CROSBY MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICES.	AMOUNT 1 9 1 8.	AMOUNT 1 9 1 7.
30% Powder	59,400	.1650	9803.80	6285.36
40% "	2,875	.1773	509.81	3178.81
XXXX " (Black)	37,950	.086	3247.80	3069.99
Total Powder	100,225	.1353	13561.41	12534.16
Fuse	76,200	8.00	609.76	529.62
Caps	24,200	12.86	311.37	336.09
Cap Crimpers				2.69
Electric Exploders	3,538	.094	337.81	459.59
Connecting Wire	9.9	.425	4.21	4.60
Blasting Machine	1		40.00	25.00
Total Fuse, Etc.			1303.15	1357.59
Total Explosives			14864.56	13891.75
Product	298,265			290,795
Pounds Powder per ton Ore	.336			.377
Cost per ton for Powder	.0455			.0431
" " Fuse,Etc.	.0044			.0047
" " All Explosives	.0499			.0478
Avg.Pr.per lb.for Powder	.1353			.1143

More ore was handled during 1918 and the cost of explosive material was higher. On account of using more 30% and considerably less 40%, the cost per ton of ore for explosives was approximately the same.

CROSBY MINE.

MEADOW AND FOWLER MINES

ANNUAL REPORT FOR 1918.

While there were no serious labor disturbances during the year 1918, the shortage of underground men was felt very acutely from the 1st. of June to the end of the year and we were unable to keep our force to its required strength during this period. Even by carrying extra hands, we were unable to maintain full contracts, as the majority of the men worked less than twenty shifts per month. A good share of the employees at the Meadow and Fowler Mines were single and the high rate of wages paid did not stimulate their working full time. Aside from the shortage in labor, the inefficiency of the average employee, compared to the previous year, was a considerable item.

We had hoped that the fact that St. Louis County entered the dry column March 15th, would result in a decided betterment of labor conditions. Apparently the men in the Aurora District, however, secured a considerable supply of liquor, or prepared alcholic drinks, as the number of employees absent from work following pay-days and holidays showed no decrease.

The building up of the Stein O'Rourke addition, to the southeast of the Meadow shaft, did not benefit us to the extent that we had anticipated.

The production from the Meadow-Fowler Mines for the past year amounted to 93,389 tons, 81,971 tons of which was shipped and the balance, 11,418 tons, placed in stock subsequent to the closing of navigation. This tonnage is divided between the Meadow and Fowler Mines as follows:

	Produced	Shipped	Stock. Jan.1st.1919.
Meadow Mine----	46,120 Tons	42,094 Tons	4,026 Tons
Fowler Mine----	47,269 "	39,877 "	7,392 "
TOTAL----------	93,389 "	81,971 "	11,418 "

The estimate of production for the calendar year 1919 is placed at 42,000 tons from the Meadow Mine and 54,000 tons from the Fowler Mine, making a total of 96,000 tons of this grade.

Meadow Mine Ore Estimate January 1st. 1919.

Following is an estimate of the ore in sight at the Meadow Mine on January 1st., 1919, the tonnage reported January 1st., 1918 and the amount mined during the past year.

A factor of 13 cubic feet per ton was used in this estimate and a 10% deduction made to cover mining loss:

	Tons.
Ore in sight January 1st., 1918------	238,000
Ore mined during 1918----------	46,120
Balance from these figures----------	191,880

The development work during the past year has not proven up any new ore, nor has it caused us to alter our previous assumptions and figures. The estimated Meadow ore in sight January 1st, 1919, is, therefore, as follows:

Tons.	Fe.	Phos	Mn.	Sil.	Mois.	Fe.Nat.
192,000	57.00	.075	2.00	10.00	12.00	50.16

Of the above ore reserve 50,000 tons remains on and above the main tramming level and 142,000 below this level.

We do not consider that there is any good prospect of developing any additional ore of shipping grade in the Meadow Mine.

Fowler Mine Ore Estimate January 1st. 1919.

Following is an estimate of the ore in sight at the Fowler Mine on January 1st., 1919, the tonnage reported January 1st., 1918 and the amount mined during the past year.

A factor of 13 cubic feet per ton was used in this estimate and a 10% deduction made to cover mining loss.

	Tons
Ore in sight January 1st., 1918	81,000
Ore mined during 1918	47,269
Balance from these figures	33,731
Ore estimate of January 1st., 1919	84,000
Increase in the estimate of January 1st., 1919, over that for the previous year	50,269

The increase in our 1919 estimate is the result of development work done during the past year on the 1345 and 1365 Foot Levels. The mine extensions in 1917 resulted in showing an increase of 54,287 tons in our ore reserves and this year the amount added has been almost as great. We do not anticipate the development of any appreciable tonnage during 1919, as the lower workings of the mine have been extended to the ore limits, and, basing our judgement on the results of drilling, there is small chance of encountering an additional tonnage of shipping grade at a greater depth.

The Fowler tonnage and grade in sight January 1st., 1919, is as follows:

Tons	Fe.	Phos	Mn.	Sil.	Mois.	Fe.Nat.
84,000	58.00	.060	.80	10.50	11.00	51.62

Based on our data, we do not feel justified in anticipating the development of any further merchantable ore in this property.

STOCKPILES

Following is the tonnage of Meadow-Fowler ore reported in stock at the opening of navigation, that loaded out and the average analysis of the ore as obtained in making and shipping the pile;

	Tons	Fe.	Phos	Mn.	Sil.
Meadow Stockpile (Skip Tally)	28,425	55.65	.083	2.61	10.04
Fowler Stockpile (Skip Tally)	12,931	56.53	.063	.94	11.16
TOTAL AND AVERAGES	41,356	55.93	.077	2.09	10.39
Shipping Meadow stockpile	28,657	55.81	.080	2.51	10.50
Shipping Fowler Stockpile	12,981	56.59	.060	1.30	11.71
TOTAL AND AVERAGES	41,638	56.05	.074	2.13	10.88

The overrun in these stockpiles was so small that it was deemed advisable to reduce the skip tally from 2.75 tons to 2.60 tons. This reduction should insure a more substantial overrun in our 1919 shipments.

The tonnage and average analysis of the Meadow and Fowler stockpiles as of January 1st., 1919, follows:

	Tons.	Fe.	Phos	Mn.	Sil.
Meadow----------	4,026	55.69	.065	2.37	11.15
Fowler----------	7,392	57.23	.050	.81	10.88
TOTAL AND AVERAGES---	11,418	56.69	.055	1.36	10.98

The grade of ore being mined on the Meadow side should show improvement between the 1st. of the year and the opening of navigation and this stockpile should average about 56.50 in iron content. We anticipate that the iron content of the Fowler pile upon the opening of navigation will be about 57.50. The manganese in the Meadow ore will run somewhat lower during the early months of 1919, while the manganese in the Fowler ore should average somewhat higher than for the last two months of 1918.

SHIPMENTS

Following are the cargoes of Meadow-Fowler ore shipped during the past year and the analysis of same as obtained at the Mine and by the Lower Lake Chemists:

	Fe.	Phos	Mn.	Sil.	Mois	Fe.Nat.	Tons
NEGAUNEE							4,554
Mine	56.71	.067	2.05	9.73	-----	------	
Crowell & Murray	56.64	---	----	----	12.14	49.764	
ANGELINE							5,644
Mine	57.12	.067	2.14	8.92	-----	------	
Rattle	55.60	---	----	----	11.50	49.206	
ANGELINE							6,364
Mine	57.00	.060	1.74	10.13	-----	------	
Cremer & Case	56.70	---	----	-----	11.14	50.384	
PAISLEY							5,976
Mine	57.23	.057	1.61	10.00	-----	------	
Emmerton	56.00	---	----	-----	10.23	50.271	
ANGELINE							4,104
Mine	57.15	.054	1.90	8.68	-----	------	
Textor	56.38	---	----	----	10.67	50.364	
MUNISING							4,933
Mine	57.74	.060	1.50	9.43	-----	------	
Crowell & Murray	56.66	---	----	----	11.05	50.399	
KOPP							3,746
Mine	56.82	.058	1.52	10.06	-----	------	
Cremer & Case	56.60	---	----	-----	10.85	50.459	
MUNISING							3,164
Mine	56.65	.057	1.47	11.13	-----	------	
Textor	56.30	---	----	-----	12.56	49.229	
LAKETON							2,808
Mine	57.48	.064	1.28	10.72	-----	------	
Rattle	55.90	---	----	-----	11.20	49.639	
NEGAUNEE							3,657
Mine	55.76	.066	2.06	11.00	-----	------	
Textor	54.00	---	----	-----	10.41	48.379	

	Fe.	Phos	Mn.	Sil.	Mois	Fe.Nat.	Tons
W. G. MATHER							7,388
Mine	55.66	.063	1.96	11.14	-----	------	
Rattle	55.30	---	----	-----	11.89	48.725	
J. H. SHEADLE							10,673
Mine	55.95	.062	2.05	10.70	-----	------	
Cremer & Case	55.40	---	----	-----	11.25	49.168	
ARCTURUS							10,009
Mine	55.65	.066	2.06	10.94	-----	------	
Crowell & Murray	56.10	---	----	-----	11.38	49.716	
FRANK BALL							9,919
Mine	56.00	.070	1.92	10.94	-----	------	
Crowell & Murray	55.70	---	----	-----	12.77	48.587	
SELLWOOD							9,581
Mine	56.04	.071	2.08	10.81	-----	------	
Crowell & Murray	56.04	---	----	-----	11.78	49.438	
ROBINSON							2,746
Mine	57.47	.064	1.48	10.07	-----	------	
Rattle	55.70	---	----	-----	11.70	49.183	
Textor	55.80	---	----	-----	12.42	48.870	

The average analysis of the season's shipments as sampled at the Mine and by the Lower Lake Chemists were as follows:

	Tons	Fe.	Phos	Mn.	Sil.	Mois	Fe.Nat.
Sampled at Mine	95,266	56.45	.064	1.88	10.39	-----	------
Sampled at Lake Erie	94,313	55.91	---	----	-----	11.49	49.487

Following is a list of the accidents, where the injured parties lost time, which occured at the Meadow-Fowler Mines during the past year:

JOHN PUGEL

Injured----------February 1st, 1918.
Occupation----------Miner.
Nationality----------Austrian
Time Lost----------28 Days.
Received Compensation----------$36.00.

Remarks: Pugel was struck over lumbar region by counter weight on shaft door.

HUGO RAISKA

Injured----------May 13th, 1918.
Occupation----------Miner.
Nationality----------Finn.
Time Lost----------Seven days.
Received Compensation----------None.

Remarks: Raiska fell into timber raise, straining his back.

TONY SKARJANC

Injured----------May 30th, 1918.
Occupation----------Miner.
Nationality----------Austrian.
Time Lost----------14 Days.
Received Compensation----------$12.00.

Remarks: A tram car ran over Skarjanc's foot, bruising toes.

STEVE KRZC

Injured----------June 29th, 1918.
Occupation----------Miner.
Nationality----------Austrian.
Time Lost----------Seven days.
Received Compensation----------None.

Remarks: A piece of steel from a pick struck Krzc in the eye.

FRANK LESAR

Injured----------July 12th, 1918.
Occupation----------Miner.
Nationality----------Austrian.
Time Lost----------37 Days.
Received Compensation----------$50.00.

Remarks: Lesar's partner dropped a plank down raise and it struck his foot, fracturing the tarsal bone.

CROSBY MINE.

ANDREW KANGAS

Killed----------September 3rd, 1918.
Occupation----------Miner.
Nationality----------Finn.

Remarks: Caving ground resulted in asphyxiation of Kangas. This accident will be described fully below.

JOHN JAMBACK

Killed----------September 3rd, 1918.
Occupation----------Miner.
Nationality----------Finn.

Remarks: Caving ground resulted in asphyxiation of Jamback. This accident will be described fully below.

ZEKO DOBRILOVICH

Injured----------December 27th, 1918.
Occupation----------Chuteman.
Nationality----------Montenegrin.
Time Lost----------18 days.
Received Compensation----------$18.00.

Remarks: A chunk of ore struck Dobrilovich's finger resulting in the loss of a finger nail and severe bruise.

John Jamback and Andrew Kangas, working in contract No. 3 at the Fowler Mine, were killed about 11:30 P. M. on the night of September 3rd. Jamback and Kangas were miners of considerable experience and had been employed in No. 3 contract for some time.

John Bradach, the boss in charge of the shift upon which Jamback and Kangas worked, states that he inspected their room about 11:00 o'clock on the night of the 3rd and found everything in good condition. There was no evidence of weight on the 1407 Foot Sub, where they were working, or on the 1393 Foot Sub below. Bradich says that he went into the room on the 1393 Foot Sub and that he found no evidence of weight. Captain Wivell and shift boss Kos also state that they were in this room on the day shift and could see no signs of working ground. Contract No. 3 had started to cut out on the east side of the drift and were preparing to blast here when the cave occured. We are convinced from our investigation that the caving of the ground was due to the shock from No.12's blasting, 90 feet to the west and 20 feet below No.

