the motor on the centrifugal pump burned out so that it had to be dismantled and taken to Ishpeming for repairs. The flow was more than the plunger pump could handle so it was necessary to place dams on the second and third levels to hold back as much water as possible, and also to deflect the water to the 4th level. Immediately after the centrifugal pump stopped the water flowed over the sump and ran down the shaft that was being stripped to the 4th level. This dirty water filled the crevices of the rock in the raise in the bottom of the shaft and blocked it off so that the shaft filled with water. This was not discovered until the water reached the third level. While the dams were being built on the second level the water had been permitted

to flow back to the shaft expecting that it was going to the 4th level. When the shaft filled to the third level the water on the second level was immediately diverted to the 4th level by an inside route, but not until the 3rd level plat had been covered and the water was withing a few inches of the pumphouse floor. The motor on the centrifugal pump was returned to the mine and started operating on the afternoon of the 12th, but not until the 4th level had filled almost to the back of the plat at the winze. It was necessary to install pumps in the winze to recover this level. As the fourth level makes about 200 gallons per minute, it took considerable time to gain on this water. Various delays occurred on account of current or trouble with the suctions at the main pump house, during which time it was necessary to divert the water to the 4th level again so that it took practically the whole month before the work could be resumed there. During the latter part of the month concrete abutments were placed in two second level drifts at points where the water can be made to flow back towards the Negaunee by daming. A pump was located on the second level just outside of the outer dam and a 6-inch pipe line run from this pump to the Negaunee Mine. This pump deflected to the Negaunee what extra water the Maas pumping plant could not handle. Later in the year an auxillary pumping plant was put in commission at the 2nd level plat. The inside pump was left in position so that it can be used in the future in case of an emergency.

No further settlements of any particular note have occurred in this end of the mine since the March cave. On account of the large open raises, great care is taken in lagging down the floors in case further sand runs occur. The weakest places would naturally be along the sides of the old raises.

RAISES.

The Maas Mine was opened originally with raises without cribbing, generally extending from the foot wall drift of one level to the level above. These were 200 feet vertically in height and considerably longer on the incline. The original cost of these was small as they required no cribbing, but we have found to our sorrow that in most cases they have opened out until they have reached the dimensions of small stopes. Large slabs of ore occasionally break

off from the sides, completely blocking the raise. Whenever these occur it is necessary to blast the chunks any way possible, often these obstructions were 50 feet or more from the mouth of the chute. During the early part of the year these raises between the 1st and 2nd levels had opened to such a size that it made one continuous stope. In places they were found to have opened out to 50 feet or more in width, making it necessary to fill them with ore in order to protect the mining in that territory, as there was no way of telling when a large slab might break from the hanging side and cave down the sub levels above. After the sand run it was deemed advisable to fill these raises completely and then abandon them. If sand entered the mine through these open holes it would have been practically impossible to have shut it off without losing a great deal of ore. The raises on this end of the mine on the foot side have all been abandoned and we are now using crib raises exclusively. These are somewhat more expensive for the first installation, but I feel confident that they will prove the most practicable in the end. Both hard and soft wood cribbing timber are used, the compartments being about 5 feet square. In filling these ore stopes during April and May, several gangs were employed. This ore otherwise would have gone into the general product. The result was a loss in tonnage without reduction in the expense.

SECOND LEVEL PUMPHOUSE.

In April it was decided to provide an auxillary pumping plant at the second level shaft station to handle the extra water which came into the mine after the surface cave, March 1st. A vertical Aldrich belt driven pump with a capacity of 600 gallons per minute against 1100-foot head was purchased from the Holmes Mine. The cutting out at the plat for this pump station was started in April and the excavation was completed for the station and sump in June. The foundation was installed the latter part of this month, and early in July the pump was placed in position. The motor which should have been delivered in May was not received until September, but the pump was unable to start as the new cable which had been ordered early in the year had not been received. This was installed in October. During the latter part of the month the pump

was tried out and found to work satisfactorily. It has been running practically continuously since November 1st. The pump is operated against a head of 900 feet.

NEW CABLE.

At the time of the increase in the water at the Maas a considerable quantity had to be thrown over to the Negaunee Mine in order that operations could start on the 4th level as early as possible. It was found that although the Negaunee Mine had a pumping capacity of 3,000 gallons per minute, the cable supplying the pumps was not built to carry a sufficient current to operate these pumps continuously. I recommended that extra cables be provided for each of the deep mines in the Negaunee district. This was approved and the new cable installed at the Maas Mine in October. This extra cable can be thrown into service at any time in case of emergency.

SUPPORTING PILLARS ABOVE THE FOURTH LEVEL.

The development above the 4th level was planned to mine as early as possible the Bessemer ore which lies directly under the hanging. On account of the thickness of this blanket, it was thought that the caving might possibly work through to surface which is from 1000to 1300 feet above. The area developed is immediately East of the Race Course tract on which are a great many residences. In case of a surface cave, these houses with their tenants would be endangered. It was decided to leave pillars to support the hanging above the 4th level. This area was therefore laid out into mining areas and pillars. The latter have their bases on the 4th level, and their sides are sloped at an angle of 50° to the horizontal, extending from the 4th level to the hanging. The width at the top of each pillar under the hanging is 80 feet, and their long axis extends in a Northeast-Southwest direction. A cross section of these pillars is a truncated pyramid with a top width of 80 feet - the width at the bottom depending on the height. The mining areas lie in the troughs between the pillars.

By this method of development, the ore in the pillars will remain intact until the 4th level is reached and on account of the sloping sides no ore should be lost as it cannot mix with the caved material in the mining areas. The percentage of ore in the pillars and mining areas is about 66 2/3% and

33 1/3%, respectively.

When these mining areas have been depleted, the pillars can be attacked, if in the mean time, the houses on surface have been removed.

SHAFT.

The work in the shaft has not progressed as rapidly as we had hoped. By the end of February the stripping had advanced to within 70 feet of the 4th level. In May and April nothing was done except cleaning up a quantity of mud near the 4th level plat. In May stripping was completed to the 4th level and in June the plat was cut. In July preparations were made to start sinking, a hoisting engine installed and chutes built. In August the shaft and storage pocket were cut to the depth of 30 feet. Work was continued in this pocket during September and also in the shaft. The depth of the latter being 50 feet at the end of the month. In October the storage and measuring pockets were cut out and two sets of timber installed. In November the sinking was resumed and carried to a point 27 feet below the measuring pocket. By the end of the year sinking had been completed to 78 feet below the 4th level. The storage pocket had been installed and concreting the storage pocket was in progress. The timbering in the shaft with the exception of the guides and runners is now completed from the pentice to the bottom. During January the auxillary loading pocket will be installed. The cleanout drift at the bottom of the shaft will be driven beyond the cage compartment and opposite the skip compartment, after which chutes under the skips will be installed. It is hoped that the new lift will be in commission by March 1st.

WATER.

I have mentioned above in this report that the water increased greatly at the time of the cave breaking through to surface on March 1st. The pumping by months during the year is as follows:

	Gals. per minute.
January	662
February	594
March	1206

April	1120
May	770
June	800
July	769
August	857
September	1494
October	1055
November	931
December	1022

It is seen that the gallons per minute varied greatly throughout the year. The excess water that could not be handled at the Maas was diverted to the Negaunee and the Maas was billed for this pumping. From now on the Maas should be able to handle its own water.

FATAL ACCIDENTS.

The first fatal accident which the Maas has had in a number of years occurred on Sunday, December the 8th, at 10:00 A. M. when George Hooper was killed by falling 110 feet to the bottom of the shaft below the 4th level. Hooper was one of the shaft crew that were placing dividings in the shaft above the 4th level. He was standing on a 10-inch dividing and was helping to place another dividing in the set directly above him. The distance between the sets was 6 feet. Hooper was standing near the North end of the dividing and was shoving up on the North end of the new dividing to get it into the joggle. At the same time one of the other shaft men pushed down on the South end of the dividing to get it into the joggle there. Hooper lost his balance and fell into the shaft. Below him was a roof that had been placed over the shaft to cut off the water, but the blasting a day or two previous to this time had made an opening in this roof just under the place where Hooper fell. He went through this opening to the bottom of the shaft and received injuries which resulted in his death about two hours later. He was a single man residing in Negaunee.