3's sub. It was rather strange, however, that this blasting did not in any way shake the ground over the drifts connecting Nos. 3 and 12 raises, which are located between their working places. Jamback was cleaning out the holes when the cave occured and apparently Kangas had detected some evidence of movement in the room and was engaged in driving wedges to tighten the timber, when the cave occured. Captain Wivell is of the opinion that Kangas might have loosened the timber and the cave might have been due in part to this fact. The 1417 Foot Sub had been mined out and blasted down and the covering boards were caught up in the back of the 1407 Foot Sub. The posts along the east side of No. 3's drift were all standing, but the caps and posts along the west side were all crushed, which shows conclusively that the rush of sand came from the side rather than from the back of the drift. No blasting had been done in No. 3's working place for 12 hours previous to the accident.

Our Safety Committee and the State Mine Inspector agree with Captain Wivell and myself that the ground above the upper subs had not come down, and although these workings were filled, there was no reason to suppose that the material had come in from the sides of the drift. The sand apparently kept working in from the side and formed an arch above the first sub. The final caving down of this arch caused the collapse of No. 3's room and resulted in the asphyxiation of Jamback and Kangas.

GENERAL SURFACE

Aside from keeping the grounds clean and spreading ashes over the mine roads, no work of a general nature was undertaken.

A small garage was erected and heaters installed for the accommodation of the Company automobile from Nashwauk.

The usual amount of nominal repairs were made on the coal dock, permanent ore trestle and mine buildings.

The surface drainage ditch to the north of the Fowler caves overflowed its banks, due to the fact that the comparatively small amount of water flowing continued to freeze until the ditch was completely filled with ice. The overflow water drained into the old Fowler caves and finally broke through and washed a considerable quantity of sand and boulders down No. 1 F raise onto the 1365 Foot Sub. A new dam was constructed to the south of the break and the flood water was turned back into the ditch. The second dam, just north of the caves, kept the water in the basin below the ditch from seeping into the workings, and a pumping plant was installed here to take care of any water seeping through the first dam. This pumping station was maintained for approximately two months and the water in this basin, from the melting ice, was pumped back into the ditch.

The dams have been repaired and strengthened and in consequence we anticipate no trouble during the Spring thaw this year.

Minor repairs were made on the compressor and hoist and the three boilers were overhauled and the fire-boxes relined with new brick.

A force of men was employed off and on during the latter part of the summer in clearing inflammable material from the immediate vicinity of the powder magazine and fighting brush fires in the neighbrohood of our timber yards.

DRILLING

The drilling campaign, which was started in November of 1917, was continued to the latter part of March. Five holes were put down in 1917 and thirteen holes in 1918. With the exception of the first hole put down, no ore was encountered in this drilling.

The results of the 1918 drilling follows:

	Footage	Material
Drill Hole No. 305	32	Gravel and boulders.
	110	Taconite, cherty and magnetic.
	8	Quartzite.
		Hole Bottomed.
Drill Hole No. 306	27	Gravel and boulders.
	116	Taconite, cherty and magnetic.
		Hole Bottomed.
Drill Hole No. 307	56	Gravel and boulders.
	84	Taconite, magnetic, sideritic and cherty.
	14	Slate and taconite seams.
	8	Quartzite.
		Hole Bottomed.
Drill Hole No. 308	20	Gravel and boulders.
	131	Taconite, magnetic, sideritic and cherty.
	6	Quartzite.
		Hole Bottomed.
Drill Hole No. 309	35	Gravel and boulders
	28	Taconite, magnetic, sideritic and cherty.
		Hole Bottomed.
Drill Hole No. 310	17	Gravel and boulders.
	125	Taconite, magnetic, sideritic and cherty.
Drill Hole No. 311	37	Gravel and boulders.
	12	Taconite.
	20	Taconite-magnetic.
	71	Taconite-sideritic.
		Hole Bottomed.
Drill Hole No. 312	17	Gravel and boulders.
	92	Taconite, magnetic and sideritic.
		Hole Bottomed.
Drill Hole No. 313	52	Gravel and boulders.
	88	Taconite, magnetic and sideritic.
		Hole Bottomed.

	Footage	Remarks
Drill Hole No. 314	26	Gravel and boulders.
	64	Taconite and lean ore.
		Hole Bottomed.
Drill Hole No. 315	31	Gravel and boulders.
	18	Taconite.
	26	Taconite and paint rock.
		Hole Bottomed.
Drill Hole No. 316	46	Gravel and boulders.
	35	Taconite.
	4	Mixed taconite and paint-rock.
		Hole Bottomed.
Drill Hole No. 317	17	Gravel and boulders
	35	Taconite.
	9	Mixed taconite and ore.
	27	Taconite.
		Hole Bottomed.

UNDERGROUND

At the beginning of the year ten contracts were employed on ore and one on rock work. Seven gangs were working on the Meadow side and four on the Fowler.

As the pillars on the 1365 Foot Sub-Level (Meadow Mine) were drawn back to the raises, the contracts were transferred to the Fowler side or moved down to the main tramming level workings, and at the end of the year we find four gangs employed on the Meadow side and six in the Fowler workings.

On the Meadow side the few pillars in the vicinity of Nos. 201 and 14 raises were mined out on the 1385 Foot Level, the deposit on the 1365 Foot Sub was sliced and caved back to the vicinity of these pillars and slicing operations were underway on the main tramming level. The development work on the 1260 Foot Level had progressed to a point under No. 10 raise and raises started from this drift, which will tap the ore body below the old 1340 tramming level. The 1340 Foot Level will be pretty well mined back during the present year and we now anticipate that several contracts will be engaged below this elevation prior to January 1st. 1920.

On the Fowler side, the chimney of ore was mined out to the east of the McInnis shaft between the 1425 and 1380 Foot Subs.

The entire 1380 Foot Level was sliced and caved back, with the exception of the McInnis shaft pillar and a narrow strip of ore between No. 7 F and 9 F raises. The central part of the 1365 Foot Sub had been mined and development work on the 1340 Foot Level carried to the north boundary of the property.

As operations on the Meadow side warrant the addition of extra contracts, the gangs will be transferred from the Fowler side. In order to get the best results it is desired that the Fowler and Meadow ores be mined in like quantities. Further than this, the Fowler ore body narrows considerably with depth and it will not be expedient to continue operating with the six contracts now employed.

MEADOW WORKINGS

"1385 Foot Sub-Level"

Contract No. 6 spent the first half of the year slicing out the pillars of high grade ore adjacent to Nos. 14 and 201 raises. This deposit was mined up along the north taconite wall for a distance of from 15 to 20 feet, the sub above not having extended this far north. This ore was exceptionally high grade, averaging better than 58% iron.

"1365 Foot Sub"

Contracts Nos. 1, 5, 7 and 11 were employed at this elevation January 1st. This force was reduced as the pillars were exhausted and at the end of 1918 but one contract, No. 7, remains. This gang is engaged in slicing out and caving the pillars adjacent to Nos. 14 and 201 raises.

Operations during the year consisted in mining out the small pillars between Nos. 204, 207, 208 and 209 raises and drawing back the large pillars between Nos. 204 and 202 raises. The bulk of the product from the Meadow Mine came from this sub. The ore from these workings ran somewhat under the average in iron

content, but the manganese was quite satisfactory. The deposit between the 1385 and 1340 Levels contains a considerable quantity of painty material as well as seams of soap rock and it is necessary to sort this out in order to hold the analysis to our specified grade. Although we did our best to eliminate all of the undesirable material, it was an extremely difficult job and the iron content of our Meadow product during the past year suffered somewhat in consequence. The iron in the 1919 output should show some improvement.

"1340 Foot Level"

Owing to the fact that the main tramming drift, leading out through the central part of the deposit was taking considerable weight and the expense of keeping it open had become a considerable item, it was deemed advisable to drive along the north and south ore limits. This work was completed and two gangs, Nos. 5 and 6, were engaged the last months of the year in mining out the deposit with top sets in the vicinity of No. 203 raise. There is too much ground between the 1340 and 1365 Foot Sub to warrant operations from the 1340 Foot sill floor only and in consequence the ground will be gained from top sets or an intermediate sub, depending on conditions encountered.

The ore to be mined on and above the 1340 Foot Sub averages better in iron content, but lower in manganese than that gained on the 1365 Foot Sub above.

"1260 Foot Level"

One contract, operating intermittently, has extended this level to the northward from No. 4 to No. 10 raise, a distance of 330 feet. This work was all done in rock. Two rock raises have been put up from the 1260 to the 1325 Foot Sub and as soon as the deposit has been caved back on the 1345 Foot Level, mining activities will be inaugurated from these raises.

It is our intention, however, to do some development work from these raises during the first half of 1919. One drift will be extended into the Fowler workings for the purpose of investigating the quantity and grade of the Fowler ore below the present tramming level. We do not anticipate developing any considerable amount of Fowler ore at this elevation.

FOWLER WORKINGS

"1380 Foot Sub-Level"

Two contracts were engaged in opening up and slicing out the narrow deposit at this elevation between Nos. 1 F and 3 F raises during the forepart of the year and three gangs spent the last half of the year slicing and caving back the ore body in the vicinity of Nos. 7 F, 8 F and 9 F raises to the north. These north workings were carried up to the covering boards of the McInnis sub, but no work had been done previously above the southerly workings of the 1380 Sub. The ore body is narrowing somewhat below the 1380 foot sub at the north end and widening to the south. The southerly workings extend to the rock capping and it has been extremely difficult to bring down the back on account of the narrowness and arching formation of the ore lens.

A chimney of ore, 25' X 35', was followed up to the east of the McInnis shaft for three subs. This material was of rather low grade, but the Fee Interests insisted on its being mined. A part of the 1380 Foot Sub ore has also been somewhat below our desired grade and it has been due to the insistence of the Fee Interests that operations have been carried on as extensively at this elevation.

"1365 Foot Sub-Level"

This sub had been pretty well developed during 1917 and operations for the past year have consisted in slicing and caving out pillars south from the McInnis shaft to No. 2 F raise.

The lens of high grade ore at this elevation is 550 feet long and has an average width of 110 feet. The central part of the sub has been exhausted and operations at the end of the year consisted in the slicing out of the pillars in the vicinity of Nos. 5 F, 6 F, 7 F, 8 F and 9F raises and to the south of No. 3 F raise. The bulk of the Fowler ore came from this elevation during the last half of the year and the average grade has shown some betterment as a result. Several contracts will be employed here during the coming year. There will be room for one sub between the 1365 Foot and main tramming level.

"1340 Foot Level"

This main tramway was extended to the Oliver Iron Mining Company's boundary, a distance of 340 feet, during the year and crosscuts driven to the east and west along the line to demonstrate the width of the body. The ore has a width of 160 feet along the north boundary. It was deemed inadvisable to drive additional crosscuts to the south until such time as the development and mining of the ore body below the 1365 Foot Sub should be started, due to the fact that the drifts would show considerable weight and necessitate repairs. The ground has a tendency to cave in large masses and we have found that it is inexpedient to complete our tramways much ahead of mining operations above.

Without doubt we will develop some additional ore below this level, but it is very questionable whether the grade and character of such ore would be desirable. Several winzes will be put down from the 1340 Foot Level during the coming year, and as stated before, a drift will be extended into the Fowler ground from the lower Meadow workings.

ANALYSIS OF COST SHEET

Mining activities were conducted without interruption during 1917 and with the exception of a tie-up on the Fowler side in March, 1918, due to the rush of water from our surface drainage ditch through the caves and the few shifts lost at the time of our fatal accidents in the Fowler workings the early part of September, operations were conducted continuously during 1918.

The labor situation was less satisfactory in 1918 and we were unable to maintain a full working force from June 1st to the end of the year. While the labor situation was far from satisfactory in 1917, conditions were much worse the past year. The advance in wages and supplies, added to a shortage and inefficiency of labor, resulted in a decided increase in our 1918 costs of production, and with few exceptions the items making up such costs were affected on an upward scale.

The production from the Meadow and Fowlers Mines for 1918 amounted to 93,389 tons and compares with an output of 103,987 tons for the previous year. The average daily hoist for 1918 was 303 tons, as against 337 tons in 1917.

The charges per ton against the several main captions, making up the cost of production at the Meadow and Fowler Mines, for the years 1917 and 1918 follows:

	1918.	1917.
General Expense--	.182	.096
Maintenance------	.099	.072
Mining Expense---	1.552	1.102
TOTAL-----------	$1.833	$1.270

GENERAL EXPENSE

The 1918 charges to this caption were almost double those for 1917 and with the exception of "Insurance" and "Engineering" all the items showed a decided increase.

The charge to "Engineering" was $.004 per ton less for 1918 than for the previous year, due to the fact that the sur-

veys had been completed and it was not necessary to devote as much time to the properties.

The increase of $.005 per ton against "Analysis" is explained by the higher wages paid for sampling and the advance in the rate per determination.

Under "Personal Injury" expense the increase was exceptionally large, the result of compensation payments to the estates of Andrew Kangas and John Jamback, who were killed on September 3rd. The amount of compensation was $6314.00.

The advance in wages and supplies explains the 1918 increase of $.020 per ton against the item "Mine Office".

MAINTENANCE

The charges under this caption to "Docks, Trestles & Pockets", "Buildings", "Boiler Plant", "Hoisting Machinery", "Compressor & Power Drills", "Top Tram Engine & Cars", "Skips & Skip Roads" and "Telephone & Safety Devices", were nominal during the years 1917 and 1918 and there was comparatively little change in the rate per ton during 1917 and 1918.

An increase of $.01 to "Tracks & Yards" was caused by the Railway Administration's charges for maintenance of tracks. We have never paid any expenses in connection with maintenance of railway tracks prior to 1918. An invoice from the Railway Company for $706.27 was paid during 1918.

There was a decrease of $.006 per ton in "Pumping Machinery" expense for 1918, as compared to the previous year. Our compound steam pump was thoroughly overhauled in 1917, whereas the repairs were nominal in 1918.

The account "Underground Tracks & Cars" shows an increase of $.019 for 1918, due to the extensive repair work on the underground tracks. The 1918 repair item was very high here.

There was a charge of $.005 per ton for maintenance of "Gasoline Locomotives" in 1918. There were no charges to this account in 1917.

MINING EXPENSE

There was an increase in the rate per ton for each item making up this caption during 1918. This was due to the advance in wages and unfavorable labor conditions during the past year.

The item "Air Pipes" shows an increase of $.003 per ton and "Compressors" of $.013.

The higher price paid for coal and the advance in labor was responsible for an increase of $.015 in the account "Hoisting" and $.086 in "Pumping".

The bottom level of the Meadow Mine was extended to No. 10 raise, a distance of 330 feet, in 1918. As comparatively little rock drifting was attempted in 1917, the charges to this item show an increase of $.045 per ton.

The advance in wages and the higher price paid for powder and other supplies resulted in an increase of $.202 per ton for "Breaking Ore" for 1918, as compared to the previous year.

While the higher wages paid in 1918 tended to increase the item "Tramming" materially, the fact that gasoline locomotives were used in place of mules tended to hold the expense down, with the result that the increase here only amounted to $.005 per ton.

The cost for timbering and the higher prices paid for the material explains the increase of $.030 per ton in the 1918 rate for "Timbering".

The 1918 item "Captain & Bosses" shows an increase of $.022 per ton, due to the advance in wages.

There was an increase of $.004 to "Dry House", which was the result of the wage advance.

The increased cost per ton charged against "Top Landing and Tramming" was the result of the advance in wages and this also explains the increase of $.006 per ton for "Stocking Ore".

MEADOW MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1918.

GRADE	IRON	PHOS.	SILICA	MANG.
Meadow,	56.11	.073	10.07	2.51

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1918.

GRADE

Meadow, (
) All Mixed
Fowler, (

ORE STATEMENT AND SHIPMENTS FOR YEAR 1918.

	MEADOW	TOTAL LAST YEAR
On hand Jan. 1st, 1918,	10,420	11,516
Output for Year,	45,888	91,912
Stockpile Overrun,	232	3,183
Total,	56,540	106,611
Shipments,	52,514	96,191
Balance on Hand,	4,026	10,420
Decrease in output - 51%	48,975	
Decrease in ore on hand,	6,394	

1918 - 2-8 Hr. Shifts during year

1917 - 2-8 Hr. Shifts during year

FOWLER MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1918.

GRADE	IRON	PHOS.	SILICA	MANG.
Fowler,	57.29	.058	10.58	.97

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1918.

GRADE	
Fowler, ( ) Meadow, (	All Mixed

ORE STATEMENT AND SHIPMENTS FOR YEAR 1918.

	FOWLER	TOTAL LAST YEAR
On hand Jan. 1st, 1918,	2,875	2,725
Output for Year,	47,219	10,306
Stockpile Overrun,	50	981
Total,	50,144	14,012
Shipments,	42,752	11,137
Balance on Hand,	7,392	2,875
Increase in output - 40%	35,982	
Increase in ore on hand,	4,517	

FOWLER MINE.

MEADOW MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 8.	1 9 1 7.	INCREASE.	DECREASE.
PRODUCT	93,389	103,987		10,598
General Expense	.182	.096	.086	
Maintenance	.099	.072	.027	
Mining Expense	1.552	1.102	.450	
Cost of Production	1.833	1.270	.563	
Extraordinary Drifting & Exploratory	.110	.053	.057	
DEPRECIATION.				
Plant	.050	.050		
Equipment	.004	.018		.014
Total Depreciation	.054	.068		.014
Taxes	.078	.064	.014	
Central Office	.072	.058	.014	
Sundry Expense	.031	.016	.015	
Cost on Stockpile	2.225	1.529	.696	
Loading & Shipping	.082	.041	.041	
Total Cost on Cars	2.307	1.570	.737	
No. Days Operating	308	309		1
No. Shifts and Hours	2-8hr	2-8hr		
Avg. Daily Product	303	337		34
COST OF PRODUCTION.				
Labor	1,237	.901	.336	
Supplies	.596	.369	.227	
Total	1.833	1.270	.563	

MEADOW MINE.

COMPARATIVE WAGES AND PRODUCT.

	1918.	1917.	INCREASE.	DECREASE.
PRODUCT	93,389	103,987		10,598
No.Shifts and Hours	2-8hr	2-8hr		
AVERAGE NUMBER MEN WORKING				
Surface	22	21	1	
Underground	51	58		7
Total	73	79		6
AVERAGE WAGES PER DAY				
Surface	4.55	3.60	.95-26.4%	
Underground	5.50	4.42	1.08-24.5%	
Total	5.21	4.03	1.18-29%	
WAGES PER MONTH OF 25 DAYS				
Surface	113.75	90.00	23.75	
Underground	137.50	110.50	27.00	
Total	130.25	100.75	29.50	
PRODUCT PER MAN PER DAY				
Surface	13.51	15.95		2.44
Underground	5.89	5.76	.13	
Total	4.10	4.23		.13
LABOR COST PER TON				
Surface	.337	.226	.111	
Underground	.932	.727	.205	
Total	1.269	.953	.316	
AVG. PRODUCT BRK'G & TRM'G	8.52	8.56		.04
" WAGES CONTRACT MINERS	5.81	4.52	1.29	
" " " TRAMMERS	0	0		
" " " LABOR	5.81	4.52	1.29	
TOTAL NUMBER OF DAYS				
Surface	6,913¼	6,518½	394¾	
Underground	15,848	18,040¼		2,192¼
Total	22,761¼	24,558¾		1,797½
AMOUNT FOR LABOR				
Surface	31,455.42	23,453.21	8,002.21	
Underground	87,081.15	75,586.41	11,494.74	
Total	118,536.57	99,039.62	19,496.95	

Proportion Surface to Underground Men:
1918 - 1 to 2.31
1917 - 1 to 2.8
1916 - 1 to 3.

MEADOW 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" Timver	18,075	.02	361.50	267.06
6" to 8" "				878.69
8" to 10" "	59,920	.071	4267.25	3136.04
10" to 12" "	12,176	.079	957.84	1312.56
Total - 1918	90,171	.062	5586.59	
Total - 1917	97,292	.0575		5594.35
	LINEAL FEET.	PER 100'.		
6' Lagging	274,380	.583	1599.87	1491.00
Total Lagging (1)	274,380	.583	1599.87	1491.00
Total - 1918	274,380	.583	1599.87	
Total - 1917	348,840	.427		1491.00

Product for year	93,389	106,382
Feet Timber per ton of Ore	.965	.914
Feet Lagging " (1)	2.938	3.279
Feet Lagging per foot of Timber	3.043	3.584
Cost per ton for Timber	.060	.052
" Lagging	.017	.015
" Poles	0	0
" Timber, Lagging & Poles	.077	.067
Equivalent of stull timber to Board Measure	138,165	144,892
Ft.Bd.Measure per ton of ore	1.48	1.36

Total cost for Timber, Lagging & Poles - 1918		7186.46
" 1917		7085.35
" 1916		2482.70

MEADOW MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICES.	AMOUNT 1 9 1 8.	AMOUNT 1 9 1 7.
30% Powder				48.21
40% "	32,150	.1833	5894.44	4204.07
Total Powder	32,150	.1833	5894.44	4252.28
Fuse	61,000	8.14	495.56	403.44
Caps	23,400	12.62	295.53	312.48
Cap Crimpers				.25
Tamping Bags	9,462		12.40	
Total Fuse, Etc.			803.49	716.17
Total Explosives			6697.93	4968.45
Product			93,389	106,382
Pounds Powder per Ton Ore			.344	.262
Cost per ton for Powder			.063	.040
" " Fuse,Etc.			.009	.007
" " Explosives			.072	.047
Avg.Price per Lb.for Powder			.1832	.1529

HELMER MINE

ANNUAL REPORT FOR 1 9 1 8.

Operations at the Helmer Mine from January 1st. to the opening of navigation consisted in repairing the pumping shaft, cleaning out the drainage ditches, thoroughly overhauling the plant equipment and preparing the pit for mining activities.

It was necessary to replace a large number of the casing planks in the shaft and to brace several of the sets. Some minor repairs were made to the compound Prescott and small electrical centrifugal pump.

The surface drainage ditches were more or less filled with debris and were thoroughly cleaned so that the water from the Spring freshets could be carried off without any danger of overflowing the banks and draining to the open pit.

The steam line leading from the boiler house to the pump shaft was placed on substantial carriers and the steam boilers used in connection with Helmer pumping operations were thoroughly overhauled and furnished with new stacks.

A rough shed was erected to house one locomotive and was piped for steam heat. The four locomotives were run into this building one at a time and were given a thorough overhauling. It was necessary to reflue one of the boilers throughout and the other three required a number of new flues. Bent frames were straightened, worn out gears replaced and considerable carpenter work put on the cabs and riding platforms. The locomotives were also scraped and painted.

Rather extensive repairs were made on one of the Model "60", the No. "31" revolving and the small Thew revolving shovels. This equipment had been subjected to rather severe service by the former operators and had been allowed to run down, anticipating

that the property would be sold. The Thew boiler was entirely reflued and men from the Hibbing Boiler Works devoted considerable time to the repairs on the Model "60" and "31" shovels. A number of worn out pinions were replaced, the dipper sticks and buckets repaired and new cabs furnished.

Of the forty 7-yard dirt cars, which we purchased with the Helmer equipment, sixteen were overhauled and put in service at the Helmer Mine during the Spring and Summer and eight were sent to the Crosby Mine. The trucks of these cars were in very fair shape, but the flanges on some of the wheels had worn very sharp and the metal framework of the boxes badly bent and the hardwood boxes in such a bad state of repair that they were not serviceable. Sixteen of these cars were fitted out by robbing parts from the other cars and were furnished with new boxes and painted. The sixteen cars went through the year in very good shape and unless the winter stripping at the Wade Mine batters them up badly, it will not be necessary to make any extensive repairs this Spring.

It was necessary to replace a number of ties and splicing bars along the approach track. On account of the steepness of the stripping banks, a considerable amount of boulders had been loosened when the frost left the ground in the Spring and had rolled onto the approach track and around the edges of the pit. These boulders were loaded into the dirt cars and taken out to the waste dump. A force of from 8 to 10 men was employed for several weeks prior to the opening of navigation in drilling and blasting the east ore face. The frost had penetrated about 8' into the bank of ore and it was advisable to have this blasted to aid in thawing out the material. Loading tracks were laid along the pile of blasted ore.

Some repairs were made to the boiler and hoisting equipment for the inclined tramway and new chutes were built for dumping into railroad cars. It was also necessary to straighten the inclined track and place new carrying timbers under the rail grizzly in the open pit pocket.

Helmer Mine Ore Estimate of January 1st., 1919.

Following is an estimate of the ore in sight at the Helmer Mine on January 1st., 1919, the tonnage reported January 1st., 1918 and the amount mined during the year.

A factor of 13 cubic feet per ton was used in this estimate, with a 10% deduction for mining loss in the case of the underground ore, a deduction of 20% for rock in the open pit ore and a deduction of 25% for rock and mining loss in the case of the ore to be scrammed along the open pit banks.

	Tons
Open pit ore in sight January 1st., 1918	281,000
Scram ore in sight January 1st., 1918	40,000
Underground ore in sight January 1st., 1918	129,000
TOTAL ORE IN SIGHT JANUARY 1ST., 1918	450,000
Ore mined from open pit during 1918	207,498
Underground ore mined and stocked in open pit during 1918	8,930
TOTAL ORE MINED DURING 1918	216,428
Open pit ore in sight January 1st., 1919	73,000
Scram ore in sight January 1st., 1919	40,000
Underground ore in sight January 1st., 1919	120,000
TOTAL ORE IN SIGHT JANUARY 1ST., 1919	233,000

While there has been no decrease in the estimated tonnage, as of January 1st., 1919, other than the quantity mined during 1918, it has been necessary to show a lower iron content in the ore, due to diamond drilling in the open pit and underground development work.

I estimate the average grade of ore in the Helmer Mine as of January 1st., 1919, as follows:

Tons	Fe.	Phos	Mn.	Sil.	Mois.	Fe.Nat.
233,000	57.17	.070	1.35	8.40	12.67	49.92

We consider that exploration and development work on this property has exhausted any possibility of our showing any additional tonnage in future operations.

HELMER MINE.