SURFACE

During December a year ago every effort was being made to get the new

temporary boiler house to the Southeast of the permanent boiler house in commission. This was equipped with three firebox boilers which had been shipped from the Imperial Mine. This boiler house was put in commission on January 7th and operated until March 19th. It was installed to supply the hoists and compressors with steam as the turbine required all that could be supplied by our Four Sterling boilers. The temporary boiler house has not been used since it was shut down last spring. At the permanent boiler house the masons have worked intermittantly throughout the year. During the first few months, the boilers were pushed to their capacity and the arches broke down, making continuous repairs. On January 21st the Link-Belt coal crushing plant went into commission. This eliminated considerable labor as previous to this time the coal for the Sterling boilers had been crushed by hand - a small grizzly being placed on top of the coal cars in the dock. This was extremely expensive. The coal being of inferior quality; a larger quantity was needed than ordinarily to make the necessary steam for operation.

COAL DOCK.

Small repairs on the dock were made in April, so that it was ready to receive coal as soon as navigation opened, as practically all of the coal had been used during the winter. Most of the coal received for the coming season was of three-quarter size, however, one cargo contained slack coal. This had to be dumped with the three-quarter coal. We were afraid at the time that it might cause trouble. In October it was discovered that the pile was on fire near where the slack coal had been dumped on the West end of the dock. On November 11th, this end of the dock burst out in flames, so that the City Fire Department had to be called to extinguish it. This did but little damage to the structure, but we were unable to wholly quench the fire in the coal. By the end of the year, most of the fire had been extinguished but not before a quantity of the coal had been transformed into coke.

The coal for the past two years has apparently been much below the standard which we had before the war. That received this year, I understand, contains a high percentage of sulphur.

PERMANENT TRESTLE.

Repairs were started on the permanent trestle in July and concluded in September. These were on the South and West trestles leading to the rock and ore piles. Here we had considerable trouble last year with top tram cars jumping off of the track, it being impossible to hold the tracks in place on account of the condition of the floor of the trestle. During the present season we have had no trouble from this cause.

CAGE HOIST.

In August the cage hoist was shut down for three days on account of an accident which happened to the throttle. This hoist has given continual trouble ever since it was installed and I would recommend that it either be equipped with a motor when the McClure Power Plant starts operating or else that it be discarded and a new electrically operated hoist be installed. When this hoist is out of commission it is necessary for the men to go to and from their work through the Negaunee shaft.

GARDEN LOTS.

This year garden lots were offered to the employees of the Company desiring small plots for planting. Most of these were looked after in good shape by the men who seemed to appreciate having an opportunity to have a garden. I hope that the Company will continue to supply the men with garden lots.

MAAS CRUSHER.

Early in April repairs on the crusher were started and by the 20th it was in shape to operate. Crushing started on the 29th and continued to May 10th when it was shut down and the crew taken to the Jackson Mine to crush Scotch ore until the end of the month. Crushing continued from this time throughout the season until November 13th. Most of the Scotch ore of the Company for the season was handled through the Oliver Iron Mining Company's crusher at Ishpeming, but a larger quantity had to go forward than this company was willing to crush. It was therefore necessary to crush this extra quantity at the Jackson Crusher, or else rig up at the Maas Crusher, so that it could be handled there. It was decided to crush this at the Maas Crusher if possible as it would be much cheaper than handling it at the Jackson. Rails were placed on top of

the grizzly and big baffle boards made of hardwood planks faced with rails were hung just above the grizzly to retard chunks as they slipped to the saucer of the crusher. This arrangement was made in August and worked very nicely. No trouble was had from this class of ore from this time to the end of the season.

There were no serious delays at the crusher this year. It handled the different grades without any trouble and a much larger daily tonnage could have been handled if it had been required. This would have reduced the cost per ton considerably as there were times when the crew had little to do.

The tonnage at the Crusher for the past season was as follows:

Salisbury	4,932 tons
Lake	37,271 "
Jackson	15,879 "
Morris-Lloyd	35,304 "
Holmes	4,068 "
Moro	10,166 "
TOTAL -	107,620 tons.

PRODUCTION

Month	Bessemer	Maas	Total	Rock
January	6,376	23,332	29,708	873
February	4,816	22,544	27,360	969
March	1,948	17,120	19,068	129
April	4,984	16,094	21,078	543
May	5,805	20,379	26,184	1,117
June	5,995	16,832	22,827	1,032
July	7,616	20,979	28,595	1,020
August	8,829	19,288	28,117	956
September	8,693	16,429	25,122	1,092
October	7,633	19,268	26,901	1,144
November	5,855	14,940	20,795	612
December	7,072	16,544	23,616	712
Total	75,622	223,749	299,371	10,189
Stock pile overrun	808	7,257	8,065	
	76,430	231,006	307,436	
Transferred from	11,228 to	11,228		
" to	44 from	44		
Total	65,246	242,190	307,436	10,189

ANALYSIS OF PRODUCTION

Production of 1917	320,356 tons,
" 1918	307,436 "
Decrease 1918	12,920 tons.

For the year this mine worked two eight hour shifts for 295 days, having been idle 18 days. The average number of men employed for the year was 272 who worked 93,805 days, which shows a product per man per day of 3.19, and of this the underground worked 75,090 days and produced 3.99 tons per man as against 4.67 in 1917. The night shift miners were employed principally along the Negaunee Boundary and between the 3rd and 4th levels in the Bessemer area under the hanging.

"War Conditions" were principally responsible for the decreased product and increased cost, and these include the three wage increases during the year, the continued increased supply costs and the labor situation during the greater portion of the year as is shown by the fact that some 564 men left their positions at this mine between August 1st and December 31st, and these had to be replaced by new men who were mostly strangers, but who had to be retained until better men could be hired to replace them. Because of this condition an effective organization underground was impossible.

Another contributing factor was the cave in of sand and water that occurred March 1st, reducing the product on the first, second and fourth levels by one half for that month, and having some effect on the production for the next three months.

Month	First Level	Second Level	Third Level	Fourth Level
January	2,580	9,908	10,696	6,524
February	2,532	7,792	10,352	6,684
March	1,004	4,944	10,072	3,048
April	138	6,504	8,710	5,726

The change in mining made necessary by this run of sand practically stopped production on the first level, no ore at all having come from that level since September, and the mine as a whole did not recover from this run

until mid-summer. The total direct charges to "Cave In" for the year were $7,-200.00 or about .024 per ton on the product.

In July the product was nearly to the January figures, being 28,595 tons and in August 28,117 tons. In September the product dropped to 25,122 tons, more than one half of the men engaged in stoping having quit during the last few days in August and in September, the tons per man dropping from 8.50 in July to 7.54 in September. It is possible some of the men were trying to dodge the Liberty Loan drive.

In the following analysis, 1918 showed a consistent increase over 1917 due wholly to increase in labor and supplies; only where some extraordinary expense was incurred is there a detailed explanation.

GENERAL EXPENSE.

No. 26 Insurance,

1917 Amount	$123.66	Cost per ton .000
1918	755.12	.002
Increase	631.46	.002

Due to General Office charge.

No. 27 Engineering,

1917 Amount	2686.28	Cost per ton .008
1918	2662.04	.009
Increase	24.24	.001

No. 30 Personal Injury,

1917 Amount	2609.80	Cost per ton .008
1918	5135.49	.016
Increase	2525.69	.008

Fatal accident to George Hooper in December. Continuing payments to Peter Bessola, eye injury.

No. 31 Mine Office,

1917 Amount	12644.54	Cost per ton .040
1918	14927.25	.047
Increase	2282.71	.007

Increase due to higher labor costs and contributions to Marquette Co. War Relief Ass'n.

MAINTENANCE.

No. 125 Tracks and Yards,

1917 Amount	$2,277.81	Cost per ton	.007
1918	3,855.36		.012
Increase	1,677.55		.005

L.S.&I. charges for maintenance of tracks as per government ruling. Extra work on lawn.

No. 126 Docks Trestles & Pockets,

1917 Amount	1,126.46	Cost per ton	.003
1918	1,738.29		.005
Increase	611.83		.002

Extensive repairs required on permanent trestle, $1,594.15 being expended. There were also two bents added to the rock trestle.