OPEN PIT OPERATIONS

Prior to the opening of navigation, vertical holes were put down along the south and east banks from 10 to 20 feet, depending on the hardness of the ore and frost conditions. These holes were placed at intervals of 20 feet and the blasting was done with black powder. The men then trimmed down the ore for the depth blasted and similar operations were conducted from the lower bench. The ore banks vary from 40 to 50 feet in height and on account of the frost and seams of hard ore, it was impossible to blast them with horizontal gopher holes. The south bank was blasted and trimmed to the Oliver Iron Mining Company's line in several places and the east bank to the Wade boundary along the central part of the pit.

Open pit mining operations were inaugurated on the 17th of April and continued to November 1st. One of the Model "60" shovels was engaged in digging out the approach ore and attacking the two islands of rather inferior material, which had been left by Swallow & Hopkins in the center of the pit, between April 17th and June 15th. This shovel loaded the material into Great Northern ore cars, which were spotted and hauled out of the old Helmer approach with our Lima locomotives. Due to the excessive grades, the locomotives could haul but one car, two engines being engaged on this work. The Model "60" shovel also took one cut along the Oliver Iron Mining Company's line, the product therefrom being loaded into ore cars and hauled out of the approach.

Unfortunately the islands of lean ore contained considerable lumpy material and it was impossible to sort this out to advantage with the larger type of shovel. The greater part of the chunks were cast to one side on the day shifts, but undoubtedly the night crew was so desirous of getting a tonnage, that the sorting was not conducted in a very careful manner. It was absolutely necessary to remove these islands prior to attacking

the approach ore along the north bank.

On account of drainage conditions in the bottom of the pit, it was inadvisable to start any sinking cuts with the Model "60" shovel. With the exception of a small tonnage of Helmer ore along the Wade line, operations had progressed to such an extent by the middle of June that it was impossible to secure a satisfactory tonnage from the Model "60" shovel cuts and we, therefore, decided to attack the approach ore. The Model "60" shovel was taken out of the pit and the Model "36" revolving shovel sent over from the Meadow Mine.

The Model "36" shovel was operated on the approach ore bank along the north and west sides of the pit during the months of July and August, the product being hauled to the incline pocket. After removing the Model "60" shovel and starting to attack the approach berm, no ore was hauled out of the approach. Subsequent to the digging out of the approach ore, the Model "36" shovel was engaged along the Wade line, finishing the season in this operation.

The north ore wall, standing along the foot rock, was too lean to mine in any quantity, but it was deemed advisable to blast this down and cast it back from the rock, so that the boulders and surface material would not roll down the bank and become mixed with the ore during the Spring thaw.

It is the intention to load out this ore during the coming season, whenever our grade is such that we can stand some lean material in the mixture. The proportion of lumps in this ore is not large.

After taking the Model "60" shovel from the pit, the machine was used in digging a berm along the Oliver Iron Mining Company's line. This work was done in connection with Wade ore operations and was not taken up under Helmer accounts.

Two locomotives, six dirt cars and the Models "30" and "36" shovels were left in the bottom of the Helmer pit. This equipment will be utilized in the handling of the balance of the Helmer ore and in the mining of the bulk of the Wade ore, to be extracted by the open pit method. The product mined from the bottom of the pit is all hauled to, and handled on, the inclined tramway.

It will be feasible to start mining the Helmer pit bottom during the coming summer, as the Wade underground drift will drain the water therefrom. The bulk of the 50,000 tons of Helmer ore to be mined by open pit methods in 1919 will be derived from the bottom and northeast corner of the pit. Some of the north ore will be worked in, as well as the small remaining tonnage along the Oliver Iron Mining Company's line.

OPEN PIT DRILLING

In order to definitely determine the character and analysis of the ore in the bottom of the Helmer pit, seventeen drill holes were put down. We have mined down to the rock over the Westerly half of the pit, consequently the drilling was confined to the east half.

The drilling showed that the higher grade ore occurs along the Wade line and in the northeast corner of the pit. There is a horse of taconite which comes up practically to the present pit bottom and extends from Drill Hole No. 16 to Drill Hole No. 10. The taconite dies out toward the east and by far the best ore section is that along the Wade line.

Following are the results of the Helmer drilling:

DRILL HOLE NO. 200

Footage	Fe.	Phos	Mn.	Sil.
0- 5	45.92	.050	6.64	5.62
5-10	58.86	.056	.63	8.14
10-15	62.10	.057	.37	3.34
15-20	62.12	.061	.63	3.91
20-25	56.27	.059	.44	14.27
25-30	60.00	.095	.42	8.25
30-33	56.43	.108	.24	13.20
33-58	Taconite.			

DRILL HOLE NO. 201

Footage	Fe.	Phos	Mn.	Sil.
0- 5	61.45	.068	.62	5.57
5-10	62.58	.048	.24	6.62
10-12	55.14	.044	.25	16.18
12-17	58.54	.070	.16	11.50
17-18	60.32	.097	.38	7.34
18-31	Taconite.			
	Hole Bottomed.			

DRILL HOLE NO. 202

	Fe.	Phos	Mn.	Sil.
0- 5	57.38	.073	1.14	8.71
5-10	63.21	.079	.36	5.20
10-15	62.89	.087	.32	8.47
15-20	64.03	.109	.46	4.56
20-45	Taconite.			
	Hole Bottomed.			

DRILL HOLE NO. 203

	Fe.	Phos	Mn.	Sil.
0- 5	62.89	.061	.52	4.65
5-10	62.87	.065	.56	3.23
10-15	62.24	.061	.37	5.74
15-20	60.62	.074	.46	8.78
20-24	50.41	.082	.33	19.70
24-36	Taconite.			
	Hole Bottomed.			

DRILL HOLE NO. 204

0- 5	62.25	.054	.42	6.15
5-10	62.26	.060	.24	6.51
10-15	49.50	.053	.38	23.25
15-19	53.90	.076	.26	18.00
19-36	Taconite.			
	Hole Bottomed.			

DRILL HOLE NO. 205

	Fe.	Phos	Mn.	Sil.
0- 5	55.27	.075	.68	14.34
5-10	54.30	.026	.20	15.93
10-15	55.60	.025	.62	14.96
15-20	47.18	.027	.34	27.74
20-25	56.73	.022	.35	15.24
25-30	58.35	.030	.44	13.40
30-35	56.41	.038	1.06	14.48
35-37	52.03	.037	1.21	19.67
37-62	Taconite.			
	Hole Bottomed.			

DRILL HOLE NO. 206

	Fe.	Phos	Mn.	Sil.
0- 2	61.34	.041	.81	6.20
2-41	Taconite.			
	Hole Bottomed.			

DRILL HOLE NO. 207

Footage	Fe.	Phos	Mn.	Sil.
0- 5	56.81	.030	2.40	9.00
5-10	62.40	.026	.41	5.26
10-15	60.93	.023	.37	9.15
15-20	56.19	.024	.30	15.00
20-25	55.68	.064	.28	15.93
25-44	Taconite. Hole Bottomed.			

DRILL HOLE NO. 208

	Fe.	Phos	Mn.	Sil.
0- 5	53.81	.059	.42	16.76
5- 8	59.00	.057	.38	10.64
8-15	Taconite. Hole Bottomed.			

DRILL HOLE NO. 209

0- 5	59.33	.067	.52	5.44
5-10	62.73	.080	.60	3.04
10-15	61.42	.061	.72	5.12
15-20	60.62	.120	.54	4.80
20-25	59.65	.115	.40	7.84
25-27	53.17	.214	.80	12.50
27-40	Taconite. Hole Bottomed.			

DRILL HOLE NO. 210

	Fe.	Phos	Mn.	Sil.
0- 5	61.12	.054	.50	6.87
5-10	57.10	.043	.32	13.32
10-11	50.10	.077	.51	21.48
11-27	Taconite. Hole Bottomed.			

DRILL HOLE NO. 211

	Fe.	Phos	Mn.	Sil.
0- 2	41.09	.051	.27	34.10
2-18	Taconite. Hole Bottomed.			

DRILL HOLE NO. 212

0- 5	52.80	.058	.54	18.17
5-21	Taconite. Hole Bottomed.			

DRILL HOLE NO. 213

	Fe.	Phos	Mn.	Sil.
0- 5	62.15	.059	.75	4.83
5- 8	59.48	.051	1.64	7.81
8-13	55.24	.055	2.40	10.98
13-18	57.46	.083	.57	10.87
18-28	Taconite. Hole Bottomed.			

DRILL HOLE NO. 214

Footage	Fe.	Phos	Mn.	Sil.
0- 5	55.71	.055	1.35	12.36
5-10	57.49	.048	1.60	9.83
10-15	60.58	.038	.60	9.00
15-20	52.00	.040	.46	21.23
20-25	54.87	.055	.30	17.97
25-28	50.93	.077	.25	21.18
28-39	Taconite.			
	Hole Bottomed.			

DRILL HOLE NO. 215

	Fe.	Phos	Mn.	Sil.
0- 5	61.57	.063	.68	5.70
5-10	59.56	.059	.34	8.07
10-14	59.36	.112	.32	7.63
14-26	Taconite.			
	Hole Bottomed.			

DRILL HOLE NO. 216

0- 5	Ore.
5-17	Taconite.
	Hole Bottomed.

SHIPMENTS

Following are the cargoes of Helmer grade shipped during the 1918 season and the analysis of same as obtained from Mine and Lower Lake Chemists' sampling. The first thirteen cargoes were made up entirely of Helmer ore, whereas the last eleven cargoes carried a mixture of Helmer and Wade ore, the bulk of which came from the Wade.

	Fe.	Phos	Mn.	Sil.	Mois	Fe.Nat.	Tons
SHAUGNESSY							8,264
Mine	58.69	.054	1.08	6.77	-----	------	
Textor	59.25	---	----	----	12.51	51.838	
Cremer & Case	59.20	---	----	----	13.54	51.184	
MICHIGAN							6,471
Mine	58.81	.055	1.14	6.72	-----	------	
Textor	58.87	---	----	----	13.26	51.064	
STACKHOUSE							9,327
Mine	58.11	.067	.99	7.43	-----	------	
Crowell & Murray	59.06	---	--	----	12.71	51.553	
Cremer & Case	58.80	---	---	----	12.41	51.503	
SHENANGO							3,830
Mine	58.98	.067	.93	6.28	-----	------	
Cremer & Case	59.70	---	--	----	13.63	51.563	
SLICK							9,962
Mine	58.47	.071	1.13	6.78	-----	------	
Emmerton	58.43	---	----	----	13.97	50.267	
Rattle	58.60	---	----	----	13.67	50.589	
MUNISING							6,414
Mine	59.14	.064	.91	6.58	-----	------	
Crowell & Murray	59.27	---	--	----	14.35	50.765	
WILPEN							10,864
Mine	57.55	.071	1.18	7.75	-----	------	
Cremer & Case	57.40	---	----	----	14.61	49.014	
Textor	57.00	---	----	----	14.55	48.707	
CRAWFORD							9,987
Mine	56.51	.069	1.23	8.89	-----	------	
Textor	56.35	---	----	----	13.83	48.557	
Cremer & Case	56.70	---	----	----	13.27	49.176	

	Fe.	Phos	Mn.	Sil.	Mois	Fe.Nat.	Tons
WILPEN							11,544
Mine	56.55	.069	1.14	8.91	-----	------	
Textor	55.33	---	1.21	10.30	13.47	47.877	
WILPEN							5,507
Mine	58.29	.063	.97	8.01	-----	------	
Crowell & Murray	58.00	---	--	----	15.01	49.294	
SLICK							10,388
Mine	57.08	.086	1.28	7.39	-----	------	
Cremer & Case	57.30	---	----	----	14.74	48.854	
SNYDER, JR.							4,730
Mine	57.49	.090	1.11	7.47	-----	------	
Cremer & Case	57.90	---	----	----	13.40	50.141	
SNYDER, JR.							4,903
Mine	57.97	.082	1.23	7.85	-----	------	
Crowell & Murray	58.43	---	----	----	12.87	51.494	
PONTIAC							5,836
Mine	57.84	.081	1.29	8.06	-----	------	
Rattle	57.40	---	----	----	13.74	49.513	
GLENSHEE							9,157
Mine	57.56	.069	1.26	9.01	-----	------	
Emmerton	56.88	---	----	----	13.31	49.309	
Cremer & Case	57.00	---	----	----	13.51	49.299	
SANOMA							5,511
Mine	57.08	.071	1.33	9.59	-----	------	
Crowell & Murray	56.95	---	----	8.55	13.42	49.307	
CADILLAC							6,871
Mine	57.98	.072	1.55	8.39	-----	------	
Textor	57.70	---	----	7.80	11.92	50.822	
ANGELINE							7,103
Mine	57.92	.070	1.21	7.49	-----	------	
MIDVALE							12,350
Mine	57.51	.069	1.34	8.28	-----	------	
Crowell & Murray	57.90	---	----	----	13.15	50.286	
Cremer & Case	58.00	---	----	----	12.66	50.669	
CADILLAC							6,866
Mine	57.88	.074	1.28	8.54	-----	------	
Rattle	58.30	---	----	----	12.81	50.832	

	Fe.	Phos	Mn.	Sil.	Mois	Fe.Nat.	Tons
ANGELINE-							7,138
Mine	57.67	.075	1.13	8.60	-----	------	
Crowell & Murray	57.40	---	----	----	13.40	49.708	
PRESQUE ISLE-							6,913
Mine	58.05	.072	.98	8.33	-----	------	
Textor	58.95	---	--	----	13.52	50.980	
ROGERS-							10,530
Mine	57.15	.070	1.16	8.94	-----	------	
Cremer & Case	56.70	---	----	----	13.19	49.221	
Crowell & Murray	56.62	---	----	----	13.45	49.005	
PIONEER-							9,969
Mine	58.48	.080	.58	8.40	-----	------	
Crowell & Murray	58.47	---	--	----	15.08	49.653	
Cremer & Case	58.90	---	--	----	15.00	50.065	
SCHOONMAKER-							4,559
Mine	58.60	.071	.66	7.86	-----	------	
Rattle	56.80	---	--	----	14.37	48.630	
QUINCY SHAW-							10,152
Mine	59.12	.069	.59	6.64	-----	------	
Crowell & Murray	59.64	---	--	----	12.32	52.292	
RIVERTON-							7,165
Mine	58.82	.074	.79	6.85	-----	------	
Crowell & Murray	59.39	---	--	----	12.18	52.156	
Cremer & Case	59.20	---	--	----	12.26	51.942	
ISHPEMING-							10,929
Mine	59.73	.067	.63	6.21	-----	------	
Textor	60.30	----	--	----	11.90	53.124	
Cremer & Case	60.30	---	--	----	11.88	53.136	
REPLOGLE-							-10,892
Mine	59.97	.063	.64	6.64	-----	------	
Emmerton	59.30	---	--	----	11.66	52.386	
Cremer & Case	60.10	---	--	----	11.23	53.351	
SINALOA-							3,550
Mine	59.73	.062	.62	6.79	-----	------	
Textor	59.00	---	--	----	11.40	52.274	
WILPEN-							2,552
Mine	60.55	.062	.77	5.67	-----	------	
Crowell & Murray	61.13	---	--	----	12.08	53.745	
MORRELL-							7,659
Mine	60.05	.063	.79	6.34	-----	------	
Cremer & Case	61.10	---	--	----	12.38	53.536	
Textor	61.20	---	--	----	12.36	53.636	

HELMER MINE.

	Fe.	Phos	Mn.	Sil.	Mois.	Fe.Nat.	Tons
ANGELINE							6,914
Mine	59.87	.064	.92	5.95	-----	------	
Textor	60.20	---	--	----	13.64	51.989	
CLEMENT							5,289
Mine	60.76	.056	.79	5.81	-----	------	
Emmerton	60.73	---	--	----	12.36	53.224	
Cremer & Case	61.00	---	--	----	12.27	53.515	
CADILLAC							6,324
Mine	60.69	.067	.84	5.03	-----	------	
Rattle	60.80	---	--	----	13.12	52.823	
NEGAUNEE							4,504
Mine	60.14	.072	.88	4.67	-----	------	
Emmerton	60.76	---	--	----	11.88	53.542	
Crowell & Murray	61.31	---	--	----	12.06	53.916	
PETER WHITE							4,100
Mine	60.43	.076	.94	4.69	-----	------	
Textor	60.70	---	--	----	13.03	52.791	

Following is the average analysis of the Helmer grade shipped during the 1918 season, as obtained from Mine and Lower Lake Chemists' sampling:

	Fe.	Phos	Sil.	Mn.	Mois.	Fe.Nat.
Mine	58.40	.070	7.42	1.05	-----	------
Lower Lake	58.32	---	----	----	13.24	50.878

This grade is made up of 207,498 tons of Helmer and 67,577 tons of Wade ore.

ACCIDENTS

There was but one accident at the Helmer Mine during the 1918 season, where the injured person lost any appreciable time.

Following is a record of this accident:

JOHN SODEE

Injured----------March 23rd, 1918.
Occupation----------Car repairer.
Nationality----------Austrian.
Time Lost----------18 Days.
Received Compensation----------None.

Remarks: A piece of iron fell from Sodee's hands onto his left foot.

UNDERGROUND OPERATIONS

Underground development work was started the latter part of October and three gangs were employed in opening up the 1407 Foot Sub and driving a heading westward on the rock at an elevation of 1386 feet. The bottom heading had been extended in 220 feet from the open pit by the end of the year and three raises, located 100, 150 and 200 feet respectively from the drift mouth, had been pushed up to the sand. Contracts Nos. 4, 5, and 6 were engaged in developing the 1433 Foot Sub from these raises the latter part of December. The sub is just under the sand at the westerly raise. There is 5 feet of ore over the back at the center raise and 10 feet in the back at the easterly raise. The top ore is of a very inferior grade, however.

The product from these raises is trammed to the pit on the 1386 Foot Level and the engine on the Model "30" shovel is used to pull the tram car up an inclined stocking trestle. The steam shovel is moved eastward as the stockpile is built out. The trestle starts at the mouth of the drift and has a 10% grade. One-yard side-dumping cars, purchased with the Helmer equipment, are used for tramming and stocking.

"1407 Foot Sub"

Two contracts were employed at this elevation during the months of November and December.

Contract No. 1 crosscutted to the south rock, 60 feet west of the old Swallow & Hopkins drift, and have followed this rock in a southeasterly direction to the Oliver Iron Mining Company's line. The ore between this drift and the open pit will now be sliced out. The sand dips rather abruptly to the south and in consequence the stope will increase in height toward the north, in fact, it will be necessary to work it out with top sets after

taking 3 or 4 slices.

Contract No. 3 was engaged in developing the westerly limits of the ore body at this elevation from Swallow & Hopkins old workings. This gang had followed the ore to its westerly limits and had started stoping and caving back before the end of the year.

The product from Contracts Nos. 1 and 3 is trammed and stocked in the open pit by the miners. The tramway enters the bank 20 feet above the pit bottom and the ore is stocked without the use of a trestle.

Development work at the end of the year has demonstrated that the underground ore body has a length of 300 feet and an average width of 90 feet at an elevation of 1433 feet. On the 1407 Foot Sub the deposit has a length of approximately 400 feet and an average width of 100 feet. Below the 1407 Foot Sub the ore body narrows rapidly, and the quality of the ore is inferior. The 1386 Foot Level was driven through rather lean material for 200 feet. From available information, the deposit at this elevation has an average width of only about 50 feet.

The development of the underground deposit has demonstrated the fact that the bottom ore and that along the foot wall is quite lean and is somewhat mixed with seams of taconite. It appears, however, that there will be sufficient ore of a desirable grade to at least realize the earlier estimates, which were based largely on drill records.

The average analysis of the Helmer ore in stockpile January 1st., 1919, is as follows:

Tons.	Fe.	Phos.	Mn.	Sil.
8,930	56.62	.064	1.89	7.52

A large part of this product came from development work on the bottom level and along the shore lines and in consequence the grade is lower than the average. When slicing operations are inaugurated, the grade of the ore will show a decided improvement and we fully expect that the average iron content in our stock-

pile will run close to 58% at the opening of navigation.

HELMER MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1918.

GRADE	IRON	PHOS.	SILICA	MANG.
Helmer,	57.83	.071	7.99	1.13

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1918.

GRADE	Mine IRON	Mine PHOS.	Mine MANG.	Lake Erie IRON	Lake Erie MOIST.
Helmer	58.40	.070	1.08	58.41	13.19

ORE STATEMENT AND SHIPMENTS FOR YEAR 1918.

	HELMER
On hand Jan. 1st, 1918,	0
Output for Year,	216,428
Total,	216,428
Shipments,	207,498
Balance on Hand,	8,930

1918 - 2-10 Hr. Shifts Jan. 1st to Nov. 1st
3-8 Hr. Shifts Nov. 1st to Dec. 31st

HEIMER ORE.

HELMER MINE.

COMPARATIVE MINING COST FOR YEAR.

		1 9 1 8.
PRODUCT		216,428
General Expense		.047
Maintenance		.105
Mining Expense		.490
Cost of Production		.642
Exploratory		.010
DEPRECIATION.		
Original Purchase		.912
Plant		.105
Equipment		.051
Total Depreciation		1.068
Taxes		.041
Central Office		.022
Supply Inventory		.001
Miscellaneous		.054
Cost on Stockpile		1.834
Loading & Shipping		.023
Cost on Cars		1.857
No.Days Operating		223
No.Shifts and Hours	2-10hr	173
	3-8hr	50
Avg.Daily Product		970
COST OF PRODUCTION		
Labor		.383
Supplies		.259
Total		.642

Mine leased in 1918.

HELMER MINE.

COMPARATIVE WAGES AND PRODUCT.

	1918.
PRODUCT	216,428
No. Shifts and Hours	2-10hr-173 3- 8hr- 50
AVERAGE NO. MEN WORKING	
Surface	18
Underground	50
Total	68
AVERAGE WAGES PER DAY	
Surface	4.75
Underground	5.15
Total	5.04
WAGES PER MONTH OF 25 DAYS	
Surface	118.75
Underground	128.75
Total	126.00
PRODUCT PER MAN PER DAY	
Surface	48.20
Underground	17.08
Total	12.61
LABOR COST PER TON	
Surface	.098
Underground	.302
Total	.400
AVG. PRODUCT BRK'G & TRM'G	26.10
" WAGES CONTRACT MINERS	Co.Acct.
" " " TRAMMERS	"
" " " LABOR	"
TOTAL NUMBER OF DAYS	
Surface	4,490¼
Underground	12,672¾
Total	17,163
AMOUNT FOR LABOR	
Surface	21,323.56
Underground	65,262.81
Total	86,586.37

Proportion Surface to Underground Men:
1918 - 1 to 2.77

Mine leased by C.C.I.Co. Jan. 2, 1918.

HELMER 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" Timber	2,164	.04907	106.20	
6" to 8" "	1,298	.04907	63.72	
8" to 10" "	866	.04907	42.48	
Total - 1918	4,328	.04907	212.40	
	LINEAL FEET.	PER 100'.		
6' Lagging	45,900	.364	167.50	
Total Lagging	45,900	.364	167.50	
Total - 1918	45,900	.364	167.50	

Product	216,428
Feet Timber per ton of Ore	.00199
Feet Lagging "	.21507
Feet Lagging per foot of Timber	10,6053
Cost per ton for Timber	.00098
" Lagging	.00077
" Timber, Lagging & Poles	.00175
Equivalent of stull timber to Board Measure	7,117
Feet Bd.Measure per ton of ore	.03288
Total cost for Timber, Lagging & Poles - 1918	379.90

HELMER MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICES.	AMOUNT 1 9 1 8.	AMOUNT 1 9 1 7.
20% Powder	10,800	.1423	1536.93	
40% "	16,850	.1741	2933.04	
Black Powder	24,600	.0861	2118.56	
Total Powder	52,250	.1261	6588.53	
Fuse	86,500	8.10	700.65	
Caps	10,600	14.10	149.54	
Cap Crimpers	4	.65	2.60	
Electric Exploders	4,800	.0948	455.07	
Total Fuse,Etc.			1307.86	
Total Explosives			7896.39	
Product			216,428	
Pounds Powder per Ton Ore			.2414	
Cost per ton for Powder			.0304	
" " Fuse,Etc.			.006	
" " All Explosives			.0365	
Avg.Price per lb. for Powder			.1261	

WADE MINE

ANNUAL REPORT FOR 1918

The work of clearing the land for the plant and location sites of the Wade Mine was started the forepart of March and was completed by the forepart of May. Roads were constructed, leading from the Helmer Mine tracks to the plant site and from the highway along the north line of the property into the location. The Township of Great Scott did considerable work on the location roads.

The installing of two 150-horse power boilers was started in April and placed in operation in May. A hoist from the Gwinn District and a compressor from the Imperial Mine were put in commission the latter part of May.

"LOCATION AND PLANT BUILDINGS"

Contractor Proksch began work on the location houses and sheds in April. All of the location sheds had been erected by June 1st., the two boarding houses completed and ready for occupancy during the month of June and beginning August 1st. two double houses per week were finished and turned over to us. All of the dwellings, including the two cottages and captain's house, were finished and painted by the forepart of September and good progress made on the dry, shops, power house and office. Contractor Proksch completed the plant buildings during October, including the painting of the woodwork, and the heating systems were installed in November. The office, shops and dry house were occupied during November and the work on the power house machinery foundations was completed during December.

While all of the location houses were ready for occupancy sometime before the end of the year, we did not fill them all up, as we deemed it advisable to reserve accommodations for miners.

Our underground operations at the Wade Mine will be gradually increased and by the opening of navigation all houses in our location should have tenants. We are also very careful not to let any of these houses to undesirable tenants and we require that our employees work some time before we are satisfied in giving them a house.

"SHAFT HEADFRAME"

Four carpenters were employed in the erection of the shaft headframe. This work was started the latter part of May and completed in August. The sill timbers were placed on substantial concrete piers and the timbers carefully braced and bolted. The lining plates were put in the pocket, the sheaves placed in position and stairways, provided with hand rails, were built, leading from the collar to the landing platform.