No. 127 Buildings,

1917 Amount	1,162.10	Cost per ton	.004
1918	1,995.82		.006
Increase	833.72		.002

Repairs to coal dock cost $1,118.00, the L.S.&I. refusing to put loaded cars on dock until some renewals were made. The dryhouse was painted and whitewashed inside and some repairs made to the showers, in all amounting to $461.00. Minor repairs to the office, stable and power house amount to $300.00.

No. 128 Shop Machinery,

1917 Amount	1,516.47	Cost per ton	.005
1918	263.14		.001
Decrease	1,253.33		.004

The only additions to this account were; an added device to the drill sharpener, $60.00.

A Rotary Air Drill $90.00, and a Portable Forge $26.00.

No. 129 Boiler Plant,

1917 Amount	$5,117.21	Cost per ton	.016
1918	3,774.74		.012
Decrease	1,342.47		.004

All four furnaces were rebuilt in 1917 and but three in 1918. It now looks as through three and possibly four will have to be rebuilt in 1919, owing to forcing the fires to run the turbine.

No. 130 Hoisting Machinery,

1917 Amount	4,546.35	Cost per ton	.014
1918	4,465.20		.014
Decrease	81.15		

No new devices were added this year and there were no extraordinary repairs to the skip hoist. The cage hoist required the following repairs:

Two Cross Heads,	$300.00
New Brake Flange & Spider,	550.00
Main Bearing,	96.50
Piston and Bull Rings,	950.00 and

numerous minor repairs.

A new 8' sheave was installed in the head frame at a cost of $207.50.

No. 131 Compressor & Power Drills,

1917 Amount	2,080.87	Cost per ton	.006
1918	1,202.19		.004
Decrease	878.68		.002

There were but three drills and cradles added to the equipment in 1918 as against seven drills in 1917. The repairs to the compressor were nominal, two sets high pressure piston rings and some repairs to valve stems.

No. 132 Pumping Machinery,

1917 Amount	$2,120.39	Cost per ton	.007
1918	3,352.14		.011
Increase	1,231.75		.004

Repairs to two steam pumps that had been in use on the fourth level since the cave-in were sent to the general shops for an overhauling, cost $351.15. Repairs to the stator of the thrid level plant, babbiting bearings and change in the piping cost $291.00. Repairs to the fourth level electric pump on account of having been submerged at the time the water flooded the 4th level, cost $133.00. The new high pressure valves were added to the third level plant at a cost of $ $227.00, and a new thrust bearing and chain block added to the pump house equipment, cost $99.00. It was necessary to provide a new electric cable for the new pump installation on the second level, and enough was purchased to reach the third level as a safety measure, giving us duplicate cables. This amounted to $591.64.

Repairs to the centrifugal pump including a complete overhauling and renewal of parts in December amounted to about $1,000.00.

No. 133 Top Tram Engine & Cars,

1917 Amount	$8,032.76	Cost per ton.	.025
1918	1,433.58		.005
Decrease	6,599.18		.020

Renewal of rollers, sheaves brackets, some new rope and repairs to two cars that went over the dump, in addition to the ordinary expenditures, made up the 1918 costs.

No. 134 Skips and Skip Roads,

1917 Amount	1,086.74	Cost per ton	.003
1918	2,612.09		.008
Increase	1,525.35		.005

In January the skip rope broke after the brakeman had over wound, letting the skip drop to the bottom of the shaft. This skip had to be cut to pieces, plates straightened and put together again. New wearing plates were put in all of the skips and three new bales were built. The skip road was gone over thoroughly during the year and needed necessary repairs made. There were 88,000 tons of ore hoisted through the auxilliary shaft, 4th to 3rd levels, and as these skips are small and shaft underlay, the expenditures for ropes, rollers and wheels were

heavy, four new ropes, 2000 feet long having been used.

No. 135 Underground Tracks & Cars,

1917 Amount	$2,417.51	Cost per ton	.008
1918	2,818.74		.009
Increase	401.23		.001

There were nine new buggies built during the year at a considerably increased cost for labor and supplies. There was used in the sub levels 18 tons of 12# rail, the most of which cost us $71.46 per ton, as compared with $59.25 in 1917.

No. 136 Electric Tram Plant,

1917 Amount	11,759.00	Cost per ton	.037
1918	16,459.61		.052
Increase	4,699.99		.015

A large part of the increase in this department was due to the extensive repairs, almost amounting to the rebuilding, of cars in use since 1914. A blacksmith and helper were employed on this work all of the year, and heavier channels were put on eighteen of the cars and all of them re-riveted. This work together with $450.00 for new and repaired wheels and axles, cost $3869.95 as compared with $2496.91 in 1917. Locomotives also called for $1254.00 more than in the previous year due mostly to high labor and supply cost. What may be called extraordinary expenditures, as comparted with 1917, were as follows:

Three sets of Rheostats	$144.00
Two sets locomotive wheels	78.80
New controler	128.00
Armature repairs	178.80
Rewinding armatures	372.87

Tracks also increased $1890.87, due entirely to increased labor costs, supplies having decreased $800.00.

Wiring also increased $158.89 for labor, supplies having dropped $210.00.

MINING EXPENSE.

No. 150, Air Pipes,

1917 Amount	6,228.50	Cost per ton	.019
1918	6,984.97		.022
Increase	756.47		.003

Continued extensions on the fourth level with

increased costs explains this increase.

No. 151 Compressor,

1917 Amount	$20,638.68	Cost per ton	.065
1918	29,697.45		.094
Increase	9,058.77		.029

$6,350.00 of the increase in this account is in the boiler house charge being for coal labor. Direct charge increase is principally labor.

Air made 1917	991999672	Cu. Ft.
" " 1918	935128335	"
Decrease	56871337	Cu. Ft.

No. 152 Hoisting,

1917 Amount	30,631.33	Cost per ton	.096
1918	42,954.44		.136
Increase	12,323.11		.040

Of this increase $6345.00 is in the boiler house charge. As there were no extra-ordinary direct charges such as additional engineers or brakemen, the increase is due to increased labor and supply costs.

No. 153 Pumping,

1917 Amount	18,933.77	Cost per ton	.059
1918	34,541.45		.109
Increase	15,607.68		.050

While this account in common with all others was affected by the increased cost of labor and supplies, a great part of the extra-ordinary increase was due to the largely increased amount of water pumped after the sand run in March.

Gallons pumped:

January	29,552,230
February	23,963,430
March	52,102,580
April	48,415,710

Gallons pumped for the year 1918 510,265,180

" " " " " 1917 293,420,640

An increase of 216,844,640

gallons or about 70%. In addition, the Negaunee pumped some water for the Maas. The charge for electric current increased $9215.00 over the previous year, due to increased pumping and to an increase in price from 1¢ to 1½¢ per K.W. since July 1st.

No. 154 Sinking & Shaft Repairs,

1917 Amount	$ 4,479.02	Cost per ton .014
1918	34,986.12	.110
Increase	30,507.10	.096

The new lift from the third to the fourth level was sunk and raised 205 feet for the year, 25 feet having been completed in December 1917. The 4th level storage pocket cut and partially concreted, shaft timbered. The bottom of the shaft is now 78 feet below the 4th level. Shaft repairs for the year were light, costing but $406.00.

No. 155 Rock Drifting,

1917 Amount	25,606.49	Cost per ton .080
1918	12,977.54	.041
Decrease	12,628.95	.039

1917 3744 feet drifted
1918 2234 " "
Decrease 1510 feet.

Aside from some cutouts on the first and second levels, there were no rock main drifts driven this year. Most rock work was in the sub levels.

No. 156 Breaking Ore,

1917 Amount	$187,687.88	Cost per ton	.586
1918	232,656.82		.733
Increase	44,968.94		.147

Increase cost of labor and supplies due to war conditions was the greatest factor in increasing the costs in this account, though the cave in March contributed to it through a decreased product.

No. 157 Tramming,

1917 Amount	40,292.87	Cost per ton	.126
1918	48,055.81		.151
Increase	7,762.94		.025

Almost entirely due to the increased labor cost, supplies having increased but $628.00 over the previous year.

No. 158 Filling,

1917 Amount	2,196.16	Cost per ton	.007
1918	3,376.84		.011
Increase	1,180.68		.004

Considerably more rock was handled this year than last.