Stocking operations were conducted from a temporary trestle just above the collar of the shaft, the rock being dumped onto the swampy ground southwest of the shaft and the ore trammed out to the southeast. The mine's output will be handled from the permanent trestle, which was under construction in December, soon after the first of the year.

"SHAFT"

The Wade Mine shaft was started on the 17th of April, three 8-hour crews being employed on this work. The shaft was sunk 58 feet during April and 68 feet in May, progress being slowed up to a considerable extent at a depth of 114 feet, due to the unexpected flow of water. Two No. 10 Cameron pumps were brought over from the Meadow Mine to replace the smaller equipment which we had on hand. An 8 inch discharge column was installed and sinking operations resumed. The progress during June and July was very unsatisfactory, owing to the extreme hardness of the

ledge rock and the quantity of water pouring into the shaft. We had considerable difficulty in keeping the pumps repaired and in one instance they were drowned out, due to a broken flange in our discharge line. To recover the pumps, we were obliged to utilize two No. 9 Camerons from the Crosby Mine. The flow of water increased from 200 gallons per minute at the ledge (114 foot elevation) to 400 gallons per minute at the 200 foot level.

The shaft was bottomed in August, 223 feet below the collar. The material cut from 196' to 223' was a slaty rock and from 114' to 196' we encountered hard taconite with occasional seams of ore. Due to the shattered condition of the formation, we were unable to cut off the water from the shaft although we tried in several instances to cut in on the side for a pumping station and construct a concrete gutter around the outside of the timber.

The delays arising from our not having sufficient equipment to handle the flow of water and pump trouble was responsible for our exceeding the sinking estimate by a very appreciable amount. We had anticipated bottoming the shaft by July 1st, whereas it was the middle of August and the heavy charges to pumping and compressor affected the cost to a considerable extent. Further than this, when the estimate for sinking and timbering the shaft was made, we figured on a location showing 120 feet of surface material, 25 feet of solid rock and 80 feet of broken taconite and ore. On account of our proving an extension of our main ore channel, it was advisable to shift the location of our shaft, with the result that our sinking conditions were less favorable from the cost standpoint.

"UNDERGROUND DEVELOPMENT"

Work on the plat and pocket was started in August and completed in September, when drifting on the first level was begun. A drift to the northeast was pushed out in taconite for 60 feet and will be utilized for our shaft tail track. Our pump

room was opened to the south from the breast of this heading.

The pump room, which is 20 feet wide, 50 feet long, and 10 feet in height, was completed in November and the work of excavating the sump was well along by the first of the year. While all of this excavation was in solid rock, the material in the back of the pump room was somewhat slabby and it was necessary to timber it. It would have been desirable to have installed the electrical pumps in December, if our equipment had been delivered according to schedule. Due to the non-delivery of material, it will be sometime subsequent to January 1st. before our electrical pumps are in operation and this will be a serious item of expense. We had anticipated installing our underground electrical equipment in November at the time of making our estimate.

As the Wade Mine pumping equipment will handle the water from the Helmer and Wade pits, we will construct a concrete dam and regulate the flow of water into our sump through a 10 inch pipe, with the gate valve set on the pump room side of the dam. In this connection it will be necessary to put up a raise approximately 40 feet and drift from the top thereof to the shaft, with the idea of affording a traveling way for the pumpmen and for carrying our wiring and discharge columns and making of our main level a storage basin for flood waters. Before our electric pumps could be drowned, it would, therefore, be necessary to flood the first level workings and for the water to raise in the pit and shaft 40 feet above this level. This work will be completed before a connection is made between the Wade shaft and the pit, so that we will be safe-guarded during the Spring freshets.

The drift had been driven to the south and west from the shaft for 505 feet by the end of the year. We had anticipated cutting 200 feet of rock in leaving the shaft, basing the assumption

on the drill records. We encountered ore, however, 100 feet from the shaft and cut no further rock. The average analysis of the 405 feet of ore shows better than 60% iron.

The heading is to be extended to the Helmer pit, a distance of 1,000 feet from the shaft and crosscuts are to be turned to the north and south at intervals of 50 feet, until the area, which is to be stripped, is reached. The crosscuts will be staggered, that is, No. 1 will be pushed north, No. 2 south, No. 3 north and so on. The open sets and switches were placed in Nos. 1, 2, 3 and 5 crosscuts and No. 1 crosscut had been extended 38 feet on a 50 foot radius curve and No. 2 crosscut 52 feet by the end of the year. No. 1 crosscut starts 100 feet west of the shaft and is in rock, while No. 2 crosscut is in high grade ore. The crosscuts will be extended to the rock and raises put up at intervals of 50 feet between the main heading and north and south ore shore lines.

Underground development work was necessarily restricted, owing to the fact that we could not handle more than a limited quantity of material in our shaft and on the headframe. When the skips, top tram cars and electric haulage is installed, we will be able to add considerably to our working force and our production will show a material increase in consequence. It is our intention to have at least eight headings in ore, so that we may take advantage of the increased facilities for handling our product, when the equipment is installed. We now figure on completing the installation of our electrical equipment by the early part of March.

The results of our underground development work has demonstrated a greater width to our bottom ore and more abrupt shore lines along the north and south boundaries of the deposit. Taken in conjuction with our drilling campaign during the past year, this development work has resulted in our showing a substantial increase in our ore reserve, as compared with a year ago.

ORE ESTIMATES

Following is an estimate of the ore in sight at the Wade Mine on January 1st., 1919, the tonnage reported January 1st., 1918, and the amount mined during the past year.

A factor of 13 cubic feet per ton was used in this estimate and a 10% deduction made to cover mining loss:

	Tons
Ore in sight Jan. 1st., 1918 (West Deposit)----------	1,164,000
Ore in sight Jan. 1st., 1918 (East Deposit)----------	1,356,000
TOTAL- -	2,520,000
Ore mined during 1918 (West Deposit)----------	67,577
BALANCE FROM THESE FIGURES- - - - - - - - - - - - - -	2,452,423
Ore in sight Jan. 1st., 1919 (West Deposit)----------	1,843,000
Ore in sight Jan. 1st., 1919 (East Deposit)----------	1,515,000
Ore In sight Jan. 1st., 1919 (Deacon Deposit)---------	175,000
TOTAL- -	3,533,000

Taking into consideration the shipments of Wade ore during 1918, there is an increase from the tonnage estimated for this property of 1,080,577 tons. Our drilling campaign has made it possible for us to estimate the so-called Deacon deposit, which is located near the southeast corner of our property and is a continuation of the Deacon ore body, mined by The Oliver Iron Mining Company. We re-estimated our east deposit upon the completion of our year's drilling campaign, with the result that the previous year's figures were reduced by 5,000 tons. No mining was done on this deposit during the year. The bulk of the increase was in the west deposit and was the result of drilling and underground development work during the year.

The average grades of the ore in the three deposits, as estimated on January 1st., 1919, are as follows:

	Tons	Fe.	Phos	Mn.	Sil.	Mois.
West Deposit --	1,843,000	58.07	.074	1.03	6.66	13.50
East Deposit --	1,515,000	56.91	.075	1.83	7.44	13.50

WADE MINE.

	Tons	Fe.	Phos	Mn.	Sil.	Mois.
Deacon Deposit --	(80,000	56.65	.045	1.16	8.04	12.50
	(95,000	55.77	.053	.42	8.43	12.50

From the above it is shown that we developed 80,000 tons of Bessemer ore and 1,000,000 tons of non-Bessemer ore during the year 1918. Our drilling campaign and development work was so comprehensive that we do not consider the development of any additional Bessemer or Non-Bessemer ore likely during the coming year.

No underground development work has been undertaken on the East or Deacon deposits, nor do we anticipate drifting to these ore bodies from the shaft during the year 1919. All our activities, therefore, will be confined until 1920, at least, to the West deposit.

The first level now being opened in the West deposit will suffice as a main haulageway for the drawing off of the bulk of this ore body. The shaft will later be sunk for the ore below the first level.

Following are the tonnages and grades of ore in the West deposit above and below the main level, according to our estimate of January 1st., 1919:

	Tons	Fe.	Phos	Mn.	Sil.
Above Main Level----	1,657,000	58.06	.074	1.29	6.23
Below Main Level----	186,000	58.11	.073	.74	7.03

The above estimates are based almost entirely on the drill records and, judging from our underground development work todate, the assumptions are conservative, both as to tonnage and grade.

OPEN PIT OPERATIONS

In order to clean back the Wade ore berm from the Helmer Mine, 15,407 yards of waste material was loaded out with the Model "60" shovel during September and placed on the Helmer dump. Owing to the irregularity of the top of the ore body we had to shift our tracks to a considerable extent and change from ore to stripping operations at frequent intervals.

The Model "60" shovel loaded out 24,755 tons of ore during September. This material was loaded from shallow cuts, as the machine could only dig five feet below the loading tracks, and was hauled out of the approach. This operation did not interfere with the handling of the Helmer product on the inclined tramway and in consequence we were able to ship the two ores simultaneously. It might have been advisable, otherwise, to have loaded the Wade ore from the bottom of the pit. The banks, however, were too high to blast with horizontal gopher holes from the bottom and it would have been necessary to first put down vertical holes along the top of the ore face. The bulk of the 42,822 tons of Wade ore mined from the open pit during October was secured from the bottom of the Helmer pit and was handled on the inclined tramway. The Model "36" revolving shovel took three cuts along the ore bank, which was approximately 45 feet in height. On account of the location of the railway track along the south berm of the property, it was inadvisable to attack the Wade or Helmer ore at the southeast corner of the pit. Further, we anticipated handling some of our Wade stripping on this track during the winter and did not wish to complicate the situation by crowding mining operations here. It was also necessary to leave a substantial bench of ore at the northeast corner of the pit, owing to the fact that the stripping had not been carried back sufficiently for extensive operations. The stripping limits will be

extended and this ore made available for extraction during 1919. The three Wade cuts, therefore, reached their greatest depth at the center.

Approximately the top 25 feet of Wade ore was removed with the Model "60" shovel and hauled from the approach and the bottom 45 feet was dug with the Model "36" shovel and taken up the incline. The top ore carried satisfactory iron, but contained approximately 15% moisture. The iron content of the bottom ore benches was one-half point higher and the moisture was under 13%. The iron natural in the bottom ore was, therefore, decidedly higher.

Following is the analysis of the Wade ore shipped from the open pit during the 1918 season:

	Tons	Fe.	Phos	Mn.	Sil.
September Shipments	24,755	60.21	.078	.42	6.06
October "	42,822	60.69	.066	.79	4.72
TOTAL AND AVERAGES	67,577	60.51	.070	.60	5.03

We anticipate that the 1919 output from the open pit will average close to 60% iron. We will undoubtedly remove the top one-third of the ore bank with a Model "60" shovel and haul the product out of the approach. This will enable us to mine and ship Helmer and Wade ores simultaneously, as was done in 1918. The bulk of our Helmer grade for 1919 will be made up, however, of Wade ore and in consequence it will not be necessary to conduct operations in the Helmer pit beyond the middle of the season, unless the mixing of the two ores to maintain a desirable grade requires spreading the 80,000 tons of Helmer ore over the entire seasons shipments.

STRIPPING

One of the Model "60" shovels made a casting cut around the outside edge of the proposed winter stripping during the early part of November. The machine was then moved back near the Helmer inclined headframe and a second cut was started inside and five

feet below the casting cut. This bench was carried around to the northeast corner of the Helmer property and upon the completion of same the shovel was again moved back and a third bench started five feet under the second cut. The third cut was fifteen feet below the original surface and extended to the crest of the old open pit. Upon the completion of the third cut the shovel attacked the middle bench, the loading track being maintained on the third cut.

We removed 28,426 yards of stripping in November and 30,317 yards in December. This makes a total yardage of 58,743, which is approximately one-half of the stripping to be completed by, or soon after the opening of navigation in 1919. Stripping operations will be discontinued during the severe winter weather and the necessary repair work on the shovels, locomotives and cars, undertaken.

It is our present intention to continue our stripping operations with the "60" shovel and carry the bank down approximately 40 feet from the original surface. The remaining overburden can then be loaded on tracks layed on the ore berm and the material hauled out of the Helmer approach. The second Model "60" shovel will be overhauled and utilized for the clean up work on the lower bench. It will be possible to dig a bank 50 feet in height when the frost has left the ground. Owing to the fact that the surface material contains considerable clay and is cemented, it will be necessary to blast the top of the 50 foot bank with vertical holes.

"STOCKPILE"

We had 3,537 tons of Wade ore in stock on January 1st., 1919. This ore was secured from first level development work and was dumped on covering boards to the southeast of the shaft.

Following is the average analysis of the Wade stockpile:

Tons	Fe.	Phos	Mn.	Sil.
3,537	61.48	.084	.50	4.20

"EXPLORATIONS"

The exploration account was exceeded by over $7,000, due to the fact that the drilling campaign was extended considerably from our original plan. We completed our original drilling campaign the latter part of July, but on account of finding an extension of the main ore channel several additional holes were put down to follow this out. It was then considered advisable to drill the ground west of the Deacon Mine, as this property had been offered to us and we were desirous of proving up the deposit tributary to the Deacon shaft. While the charges to "Exploring" were almost double the original estimate, we succeeded in adding better than one-million tons of ore to our reserve. Rather than being a campaign to check up the original drilling and to assist in demonstrating the best plant and shaft sites, it was largely a question of following out the main ore channel to its easterly limits.