No. 159, Timbering,

1917 Amount	56,805.00	Cost per ton	.177
1918	70,765.30		.223
Increase	13,959.48		.046

Contributing causes to this increased cost were the cave-in in March which made necessary considerable retimbering on the first level, and four men have been employed all of the year in keeping open the main sub drifts so that they could be trammed through, the weight of ground making this necessary. December 12th a large piece of the hanging on the 375 foot sub level broke off driving the men out of their places, and these six or seven places as well as the traveling road were retimbered during the month. The third level main drift was retimbered for some 250 feet, and the rest of it was repaired and renewed in part.

No. 160 Mining Captain and Boses,

1917 Amount	$ 9,113.42	Cost per ton	.028
1918	12,526.95		.039
Increase	3,413.53		.011

Increased labor charges in 1918.

No. 161 Dry House,

1917 Amount	3,925.07	Cost per ton	.012
1918	6,250.47		.020
Increase	2,325.40		.008

Of this increase $1300.00 was in boiler house charge alone. Water charges were higher as was the charge for lighting, and minor supplies, hose, toilet paper, brooms, brushes, elevtric globes, etc., cost considerably more than in 1917.

No. 162 Top Land and Tramming,

1917 Amount	5,561.21	Cost per ton	.017
1918	7,873.62		.025
Increase	2,322.41		.008

Increase in boiler house charge $1697.36 for operating the rock car.

No. 163 Stocking Ore,

1917 Amount	4,954.31	Cost per ton	.016
1918	5,956.26		.019
Increase	1,001.95		.003

An unusual number of legs were found broken as ore was removed, 51 new ones having been used during the year.

No. 166 Cave-in,

1918 Amount 7,200.04

Includes charges occasioned by the sand run in March.

DELAYS - ELECTRICAL.

February	22nd	Washington's Birthday. No work on account of shortage of electric current.
March	26th	5 hrs. no steam - current off pumps letting in water.
April	8th	1 hr. no current.
August	12th	1½ hrs.
November	19th	Low current.

DELAYS - NON ELECTRICAL.

January	15th	Skip pulled up in dump, A.M. Skip ran away and in trying to stop it the rope broke, skip went to the bottom of the shaft, P.M.
	26th	6 hrs. 4 steel sets in shaft pulled out.
February	19th	Contracts 10, 3, 19, 20 and 21 pulled out of places. 623' sub level moving.
	21st	623' sub level still "working".
	27th	6 hrs. delay, skip hoist broken.
March	1st	Cave-in in American Mining Company's pillar, near cemetery.
	8th	Centrifugal pump broke down at 10 P.M. and was not in working order until 4 A.M., no hoisting from the 4th level.
	11th	Water in. - Centrifugal pump broke at 4 A.M.
	12th	Water in. - Centrifugal pump started 4 P.M. 4th level drowned.
	14th	No work on 4th level on account of water.
	21st	No hoisting from 3rd or 4th levels. No hoisting from 4th level since 9th of month.
June	18th	3rd level drift caved in.
	19th	No hoisting 3rd level.
August	13th	No.railroad cars after 3 P.M. Shoe came off skip at 2 o'clock wrecking shaft. Took until midnight to repair.
	21st.	Men had to go up through Negaunee shaft. Cage hoist was out of commission. About 60 men home.
	22nd	Do.
	23rd	Do.
	29th	4 hrs. 4th level hoist out of commission.
September	16th & 17th	Low steam until load on turbine was shut down.

November 25th Unable to hoist several times account of steam being low.

29th Hoisting on one side account of top tram rope broken from 8:00 A. M. to 2:30 P. M.

7th & 11th Armistice signed.

December 12th Cave on 375' sub level blocking traveling road. Hoisting only on one side until noon.

13th Top tram idle from 8:00 A.M. to 10:00 A.M. Hoisting with one skip from 10:00 A.M. to 4:00 P.M. Delay account of 3rd level cave.

ESTIMATE OF ORE RESERVES IN MAAS MINE DECEMBER 31, 1918.

Assumption 12 cu. ft. equals one ton.

10% deduction for rock.

10% " " loss in mining.

Percentage of Bessemer equals 10%.

Developed ore above 1st level - - - - - - - - - - - -	3,467 tons net.
Developed ore between 1st and 2nd levels - - - - - -	619,042 " "
Developed ore between 2nd and 3rd levels. - - - - -	1,646,220 " "
Available developed ore between 3rd and 4th levels -	2,375,559 " "
TOTAL -	4,644,288 tons net.
Unavailable ore in pillars - - - - - - - - - - -	1,025,800 tons net.

Available ore to be graded as:

BESSEMER ORE.	TRADE NAME.	TONS.
Developed	Maas Bessemer	464,428
NON BESSEMER ORE.	TRADE NAME.	TONS.
Developed	Maas	4,179,860

Total Bessemer and Non-Bessemer - - - - 4,644,288 tons.

ESTIMATED ANALYSES.

	IRON	PHOS.	SILICA.	ALUM.	MANG.	LIME.	MAG.	SUL.	IGNI.	MOIST.
Maas dried 212°	59.00	.090	8.50	2.46	.309	1.00	.252	.007	2.80	11.50
Natural	52.21	.080	7.52	2.18	.283	.88	.223	.006	2.48	
Dried 212° Maas Bessemer	60.60	.050	9.00	2.18	.265	.630	.216	.007	1.50	11.75
Natural	53.48	.044	7.94	1.92	.234	.556	.191	.006	1.32	

MAAS MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1918.

GRADE	IRON	PHOS.	SILICA
Maas Bessemer,	60.24	.049	9.64
Maas,	59.04	.089	8.96

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1918.

	Mine		Lake Erie	
GRADE	IRON	PHOS.	IRON	MOIST.
Maas Bessemer,	All mixed			
Maas,	59.44	.093	59.72	11.13

ORE STATEMENT - DECEMBER 31ST, 1918.

	MAAS BESSEMER	MAAS	TOTAL	TOTAL LAST YEAR
Onnhand Jan. 1st, 1918,	12,282	94,834	107,116	105,463
Output for Year,	64,438	234,933	299,371	320,356
Stockpile Overrun,	2,638	15,000	17,638	
Total,	79,358	344,767	424,125	425,819
Shipments,	69,458	291,440	360,898	318,703
Balance on Hand,	9,900	53,327	63,227	107,116
Decrease in Output - 1%			3,347	
Decrease in ore on hand,			43,889	
1918 - 1-8 Hr. Shift 1917 - 1-8 Hr. Shift				

SHIPMENTS FOR YEAR - 1918.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Maas Bessemer,	42,564	26,894	69,458	46,144
Maas,	133,807	157,633	291,440	272,559
Total,	176,371	184,527	360,898	318,703
Total last Year,	167,080	151,623	318,703	
Increase - 13%			42,195	

MAAS MINE.

MAAS MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 8.	1 9 1 7.	INCREASE.	DECREASE.
PRODUCT	317,009	320,356		3,347
General Expense	.108	.087	.021	
Maintenance	.142	.139	.003	
Mining Expense	1.756	1.305	.451	
Cost of Production	2.006	1.531	.475	
Exploratory		.004		.004
DEPRECIATION.				
Original Purchase	.007	.078		.001
Plant Account	.251	.250	.001	
Equipment		.006		.006
Construction		.004		.004
Total Depreciation	.328	.338		.010
Taxes	.208	.176	.032	
Central Office	.079	.060	.019	
Supply Inventory	.016		.016	
Miscellaneous	.009		.009	
Fire Loss	.003	.001	.004	
Sundry Expense	.034	.017	.017	
Cost on Stockpile	2.683	2.125	.558	
Loading & Shipping	.056	.019	.037	
Total Cost on Cars	2.739	2.144	.595	
No. Days Operating	296	303		7
No. Shifts and Hours	1-8hr	1-8hr		
Avg. Daily Product	1071	1057	14	
COST OF PRODUCTION.				
Labor	1.373	1.016	.357	
Supplies	.633	.515	.118	
Total	2.006	1.531	.475	

MAAS MINE.

COMPARATIVE WAGES AND PRODUCT.

	1 9 1 8.	1 9 1 7.	INCREASE.	DECREASE.
PRODUCT	317,009	320,356		3,347
No.Shifts and Hours	1-8hr	1-8hr		
AVERAGE NUMBER MEN WORKING				
Surface	59	50	9	
Underground	241	224	17	
Total	300	274	26	
AVERAGE WAGES PER DAY				
Surface	4.15	3.28	.87-26.5%	
Underground	4.89	3.91	.98-25.1%	
Total	4.66	3.79	.87-23 %	
WAGES PER MONTH OF 25 DAYS				
Surface	103.75	82.00	21.75	
Underground	122.25	97.75	24.50	
Total	116.50	94.75	21.75	
PRODUCT PER MAN PER DAY				
Surface	16.94	19.73		2.79
Underground	4.31	4.67		.36
Total	3.44	3.78		.34
LABOR COST PER TON				
Surface	.245	.166	.079	
Underground	1.134	.837	.297	
Total	1.379	1.002	.376-37%	
AVG. PRODUCT BRK'G & TRM'G	6.61	8.20		1.59
" WAGES CONTRACT MINERS	4.92	4.32	.60-14 %	
" " " TRAMMERS	0	0		
" " " LABOR	4.92	4.32	.60	
TOTAL NUMBER OF DAYS				
Surface	18,715	16,239¾	2,475¼	
Underground	73,480	68,557½	4,922½	
Total	92,195	84,797¼	7,397¾	
AMOUNT FOR LABOR				
Surface	77,645.62	53,235.51	24,410.11	
Underground	359,567.53	268,010.08	91,557.45	
Total	437,213.15	321,245.59	115,967.56	

Proportion Surface to Underground Men:
1918 - 1 to 4.08
1917 - 1 to 4.50
1916 - 1 to 4.34
1915 - 1 to 2.5
1914 - 1 to 5.48
1913 - 1 to 6.18
1912 - 1 to 2.88

MAAS MINE.

TIMBER STATEMENT FOR YEAR ENDING DECEMBER 31, 1918.

KIND.	LINEAL FEET.	AVERAGE PRICE PER FOOT,	AMOUNT 1 9 1 8.	AMOUNT 1 9 1 7.
6 " to 8" Timber	61,775	.0274	1694.30	1355.08
8" to 10 "	84,134	.0526	4427.60	3261.24
10" to 12" "	47,758	.0643	3072.55	2027.40
12" to 14" "	8,752	.0914	800.24	1166.48
Total 1918	202,963	.0494	10040.93	
Total 1917	182,916	.0413		7810.20
7' Lagging	1123,292	.638	7167.25	6842.51
Total Lagging	1123,292	.638	7167.25	6842.51
Poles	22,970	.954	218.78	110.00
Total 1918	1146,262	.644	7386.03	
Total 1917	1255,248	.554		6952.51
Product for Year			299,371	320,356
Feet Timber per ton of ore			.678	.571
Feet Lagging " (1)			3.75	3.88
Feet Lagging per foot of Timber			5.53	6.57
Cost per ton for Timber			.0335	.0244
" Lagging			.0239	.0212
" Poles			.00073	.0003
" Timber,Lagging & Poles			.0581	.0460
Equivalent of stull timber to Bd.Measure			383,554	356,896
Feet Bd.Measure per ton of ore			1.28	1.11
Total Cost for Timber,Lagging & Poles	1918			17426.96
"	1917			14762.71
"	1916			12790.85
"	1915			3980.85
"	1914			7411.85
"	1913			11005.86
"	1912			3726.32

MAAS MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICES.	AMOUNT 1 9 1 8.	AMOUNT 1 9 1 7.
40% Powder	134,100	.1826	24492.03	22406.16
50% "	50	.2014	10.07	40.30
60% "	550	.2660	146.33	3352.62
Total	134,700	.1829	24648.43	25799.08
Fuse	354,500	.0082	2928.58	2539.59
Caps	82,600	.0136	1124.64	1192.90
Cap Crimpers	28	.5577	15.62	15.69
Electric Exploders	50	.5050	2.75	-
Tamping Bags	10,000	2.52-M	25.20	64.87
Connecting Wire	14	.5578	7.81	7.86
Total Fuse,Etc.			4104.60	3813.91
Total All Explosives			28753.03	29612.99
Product			299,371	320,356
Pounds Powder per ton ore			.449	.478
Cost per ton for Powder			.0823	.0805
" " Fuse,Etc.			.0137	.0119
" " All Explosives			.0960	.0924
Avg.Price per Lb.for Powder			.1829	.1683

ATHENS MINE - 1918.

The production for the year was 37,568 tons, distributed as follows:

Bunker Hill,	2,457 tons,
Athens,	35,111 "

The Athens product is distributed between the different interests as follows:

Corbit Lease,	1,899 tons,
Mitchell Lease,	5,507 "
Athens,	27,705 "

This represents the product mined during the development of the main levels.

UNDERGROUND.

The mine worked throughout the year on two 8 hour shifts. The cross cuts on the 8th and 10th levels started in 1917 were pushed to the Southwest as rapidly as possible toward the Bunker Hill line. Ore was struck on the 8th level April 1st and on the 10th and 4th levels June 15th and on the 9th level in July. It was of excellent quality but where encountered on the 8th and 10th levels, lying along the dike which was running nearly parallel to the drift, it slabbed off in large chunks making the progress in drifting extremely slow. In fact, the ore so far developed at this mine seems to be less granular and of softer texture, than that at the Negaunee and Maas. Most of the drifts have required forepoling and have shown so much weight that lining sets have had to be used. On the 8th level there was considerable swelling of the bottom of the drift so that this had to be taken up twice in order to keep the track down to grade. In new deposits it is natural to expect more or less water during the initial development, but a great many places in the Athens water under pressure has been encountered in the ore body. This has retarded the development somewhat.

The sections made from the drill holes indicated that the bottom of the deposit on the Athens to be about 2400 feet. The levels were planned with

this in mind and no ore was expected on the bottom level, the 10th, which was placed at 2400 feet below the collar of the shaft. However, ore was cut here at a distance of 420' East of the Bunker Hill line. A diamond drill, at this line showing 60 feet of ore below the level, while the development on the 8th level indicates that the hanging cuts off the ore at the Bunker Hill line at the 2200' elevation. The foot wall is composed of decomposed ferruginous slate more or less folded, while numerous small dikes cross the formation. The deposit on the North side of the lower levels is cut off by a diorite dike which is running nearly East and West and is standing almost vertical.

The 4th level was opened to test the formation to the East and on the Corbit Lease where it was afraid high sulphur ore would be encountered. The development of this Lease is now under way by high raises. No high sulphur ore has yet been found.

It was expected that the mine would go on an operating basis early in the Spring, but as soon as the ore was struck it was seen that the deposit was not shaped as the drilling sections showed. This necessitated considerable development before mining could start, which work was continued throughout the year and the mine will go on an operating basis January 1st, 1919.

FOURTH LEVEL.

The development here started from the shaft in March. The main cross cut being driven in a Southeasterly direction. Slate and quartzite, and diorite and slate were successfully passed through and the ore cut at 563 feet on June 15th. The formation dipped from 45 to 55° to the Northwest; it was crossed for 375 feet where lean ore was encountered. After driving a few feet in this material work here was abandoned. Later a diamond drill was placed in this drift and a horizontal hole drilled South for 260 feet. Iron formation was crossed most of this distance, but no merchantable ore was found. The hole bottomed in slate. Near the center of the ore on this main cross cut a drift was driven to the East to the Corbit Lease. This was extended to within 100 feet to the Lucky Star line in ore and then turned North and proceeded in that direction until the foot wall was reached. It was expected in driving to the East

foot wall would be cut and that the development raises planned in the Corbit would have to push up through this rock to the ore above. However, the ore on the Corbit Lease at the 4th level elevation is of excellent quality and we have no means of telling how far it extends below this level; probably not a great distance. The drifting in the ore formation here has been slow and practically all of the ground has had to be forepoled and even with this precaution small runs have occurred which have been impossible to avoid. The breast contained a considerable quantity of water and at a point about 125 feet East of the Corbit lot, the flow was so great that it was considerably more than the pumps could handle, however this has gradually drained off.

In November, a drift was started South through the center of lot 12 to determine the position of the foot; a small dike was encountered which ran practically with the drift so that development here was stopped to be taken up later.

CORBIT LEASE.

The development of the Corbit Lease, lot 13, is to be conducted through raises #410 and #412: these raises are being extended from the 4th level to the West and Southeast respectively at an angle of 65°. On December 31st, #410 had reached an elevation of 78 feet and #412 82 feet. The formation here has been dipping to the Northwest and North.