Several drill holes were put down to ascertain the limits of the east deposit. We did not succeed in developing any additional ore here, however; in fact, the result of this drilling lead us to reduce the estimate of ore in this body by 5,000 tons.

Following are the results of the Wade Mine drilling during the year 1918:

DRILL HOLE NO. 100

Footage	Fe.	Phos	Mn.	Sil.
0-112	Surface material.			
112-117	53.94	.048	1.40	9.25
117-122	57.00	.091	1.10	6.16
122-200	Taconite.			
	Hole Bottomed.			

DRILL HOLE NO. 101

0-124	Surface material.			
124-129	60.30	.105	1.12	3.55
129-200	Taconite and ore seams.			
200-205	Taconite and slate.			
	Hole Bottomed.			

DRILL HOLE NO. 102

Footage	Fe.	Phos.	Mn.	Sil.
0-90	Surface material.			
90-95	51.60	.091	7.80	4.12
95-100	56.73	.108	.94	4.48
100-105	56.25	.152	1.70	5.86
105-110	58.38	.120	.60	5.00
110-188	Taconite and ore seams. Hole bottomed.			

DRILL HOLE NO. 103

0-100	Surface material.
100-187	Taconite and ore seams. Hole bottomed.

DRILL HOLE NO. 104

0- 91	Surface material.
91-124	Taconite and ore.
124-160	Taconite. Hole bottomed.

DRILL HOLE NO. 105

0-122	Surface material.			
	Fe.	Phos	Mn.	Sil.
122-127	60.50	.080	.50	4.80
127-132	62.74	.061	.20	4.13
132-137	60.89	.069	.30	7.57
137-142	61.08	.072	.44	4.71
142-147	59.65	.080	.48	8.09
147-152	58.62	.083	.66	7.67
152-157	60.18	.076	.70	6.20
157-162	57.81	.062	2.20	5.82
162-166	55.94	.080	2.36	6.41
166-171	46.23	.070	6.66	6.10
171-176	56.62	.065	.84	8.98
176-181	56.19	.061	.32	10.55
181-186	54.57	.101	1.38	9.67
186-191	59.69	.079	.74	5.00
191-196	50.82	.089	1.20	9.96
196-201	57.53	.078	.28	8.16
201-206	59.69	.081	.20	6.87
206-211	57.66	.065	.26	7.43
211-257	Taconite and ore seams.			
257-262	Slate. Hole bottomed.			

DRILL HOLE NO. 106

0- 96	Surface material.			
96-139	Taconite and ore seams.			
139-142	56.25	.055	.48	8.79
142-160	Taconite and ore seams. Hole bottomed.			

DRILL HOLE NO. 107

Footage		Fe.	Phos	Mn.	Sil.
0-118	Surface material.				
118-123		58.58	.056	1.92	9.77
123-128		58.92	.080	1.04	6.14
128-133		61.40	.055	.34	7.05
133-138		55.34	.067	.36	12.04
138-143		57.87	.084	1.02	6.48
143-148		61.02	.063	1.10	4.78
148-153		51.56	.055	3.56	8.37
153-158		58.92	.059	1.48	6.04
158-163		54.69	.079	1.72	7.03
163-168		55.67	.081	1.42	6.42
168-173		53.00	.069	3.40	5.42
173-176		49.34	.090	3.90	7.64
176-181		44.73	.055	4.30	10.06
181-186		52.94	.056	1.28	12.26
186-191		57.58	.039	1.60	6.65
191-196		51.21	.045	3.00	11.00
196-201		59.86	.054	1.20	5.57
201-206		44.69	.043	1.34	24.64
206-226	Taconite. Hole bottomed.				

DRILL HOLE NO. 108

		Fe.	Phos	Mn.	Sil.
0-128	Surface material.				
128-133		65.32	.066	.24	3.25
133-138		64.74	.056	.36	5.10
138-143		61.70	.055	.72	8.09
143-145		58.23	.062	1.30	5.12
145-150		62.12	.040	1.20	6.20
150-153		59.40	.045	1.72	4.98
153-158		56.84	.092	2.22	3.71
158-163		58.69	.060	.88	8.82
163-168		51.15	.063	.50	16.41
168-173		59.30	.056	.48	6.04
173-178		61.86	.056	.64	4.34
178-183		55.30	.086	1.22	5.11
183-188		59.34	.090	.88	4.78
188-193		55.87	.067	1.48	4.26
193-198		59.92	.072	.54	5.31
198-203		59.78	.072	.44	8.12
203-204		50.63	.062	.36	19.28
204-218	Taconite. Hole bottomed.				

DRILL HOLE NO. 109

0- 97	Surface material.				
97-102		61.99	.061	.34	4.53
102-107		57.52	.073	.52	10.28
107-112		55.71	.065	.48	12.12
112-117		61.27	.057	.36	4.07
117-122		61.79	.074	.50	5.29
122-127		65.07	.056	.40	4.10
127-132		61.44	.097	.50	5.64
132-137		62.54	.068	.56	4.53
137-142		60.01	.096	.45	6.10
142-147-		62.47	.076	.54	4.91
147-152		60.95	.084	.80	7.12
152-157		61.02	.109	.62	5.43
157-162		60.66	.094	.70	4.84

DRILL HOLE NO. 109-CONTINUED

Footage	Fe.	Phos	Mn.	Sil.
162-167	59.86	.088	.76	5.72
167-172	58.00	.059	.36	9.64
172-177	58.30	.062	.56	8.61
177-180	47.47	.069	7.66	5.84
180-185	47.56	.067	5.10	8.61
185-190	52.79	.065	.56	15.03
190-195	56.59	.069	.56	8.42
195-200	55.84	.120	.36	12.37
200-208	Taconite. Hole bottomed.			

DRILL HOLE NO. 110

0-131	Surface material.			
	Fe.	Phos	Mn.	Sil.
131-135	48.94	.163	.40	21.34
135-140	59.49	.087	.40	8.87
140-145	51.00	.036	1.86	12.39
145-147	49.15	.062	3.10	6.79
147-183	Taconite.			
183-188	59.17	.040	.53	7.52
188-193	58.01	.092	.50	10.93
193-198	57.03	.069	2.06	4.93
198-203	60.40	.063	.40	7.38
203-208	61.92	.040	.22	5.72
208-213	60.95	.062	.34	6.59
213-216	58.84	.054	.34	11.09
216-249	Taconite. Hole bottomed.			

DRILL HOLE NO. 111

0-121	Surface material.
121-171	Taconite. Hole bottomed.

DRILL HOLE NO. 112

0-134	Surface material.
134-190	Taconite. Hole bottomed.

DRILL HOLE NO. 113

0-131	Surface material.
131-223	Taconite. Hole bottomed.

DRILL HOLE NO. 114

0- 88	Surface material.			
	Fe.	Phos	Mn.	Sil.
88- 93	49.69	.188	2.30	13.80
93- 98	49.69	.168	6.00	7.37
98-103	55.16	.078	4.40	5.01
103-108	59.65	.151	2.00	3.70
108-113	60.34	.131	1.04	3.78
113-118	54.01	.124	.62	10.95
118-120	55.38	.111	1.16	9.86
120-148	Taconite and paint rock.			
148-158	Slate. Hole bottomed.			

DRILL HOLE NO. 115

Footage	Fe.	Phos	Mn.	Sil.
0-117	Surface material			
117-122	57.68	.061	.30	10.82
122-124	56.92	.086	.46	9.09
124-148	Taconite.			
	Hole Bottomed.			

DRILL HOLE NO. 116

0- 97	Surface material.			
97-102	Fe.	Phos	Mn.	Sil.
	50.57	.036	2.80	10.33
102-107	51.90	.041	2.42	6.88
107-112	59.05	.055	.70	7.87
112-117	58.13	.049	..70	8.18
117-122	59.21	.052	.78	6.90
122-127	58.49	.063	.66	6.25
127-132	57.32	.058	.70	5.56
132-137	57.94	.048	.92	6.39
137-142	50.93	.031	1.52	9.40
142-147	54.25	.042	.86	7.83
147-152	46.07	.045	1.26	19.82
152-157	52.69	.054	.22	15.45
157-158	48.85	.067	.20	20.51
158-163	52.05	.064	.14	18.05
163-208	Taconite.			
	Hole bottomed.			

DRILL HOLE NO. 117

0-101	Surface material.			
	Fe.	Phos	Mn.	Sil.
101-103	56.38	.045	.72	9.28
103-108	58.02	.055	.40	8.81
108-113	53.23	.060	.40	13.67
113-118	56.33	.048	1.10	8.20
118-123	56.29	.036	1.72	8.97
123-128	56.13	.033	.24	12.83
128-133	48.28	.035	1.02	15.71
133-138	47.63	.035	.24	18.67
138-143	44.07	.036	.24	21.19
143-148	54.27	.062	.82	9.84
148-153	52.90	.052	.60	10.92
153-158	49.82	.053	1.86	11.86
158-163	57.84	.053	.14	12.85
163-168	60.44	.053	.16	11.22
173-175	52.79	.054	1.00	11.96
175-177	58.03	.054	.56	7.81
177-225	Taconite and ore seams.			
	Hole bottomed.			

DRILL HOLE NO. 118

0-103	Surface material			
	Fe.	Phos	Mn.	Sil.
103-108	58.46	.047	.16	8.61
108-113	56.89	.055	.90	6.55
113-118	58.08	.070	.32	6.03
118-123	58.05	.065	.26	8.31
123-128	59.27	.068	.26	7.32
128-133	58.81	.064	.52	5.93
133-138	58.33	.060	.30	5.68

DRILL HOLE NO. 118-CONTINUED

Footage	Fe.	Phos	Mn.	Sil.
138-143	54.95	.055	.42	5.96
143-148	56.97	.050	.30	4.71
148-153	56.86	.075	.22	9.97
153-158	49.98	.071	.40	15.83
158-163	56.27	.066	.22	10.34
163-168	56.75	.068	.20	10.31
168-173	53.65	.071	.26	12.82
173-178	46.62	.041	.20	22.63
178-183	48.79	.086	.52	18.58
183-188	47.86	.088	.24	20.92
188-193	44.88	.089	.34	23.93
193-216	Taconite.			

DRILL HOLE NO. 119

0-119	Surface material.			
119-125	Paintrock and taconite.			
125-133	Surface material.			
133-135	Broken taconite.			
	Fe.	Phos	Mn.	Sil.
135-140	41.51	.044	1.09	25.66
140-145	47.82	.033	.72	19.80
145-150	51.87	.056	.78	16.20
150-155	48.63	.044	.81	18.42
155-157	52.52	.039	.29	16.90
157-160	Taconite and ore.			
160-174	Taconite.			
174-182	Taconite and ore.			
182-191	Quartzite, taconite and ore.			
	Hole Bottomed.			

DRILL HOLE NO. 120

0-123	Surface material.			
123-125	Taconite and ore.			
	Fe.	Phos	Mn.	Sil.
125-130	52.52	.055	2.23	5.10
130-135	54.46	.056	1.22	7.63
135-140	56.89	.053	.90	7.61
140-145	57.37	.055	.58	9.30
145-149	49.77	.056	1.07	13.45
149-169	Taconite.			
169-211	Taconite and paintrock.			
211-231	Ore and taconite.			
231-250	Brocken taconite and ore.			
	Hole bottomed.			

DRILL HOLE NO. 121

0-142	Surface material.			
142-147	54.03	.045	.46	9.06
147-152	58.23	.100	.24	7.00
152-157	53.55	.060	.38	11.83
157-162	52.08	.034	1.24	10.60
162-167	51.31	.059	.26	16.20
167-172	52.53	.070	.20	13.83
172-175	47.14	.025	.60	12.72
175-205	Taconite and ore.			
	Hole bottomed.			

DRILL HOLE NO. 122

0-131	Surface material.			
131-136	Fe.	Phos	Mn.	Sil.
	60.12	.059	.32	5.53
136-141	39.12	.168	.32	27.00
141-156	Taconite.			
	Hole bottomed.			

Following is a list of the accidents, where the injured parties lost time, which occured at the Wade Mine during the past year:

MATT PRYATEL

Injured----------July 10th, 1918.
Occupation----------Laborer.
Nationality----------Austrian.
Time Lost----------23 Days.
Received Compensation----------$34.00.

Remarks: Pryatel was helping carpenter in Boiler House. The scaffold broke, throwing him to the ground and straining his right ankle.

HENRY WILLEN

Injured----------August 24th, 1918.
Occupation----------Pumpman.
Nationality----------Finn.
Time Lost----------37 Days.
Received Compensation----------$53.01

Remarks: While Willen was repairing pump, machinist wishing to try same turned on steam, catching and crushing Willen's finger between follower and piston.

JOHN EDMONDS

Injured----------November 28th,1918.
Occupation----------Teamster.
Nationality----------Swede.
Time Lost----------32 days in 1918.
Received Compensation----------$44.46.