Sulphur content to date in raises #410 and #412 is:-

Raise #410	15' to 78'	.030
Raise #412	12' to 82'	.031

EIGHTH LEVEL.

On December 31st, 1917, the main cross cut from the shaft had been extended to the Southwest a distance of 426 feet. The material in the breast was diorite. The drift was continued in this direction and the ore was encountered April 1st at a distance of 1096 feet from the shaft. This ore was on the South side of a soft dike about 20 feet in thickness which was running in a East and West direction crossing the drift at such a slight angle that it gave us considerable trouble even before the ore was cut. The drift was extremely hard to hold requiring close timbering. The bottom as I have mentioned

above had to be taken up twice before we could keep it down to grade. This made drifting extremely slow. The drift was continued on the same Southwest course and after passing through 590 feet of ore went into the slate foot wall and was extended 270 feet in this material. The slate being very much altered and having much the appearance of a dike. Slides even failing to determine definitely whether it was slate or dike material.

Five cross cuts were driven to the Northwest and two to the Southeast from this main level.

The first crosscut cut to the Northwest was 250 feet from where the ore was first encountered on the level. It was extended Northwesterly about 60 feet when the North dike was met. Here drifting was stopped. From the breast of this drift two holes were drilled by a diamond drill. These were #1 to the Northwest and #2 to the Northeast.

No. 1 passed through dike and diorite for a distance of 230' and then went into iron formation of soft ore jasper which from the character of the core looked like the hanging wall jasper. At 243' a water course was encountered. This water was under pressure so that drilling had to stop. A guage placed on the end of the casing pipe registered a pressure of 625 lbs. which showed that the origin of the water was within 750 feet of surface.

Hole #2 passed through dike, diorite, and dike for a distance of 234', when lean ore was encountered. This was crossed for a distance of 82 feet and the hole was stopped at 316 feet still in lean ore. Pressure was encountered here in the shape of mud so that the hole could not be continued. The drill rods were bent almost double due to the pressure from the end. It is possible that the ore would have been found if this hole could have been finished.

The second cross cut to the North was 180 feet beyond the first. This extended through the ore for 220' until it was cut off by the North dike.

The third cross cut 110 feet beyond the second also was extended to the Northwest until the North dike was encountered. Here, however, two bunches of jasper were crossed, the first 40 feet in width and the second about 15 feet. At 100 feet back of the breast in this cross cut a water course was met making

drifting extremely difficult.

The fourth cross cut was started in the slate and ran into the ore formation about 80 feet from the main drift. By the first of the year it had been extended 130 feet in ore.

The fifth cross cut was started in the slate foot wall and after being driven 120 feet from the main crosscut was stopped in clate. From subsequent developments it looks as though the hanging cut off the ore at this elevation very close to the Bunker Hill line.

The first cross cut to the Southeast was at a point about 200 feet from where the ore was first encountered on the 8th level. To date the breast is about 40 feet to the Southeast of the main drift in ore.

The second crosscut to the Southeast is about 440 feet from where ore was first encountered on the level. It is nearly opposite the second cross cut to the Northwest. Here ore was crossed for 100 feet and then slate foot wall very much decomposed which extended 110 feet, when 25 feet of ore was again crossed, beyond which the drift was extended 50 feet in slate foot wall.

Numerous dikes were encountered in the development of this level particularly near the South foot wall. Testing the formation above this level by means of raises was delayed until late in the year on account of pumping facilities, as early in the summer the 100-gallon pump was running to capacity. As soon as the 500-gallon pump was installed the development above the level was pushed. Three raises were placed in the second drift to the Northwest. These were numbered, #821, #822, and #823, respectively. They are all being driven to the Southwest at an angle of 65° from the horizontal and placed at 60 foot centers. On the first of the year these raises were 124 feet, 120 feet and 106 feet, respectively, above the rail of the drift, but still in ore. In the 4th cross cut, #861 raise has been started in the slate foot wall near the ore. On January 1st, this was 62 feet above the level still in slate, the dip being nearly parallel to the direction of the raise.

NINTH LEVEL.

Drifting was started at this elevation at the top of #2 raise opposite

the shaft in February. The two raises were holed and the main cross cut to the ore body was extended in a Southeasterly direction for about 100 feet and then turned to the Southwest. In March a two compartment raise was started from the South side of the main tenth level drift and projected through to the ninth level. In May two contracts were placed at the top of this raise at the ninth level elevation. One drifting to the Northeast, the other to the Southwest. The drift to the Northeast met the drift being driven from the shaft about the middle of July. This improved the ventilation greatly so better progress was made in the drift to the Southwest from the two compartment raise. This drift was turned due South in order to cut the formation at right angles and to avoid if possible paralleling the dike which has been encountered on the 8th level above and the 10th level below. Ore was cut in July which at first was rather lean but it improved as the drift advanced. After crossing the formation for a distance of 80 feet, slate or dike was encountered. Work to the South was abandoned after drifting about 40 feet in this material and a drift to the Southwest was started in the ore formation; this was extended roughly 350 feet through mixed ore and dike formation and then turned due West. On the first of the year the breast was 1,675 feet from the shaft. Developments show that the formation throughout was badly cut with dikes and evidently considerable folding in the slate foot wall. A cross cut to the Northwest was started at a point about 250 feet to the Southwest of where the ore was first encountered. This struck the North dike about 105 feet from the main foot wall drift, here it was stopped. The main drift to the West will be continued until the Bunker Hill line is reached; this should be about February 1st.

In order to improve the ventilation a raise was started in the cross cut to the North in November. This will be pushed through to the 8th level elevation and holed to the second Northwest cross cut on the 8th. On the 31st of December this raise had reached a height of 110 feet on the incline. No further development will be done on this level until the cross cuts have been completed on the 8th level and the hanging definitely determined.

In March a small drift was started from the South dumping raise opposite

the shaft and driven to the Northeast. This holed to the shaft early in May, from this point a drift was started to the Southwest and early in July holed to the main cross cut driven to the Southwest from the two dumping raises. This completed the main cross cut through to the cage compartment at the shaft. In May a raise from the 10th level pump room holed through to the elevation of the 9th level and was connected to this level by a stub drift at a point about ten feet Southwest of the shaft ladder compartment. At 52 feet below the 9th level between the shaft dumping raises, a small man way raise was started. From the bottom of this raise small drifts connected with the two ore chutes. This raise will be used in cleaning down the raises in case the ore hangs up, which is likely to occur in ore of this character.

TENTH LEVEL.

On the beginning of the year the main cross cut from the shaft toward the ore body had advanced 450 feet. This cross cut was continued in a Southwesterly direction and ore was encountered at 1424 feet from the shaft on June 15th; 170 feet beyond this point the drift was turned slightly to the right and extended through to the Bunker Hill line; the drift being in ore the entire distance. At a point 25 feet beyond the Bunker Hill line curves were made to the North and South and drifts extended due North and South. In the North drift the diorite dike was cut at 80 feet inside of the curve. The drift to the South cut through the dike then through a small seam of ore and the balance of the drifting, which was 80 feet beyond the end of the curve, was wholly in decomposed ferruginous slate. This was very highly stained with iron so to test the formation a drill was placed at the breast and a horizontal hole drilled due South a distance of 193 feet to the Breitung Hematite Mining Company's line, the formation the entire distance was ferruginous slate. The drift to the North cut the main dike on the 3400 foot coordinate slightly North of where this dike was cut by the main shaft cross cut. It was determined to test the depth of the formation on the Bunker Hill from the North drift. A drill was set up 40 feet from the North dike and a vertical hole drilled. This continued in ore 67 feet and then passed in to dike. At the end of the year this hole was 161 feet deep still

in dike. The dike is very much decomposed and is very similar to the dike to the North. It was necessary to keep the casing down to within a few feet of the bit as the material caved continually if not supported by the casing; If possible this hole will be continued until the bottom of the formation is definitely established. From this same position a hole will be drilled to the East at an angle of 45° and one to the South at an angle of 45°. These should give us the absolute location of the bottom of the trough at this point.

A cross cut to the South was started near the East line of Lot 2 300 feet East of the Bunker Hill line. Forty feet from the main drift foot material was encountered; here as on the 8th level and on the Bunker Hill, the material was very much decomposed and it is almost impossible to determine the slate from dike. After drifting 60 feet this drift was stopped.

The raise near the center of Lot 5 started in February holed through to the 9th level in April. This was a two compartment raise comprising a man way and a rock or ore chute and intended to help the development of the 9th level.

BUNKER HILL.

The 10th level drift on the Athens was driven onto the Bunker Hill property with the idea of mining a triangular segment of ore on the Bunker Hill side of the line just to the West of the boundary. It was expected that the 10th level would be at the bottom of the ore formation on the Athens and the segment of ore to be mined would be wholly above this level; however, when it was found that the ore extended below the 10th level, it was decided that no mining would be done on the Bunker Hill property for the time being. The only work to date here has been the cross cutting of the formation to the North and South at a point about 80 feet West of the Athens line and testing the depth of the formation by a diamond drill, the ore being found to extend a distance of 67 feet below the level at a point about 20 feet South of the dike.

UNDERGROUND IN GENERAL

The development of the mine was pushed during the year as rapidly as

possible not only on the four levels but in the pump house on the 10th level as well. Ore was struck somewhat earlier on the 8th and 10th levels than was anticipated, but it was of such character that instead of being able to speed up the drifting as we had hoped when ore was struck, they headway was retarded. The dike immediately to the North of the ore was very much decomposed, the ore and dike material slabbing off in large chunks. Throughout most of the ore drifting forepoling was used and in most of the main level drifts lining sets have been installed.

The drill hole to the North from the 8th level encountering water pressure also warned us against too much development before adequate pumping facilities were had. These were delayed on account of our not receiving the special pipe fittings. The pump room was in readiness for the pump early in the year. From September 1st until November 1st we were in constant fear that a little extra water would be encountered when we already had more than we could handle with out pumps. During part of October water was hoisted daily by means of the skips and the main sumps were filled. Light bulkheads of concrete were placed on the 4th, 8th and 10th levels near the shaft where water could be impounded to a height of five or six feet in the main cross cuts where necessary. With the 500-gallon pump working satisfactorily the development above the 8th level as well as above the 4th can be carried on without any particular danger of the mine flooding.

The regular development was also hampered greatly by finding the deposits shaped very differently than expected from the cross sections, it being considerably narrower and deeper than was shown by the sections. To the North of the dike there is an ore formation on the Athens which should be developed at some future time. This was proved by the drilling from the 8th level. A deposit of merchantable ore there of considerable size may be developed. For the present, however, the development will be confined to the Area South of this large dike and lying between it and the slate foot wall to the South.

SULPHUR.

The Lucky Star property adjoins the Athens on the East. The ore here

contains a high percentage of sulphur making it practically unmerchantable. There were misgivings that sulphur might be encountered in the Athens ore body so sulphur analyses have been made weekly and the results watched closely. To date the development has shown the following sulphur content on the different leases:

Athens, 4th, 8th, 9th, and 10th levels,	.027
Corbit Lease, 4th level and above,	.027
Mitchell Lease, 4th level,	.027
Bunker Hill,	.029

SHAFT.

The principal work in the shaft during the year was the installing of the counterweight and dump discharge columns. Most of the counterweight pipe was placed in the shaft in December, 1917, the balance, 230 feet, in January. The counterweight was installed during January. In June a concrete support for the water column was placed in the ladder compartment of the shaft below the 10th level. This was heavily reinforced as the weight of the water column is tremendous. In September as soon as the long turn elbow for the discharge was received it was placed on this concrete support and the installation of the water column started. This is 10" in diameter and was built to withstand a pressure of more than 1000 pounds per square inch, as the water is pumped from the 2400' level direct to surface. The flanges on this column from the bottom of the shaft to within 600 feet of surface are of cast steel. Those in the upper section of the shaft are cast iron. The thickness of the wall of the pipe varied from 3/4" for the bottom sections to 1/4" at the top of the shaft. Great care had to be taken in this installation to avoid the possibility of any gaskets blowing out when pumping started.

The only work still to be done to complete the shaft is the wire dividings between the cage and pipe and ladder compartments.

PUMP INSTALLATION.

Early in the year the pump house was completed. This consisted of two rooms, North and South. The North room was made 24' x 40' or large enough

for the installation of one pump and also provide room for the switch board and rotary converter for the underground haulage. The South room was somewhat smaller but large enough for a second pump of the same capacity as the one in the North pump room. The sump lies directly between the two pump rooms and extends to the East a distance of 160 feet. It has a capacity of 230,000 gallons. A clean out raise from the drift 40 feet below the 10th level was extended through to the sump and holed opposite the two pump rooms. Another raise was also extended from this drift to the settling sump which is not connected in any way with the main sump. The bottom of these raises were concreted and provided with large pipes and valves through which the mud can be drawn. The drift below is at the same elevation as the top of the skips when spotted for the 10th level. This permits the loading of the material from the settling sumps into the skips without rehoisting. When water was hoisted during the month of October the skips were filled with pipes which tapped the bottom of the clean out raises leading to the sumps. By this scheme we were able to hoist our water without using the bailers; each skip having about two-thirds the capacity of a bailer.

The foundation for the North pump room was concreted in April and the pump installed in June. Nothing further could be done until the long turn elbow was received for the bottom of the water column. This arrived in September and immediately the water column was carried through to the collar of the shaft. The second delay then occurred as the gate valves, shock absorber, and other special pipe fittings were not received until October. They were installed the latter part of the month and the pump started operating November 1st. It worked perfectly until December 12th when the cast steel cross head on the West side of the pump broke. At the request of the manufacturers it was immediately sent back to Menominee and a new one is being made. The pump was idle for two days, but it is now being operated on one side to keep the mine from drowning out. It has worked satisfactorily this way to date, but now a new trouble has developed. A crack has appeared in the North water end on the East side of the pump. This leaks considerably and is gradually growing worse. A representative of the man-

ufacturer has inspected the pump and has ordered a new water end to replace this defective section.

The pump house is located just to the East of the shaft. It is out off from the main 10th level by means of a reinforced concrete bulkhead which is covered by a 7' boiler head door, this latter being built to stand a pressure of 200 pounds per square inch. A man hole in the center of the boiler head provides the pumpman a means of getting in and out of the pump house. A raise from the pump room to the 9th level plat has also been provided, this holed through to the 9th level in March.

The pump installed in this station is of a horizontal, plunger type, driven by a 400 horsepower motor. It was built by the Fred M. Prescott Co. of Menominee, Michigan, and has a capacity of 500 gallons per minute.

ELECTRIC HAULAGE.

The motor generator set was received and installed in the pump room on the 10th level in April. Previous to this time trolly wires had been strung on the 8th and 10th levels and electric haulage started in April on these two levels immediately on completion of the motor generator installation. Electric haulage started on the 4th level in August and on the 9th in October. The rotary converter has worked perfectly to date; it takes up very little room but provides current only for the underground haulage.

CONCRETE BULKHEADS.

As mentioned elsewhere in my report concrete bulkheads about one foot in thickness were built on the 4th and 8th levels in July and on the 10th level later in the year. These were placed within 200 feet of the shaft, the idea being to use the main drifts as temporary sumps in case of an emergency - such as a break down in our pumping equipment, no current, or an unexpected flow of water which the pumps would not be able to handle. The bulkhead on the 10th level has been used to impound water since December 12th on which date the cross head broke. This has necessarily stopped operations on this level for the time being until pumping facilities are again adequate to handle the normal flow of water.

WATER PUMPED.

The water pumped during the year varied greatly. During the early part the 100 gallon pump on the 2400' level was able to take care of the coming water. This pump delivered the water from the 2400' level to the little pump station at the bottom of the circular shaft at 1080 feet from surface. Here a pump of the same capacity discharged the water to surface. Several times throughout the year water was encountered in various developments; the first was that of the diamond drill hole from the 8th level. Here the stream filled the drill hole supplying about 100 gallons of water per minute. This was shut off by means of a valve and immediately showed a pressure of 625 lbs. per square inch. During the latter part of the year after the 500-gallon pump was installed this drill hole was opened to drain the water back of the dike.

On the 4th level development to the East toward the Corbit, a water course was encountered which carried a large volume of water. This has gradually drained until now very little is coming from this section of the mine. The drill hole on the 4th level to the South also cut a water course which gave about a 2" pipe half full. An effort was made to block this hole but the formation was broken so badly that when the hole was blocked the water broke out through the end of the drift. On the 8th level a water course was encountered in the third cross cut to the Northwest. Here a stream containing about 100 gallons per minute made drifting almost impossible. This same course was later cut by the fourth cross cut. Water is still coming from this place, however, it seems to be diminishing slightly. At the end of the year it was estimated the mine was making between 250 and 300 gallons of water per minute.

EXPLORATORY.

Five holes were drilled in the Athens mine during 1918; two horizontal holes to the North on the 8th level, one horizontal, and one vertical hole on the Bunker Hill from the 10th level and one horizontal hole to the South on the 4th level. The location of these holes and details of the drilling are as follows:

Hole #1 Athens, 8th level, coordinates S3424.33; W1342; dip 0°; direction North 36°40' West; elevation -784.45. The material diorite dike. This hole was started on June 21st, and bottomed on July 18th at a depth of 243 feet. Water under pressure here 625 lbs.

Hole #2, Athens, 8th level, coordinates S3421.52; W1336.12; dip 0°; direction North 17°21' East; elevation -784.69. The material was diorite and soft ore jasper. This hole was started on July 23rd, and bottomed on August 5th at 316 feet. Had to stop account of pressure against bit.

Hole #3, Athens, 4th level, coordinates S3495.96; W141.23; dip 2°; direction South 1°04' West; elevation 390.68. The material was paintrock, soft ore jasper, and slate and graywacke. This hole was started on November 23rd, and bottomed on December 7th at 260 feet.

Hole #1, Bunker Hill, 10th level, coordinates S3668.78; W1947.90; dip 0°; direction South 1°30' West; elevation -990.90; The material slate and graywacke. This hole was started on November 2nd, and bottomed on November 12th at 193 feet.

Hole #2, Bunker Hill, 10th level, coordinates S3432.93; W1941.82; dip 90°; elevation -993.37. The material for the first 65 feet averaged 64.15 in iron and from there on it was dike. This hole was started on November 15th and on December 31st was 161 feet deep.

SURFACE

As early as the frost was out of the ground in the spring grading around the shaft was started; the concrete mixer was first removed and the hole opposite the West side of the shaft filled with rock. At the same time the grading was started around the office and mine buildings for the lawn and roads, a fence was built to keep out the cattle and cow guards installed at the railroad tracks. A road was built from Ann Street to the engine house and a path constructed from the engine house to the office yard. The whole work was under the direction of Mr. Manning and the appearance of the surface was greatly improved.

STOCK PILE LEASE.

The only ground available for stocking purposes at the Athens is to the East and Southeast of the shaft. However, in both of these directions in order to provide sufficient room for stocking, it was necessary to secure more ground. During the latter part of the year an arrangement was made with the Lucky Star Mining Company so that a portion of their ground was leased by the Athens to give us sufficient stocking room for the time being. This lease covers a term of 25 years and is described as follows:-

> "Beginning at the Northwest corner of the Lucky Star property, which point is Two Hundred Eighty-Five and Ninety-One One Hundredths (285.91) ft. east of the west quarter post of Section five (5), measured along the east and west quarter line of said section; thence south Eighty-nine degrees Forty-three minutes (89°43') east Four Hundred Eighty-seven (487) ft. along the north line of the Lucky Star property; thence south no degrees Seventeen minutes (0°17') west Two Hundred Thirty ft. (230), thence north Eighty-nine degrees Forty-three minutes (89°43') west Two Hundred Eighty-seven (287) ft., thence South One degree Three minutes (1°3') west Five Hundred Eighty-five (585) ft., thence north Eighty-eight degrees Fifty-seven minutes (88°57') west Two Hundred (200) ft. to a point on the west boundary line of the Lucky Star property; thence north along said west boundary line north One degree Three minutes (1°3') east Eight Hundred Fifteen (815) ft. to the point of beginning, containing Five and one-fourth acres (5 1/4) more or less, all in Section five (5), Township forty-seven (47) North, Range twenty-six (26) west; subject, however, to the railroad right of way of the Lake Superior and Ishpeming Railway Company now existing across said premises."

STOCKING GROUND AND ORE TRESTLES.

Stock pile ground to the Southeast of the shaft in the direction of the Lucky Star tail track was graded a sufficient distance to permit twenty-eight bents to be erected. In this direction the trestle extends from the steel permanent trestle 594 feet and provides sufficient room to stock 71,500 tons of ore.

ROCK TRESTLE.

The rock trestle was extended to the South a distance of 252 feet during the year, making a total length of 748 feet.

TIMBER YARD.

To the West of the Shop Building grading of the timber yard was started in the fall and early winter of 1917. This was continued in the spring of 1918

and new provides room for decking stull timber received at the mine.

TIMBER TUNNEL.

The timber tunnel was started in 1917, but had to be discontinued on account of the winter weather. In all 600 feet have been constructed West of the road which crosses to the Change House and from the East side of this road back to the concrete tunnel 210 feet have been built. At this latter section the tunnel is made two tracks wide to permit storing empty trucks on a switch.

TRANSFER HOUSE.

At the transfer house the South engine was set up and started operating in February. This engine is of the same type as that used at the Maas having a single grooved 8' sheave lined with rubber which is operated by a motor. It operates the West ore car and the rock car. The North engine which operates the East ore car was put in commission later in the season. The transfer house is made of cement plaster over Hy-rib. It was built in the fall of 1917 too late in the season to plaster. It was covered during the winter with composition roofing, and plastered in June of this year. This makes a construction which is compartively cheap, but which is practically fire proof.

HEADFRAME.

In September the headframe was enclosed from the landing platform to the top of the dumps. Ship lap covered with roofing being used for this construction. During the coming season we hope to spray this with the cement gun to make it as fire proof as possible. By covering the headframe in this manner it prevents the dumps from freezing and facilitates hoisting. The Negaunee headframe was covered in a similar manner last winter.

STORAGE YARD.

To the East of the rock trestle a storage yard was built enclosed by a ten foot board fence. Here are placed used materials that collect around a mine such as shaft sets, buckets, ropes, etc., which are unsightly, but which may be needed for future use.

DRAINAGE DITCH.

With the installation of the new pump a 12" pipe was placed under the

loading tracks South of the headframe and a launder provided to carry the water around the rock trestle to the West side. Here it discharges into a ditch and gradually works its way down to the South end of the property. This ditch is cutting out badly near the end of the launder and in order to provide against the possibility of its undermining the rock trestle, a spiral riveted pipe will be installed during the coming spring.

CEMENTING DIAMOND DRILL HOLES.

Stand pipes left from the surface drilling were pulled after first cementing the tops of the holes at the ledge. Holes, E, F, I, K, 4, 5, 7, 10, 11, 12 and D were cemented.

The total estimate in the Superintendent's Division on E. & A. #261 - Operating and Equipping Athens Mine - as shown by the Opening Statement is $606,-100.67.

To this should be added the Estimate of July 5th 1916 to sink the shaft to 2490 feet	$55,390.00
Estimate of opening 1800' level to explore Corbit Lease	24,100.00
Total Superintendent's Division	$685,590.67
Total expenditures Superintendent's Division to December 31st, 1917	$960,093.32
Less credit for sale of ore 1917	150,396.29
Total net expenditures	$809,697.03
Estimate	685,590.67
Balance over expenditures December 31st, 1918	$124,106.36

Over expenditures are found in practically every item under the Superintendent's Division with the exception of Sinking in Sandand Sinking in Rock. These are almost wholly explained by the great increase in labor and supplies due to war conditions of the past few years, the last two particularly and by deferring the time when the mine was put on an Operating basis to January 1st, 1919. Most of the shaft sinking was completed before the high costs from labor and supplies came into effect, which explains how this item came within the estimate figures.

The mine operated on two 8-hour shifts. Ore was encountered at about the time estimated. It was expected the mine would start operating March 15th, 1918. Ore was struck April 1st. The deposit was not shaped as anticipated, the balance of the year was spent in development. The product of 37,568 tons from this work was credited $150,396.29 on the Opening Statement - no credits appearing opposite the individual items that made up the deficit in the estimate. The explanation of the expenditures under the different items follow:-

Account No. 1. GENERAL EXPENSE.

Estimate	$ 87,487.00
Expended	158,185.00 to Dec. 31, 1918.
	$ 70,688.00 overrun