Remarks: While spreading bedding in stable, Edmonds was kicked by a mule and his leg was broken. He was confined to the hospital at the end of the year and it will be several weeks before he is discharged therefrom.

SHIPMENTS

Following are the cargoes of Helmer grade shipped during 1918, which were made up of a mixture of Helmer and Wade ores, and the analysis of same as obtained from Mine and Lower Lake Chemists' sampling. The bulk of ore in these cargoes came from the Wade Mine:

	Fe.	Phos	Mn.	Sil.	Mois	Fe.Nat.	Tons.
RIVERTON-							7,165
Mine	58.82	.074	.79	6.85	-----	------	
Crowell & Murray	59.39	---	--	----	12.18	52.156	
Cremer & Case	59.20	---	--	----	12.26	51.942	
ISHPEMING-							10,929
Mine	59.73	.067	.63	6.21	-----	------	
Textor	60.30	---	--	----	11.90	53.124	
Cremer & Case	60.30	---	--	----	11.88	53.136	
REPLOGLE-							10,892
Mine	59.97	.063	.64	6.64	-----	------	
Emmerton	59.30	---	--	----	11.66	52.386	
Cremer & Case	60.10	---	--	----	11.23	53.351	
SINALOA-							3,550
Mine	59.73	.062	.62	6.79	-----	------	
Textor	59.00	---	--	----	11.40	52.274	
WILPEN-							2,552
Mine	60.55	.062	.77	5.67	-----	------	
Crowell & Murray	61.13	---	--	----	12.08	53.745	
MORRELL-							7,659
Mine	60.05	.063	.79	6.34	-----	------	
Cremer & Case	61.10	---	--	----	12.38	53.536	
Textor	61.20	---	--	----	12.36	53.636	
ANGELINE-							6,914
Mine	59.87	.064	.92	5.95	-----	------	
Textor	60.20	---	--	----	13.64	51.989	
CLEMENT-							5,289
Mine	60.76	.056	.79	5.81	-----	------	
Emmerton	60.73	---	--	----	12.36	53.224	
Cremer & Case	61.00	---	--	----	12.37	53.515	
CADILLAC-							6,324
Mine	60.69	.067	.84	5.03	-----	------	
Rattle	60.80	---	--	----	13.12	52.823	

WADE MINE.

	Fe.	Phos	Mn.	Sil.	Mois	Fe.Nat.	Tons.
NEGAUNEE-							4,504
Mine	60.14	.072	.88	4.67	-----	------	
Emmerton	60.76	---	--	----	11.88	53.542	
Crowell & Murray	61.31	---	--	----	12.06	53.916	
PETER WHITE-							4,100
Mine	60.43	.076	.94	4.69	-----	------	
Textor	60.70	---	---	----	13.03	52.791	

WADE MINE.

Following are the charges to E & A No. 360, covering the opening and equipping of the Wade Mine from March 1st., to December 31st., 1918:

SUPERINTENDENT'S DIVISION	ESTIMATE	CHARGES TO DECEMBER 31ST. '18	UNEXPENDED BALANCE
Engineering,		$ 1869.57	
Analysis,		569.42	
Mine Office,		4023.29	
Central Office,		4626.66	
Taxes,		20118.59	
Mining Captain,		826.41	
Legal,		2.50	
Personal Injury,		316.60	
TOTAL,	$29500.00	$32353.04	2853.04
MAINTENANCE			
Boilers,		96.54	
Hoisting Machinery,		110.13	
Compressor & Air Pipe,		225.47	
Pumps,		263.49	
TOTAL,	1000.00	695.63	304.37
SINKING			
Sinking, Total 223',		21952.95	
Timbering,		3238.99	
Prop. of Acct. #7,		12533.87	
TOTAL,	20000.00	37725.81	17725.81
DRIFTING TO ORE BODY			
Drifting, Total 622',		14229.78	
Timbering,		1448.46	
Prop. of Acct. #7,		14615.47	
TOTAL,		30293.71	30293.71
PLATS AND POCKETS	3000.00	3570.62	570.62
PREPARING SITE			
Building Roads,		477.30	
Clearing lands,		3423.10	
Grading and ditching,		129.19	
TOTAL,	4000.00	4029.59	29.59
TEMPORARY EQUIPMENT			
Surface Tracks & Cars,		132.92	
Underground Tracks & Cars,		44.35	
Derricks and Buckets,		7.18	
Miscellaneous,		453.00	
Tools in General Use,		40.72	
TOTAL,	1000.00	678.17	321.83
PERMANENT CONSTRUCTION			
Undg. Tracks & Cars,		3706.02	
Power Drills,		3158.43	
Pump House & Sump,		2814.44	
TOTAL,	11060.00	9678.89	1381.11

SUPERINTENDENT'S DIVISION.	ESTIMATE	CHARGES TO DECEMBER 31ST. '18	UNEXPENDED BALANCE
WATER SUPPLY	4500.00	4822.28	322.28
OFFICE FURNITURE & FIXTURES.	420.00	319.75	100.25
EXPLORING			
Exploring,		13586.91	
Testing for Shaft Site,		2162.12	
Transfer of Explorations,		44094.17	
TOTAL,	8500.00	59843.20	51343.20
GRAND TOTAL,	82980.00	184010.69	101030.69
10% for Contingencies,	8298.00		8298.00
TOTAL SUPERINTENDENT'S DIVISION	91278.00	184010.69	92732.69

MASTER CARPENTER'S DIVISION

TEMPORARY EQUIPMENT	ESTIMATE	CHARGES TO DECEMBER 31ST. '18	UNEXPENDED BALANCE.
Engine, Boiler & Compressor House,	1600.00	1933.41	333.41
Dry House,	300.00	208.25	91.75
Launder,	100.00	45.00	55.00
Coal Dock,		744.96	744.96
Pulley Stands,		86.78	86.78
PERMANENT EQUIPMENT			
Power House,	4000.00	3250.45	749.55
Shaft House,	8500.00	9746.40	1246.40
Office & Warehouse,	3800.00	5978.55	2178.55
Shop Building,	4250.00	4786.40	536.40
Top Tram Engine House,	1000.00		1000.00
Change House,	5500.00	5805.49	305.49
Oil Storage Building,	700.00	780.11	80.11
Barn,	2000.00	1465.85	534.15
Boarding Houses,	8000.00	9448.01	1448.01
Captain's House,	3600.00	3738.21	138.21
Tenement Houses,	40000.00	45602.95	5602.95
Docks, trestles & Pockets,	4300.00	3630.49	669.51
Two six-room cottages,	5200.00	5220.43	20.43
Coal Dock,	1500.00	1529.46	29.46
Pulley Stands,	500.00		500.00
TOTAL	94850.00	104001.20	9151.20
10% for Contingencies,	9485.00		9485.00
TOTAL MASTER CARPENTER'S DIVISION	104335.00	104001.20	333.80

CHIEF MECH. ENGINEER'S DIVISION

TEMPORARY EQUIPMENT	ESTIMATE	CHARGES TO DECEMBER 31ST. '18	UNEXPENDED BALANCE.
BOILER PLANT			
Boiler,		6964.17	
Foundations,		2583.29	
Piping & Pipe Covering,		377.29	
Pumps,		24.34	
Steam and Water Lines,		95.12	
Erecting,		899.38	
TOTAL,		10943.59	
HOISTING PLANT			
Machinery,		5103.96	
Foundations,		173.28	
Steam Line,		157.01	
Erecting,		131.46	
TOTAL,		5565.71	
COMPRESSOR PLANT			
Machinery,		2208.03	
Foundations,		16.68	
Steam Line,		266.45	
Air Line,		176.66	
Erecting,		240.74	
TOTAL,		2908.56	
SINKING PUMP			
Pumps,		95.32	
Steam and Water Lines,		1079.87	
Installing,		37.87	
TOTAL,		1213.06	
HEATING SYSTEM		502.52	
TOTAL,	17000.00	21133.44	4133.44
PERMANENT EQUIPMENT			
HOISTING PLANT			
Erecting,		551.43	
Foundation,		29.04	
Skips and Cages,		2002.80	
Bell Lines & Signals,		1.22	
Sheaves and Counterweight,		7.96	
Wire Rope,		683.07	
TOTAL,	16650.00	3275.52	13374.48
COMPRESSOR PLANT	8200.00		8200.00
SHOP EQUIPMENT			
Equipment,		3973.04	
Installing,		479.39	
TOTAL,		4452.43	47.57

WADE MINE.

CHIEF MECH. ENGINEER'S DIVISION-CONTINUED

TOP TRAM PLANT	ESTIMATE	CHARGES TO DECEMBER 31ST. '18	UNEXPENDED BALANCE.
Tram Equipment,		63.72	63.72
ELECTRIC HAULAGE			
Locomotives,		8596.28	
Cars,		6712.50	
Erecting,		312.96	
TOTAL,	28250.00	15621.74	12628.26
PUMPING PLANT			
Pumps,		3706.98	
Erecting,		250.96	
TOTAL,	7100.00	3957.94	3142.06
Safety Appliances,		58.53	58.53
HEATING SYSTEM			
Boilers,		509.05	
Piping and Radiation,		2003.69	
TOTAL,	4000.00	2512.74	1487.26
Fire Protection,	1000.00	765.30	234.70
Recording Gauges,	100.00		100.00
Oil Storage Tank,		66.00	66.00
Surface Lighting,	350.00	6.02	343.98
SUB-STATION & POLE LINES			
Equipment,		1032.08	
Transmission Line,		2231.73	
TOTAL,	3500.00	3263.81	236.19
Auto Truck,	1000.00	805.07	194.93
Undg.Elec.Wiring,		128.19	128.19
TOTAL,	91650.00	56110.45	35539.55
10% for Contingencies,	9165.00		9165.00
TOTAL CHIEF MECH. ENGR'S DIVISION	100815.00	56110.45	44704.55

SUMMARY

Superintendent's Division----------	91278.00	184010.69	92732.69
Master Carpenter's Division----------	104335.00	104001.20	333.80
Chief Mech. Engr's Division----------	100815.00	56110.45	44704.55
TOTAL,	296428.00	344122.34	47694.34
Depreciation of Inventory----------		3141.77	3141.77
GRAND TOTAL,	296428.00	347264.11	50836.11
Net Earnings from Wade Rented Bldgs.,		1016.18	
TOTAL,		346247.93	
Reserve for Depreciation		10136.55	
BALANCE,		336111.38	

WADE MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1918.

GRADE	IRON	PHOS.	SILICA	MANG.
Wade,	60.48	.070	5.31	.69

All ore shipped in mixed cargoes.

ORE STATEMENT AND SHIPMENTS FOR YEAR 1918.

	WADE
On hand Jan. 1st, 1918,	0
Output for Year,	71,114
Total,	71,114
Shipments,	67,577
Balance on Hand,	3,537

1918 - 2-10 Hr. Shifts April 15th to Nov. 1st
3--8 Hr. Shifts Nov. 1st to Dec. 31st.

WADE MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 8.	
PRODUCT	67,577	
General Expense	.023	
Maintenance	.048	
Mining Expense	.811	
Cost of Production	.882	
DEPRECIATION.		
Construction	.150	
Total Depreciation	.150	
Taxes	.110	
Central Office	.020	
Total on Stockpile	1.162	
Loading & Shipping	.010	
Total on Cars	1.172	
No.Days Operating	44	
No.Shifts and Hours	2-10h	
Avg.Daily Product	1536	
COST OF PRODUCTION.		
Labor	.429	
Supplies	.453	
Total	.882	

Product - from open pit during Aug.,Sept.,and Oct.
Mine leased in 1918.

WADE MINE.

COMPARATIVE WAGES AND PRODUCT.

	1 9 1 8.
PRODUCT	67,577
No.Hours & Shifts	2-10hr.
AVERAGE NUMBER MEN WORKING	
Surface	17
Underground	61
Total	78
AVERAGE WAGES PER DAY	
Surface	5.50
Underground	6.49
Total	6.28
WAGES PER MO. OF 25 DAYS	
Surface	137.50
Underground	162.25
Total	157.00
PRODUCT PER MAN PER DAY	
Surface	66.11
Underground	18.57
Total	14.50
LABOR COST PER TON	
Surface	.083
Underground	.350
Total	.433
AVG. PRODUCT BRK'G & TRM'G	-
" WAGES CONTRACT MINERS	-
" " " TRAMMERS	-
" " " LABOR	-
TOTAL NUMBER OF DAYS	
Surface	1,022½
Underground	3,638½
Total	4,661
AMOUNT FOR LABOR	
Surface	5,621.32
Underground	23,639.49
Total	29,260.81

Proportion Surface to Underground Men:
1918 - 1 to 3.59

ABOVE TONNAGE FROM OPEN PIT.

ANNUAL REPORT FOR THE YEAR ENDING DECEMBER 31ST, 1918.

Ishpeming, Michigan,

March 7, 1919.

ENGINEERING DEPARTMENT.

Mr.M.M.Duncan, Vice Pres. & Gen.Mgr.,

Building.

Dear Sir:-

The following report of the Engineering department is herewith handed to you. The maps and photographs which form part of this report are bound and the books have been labeled as follows:

LIST OF ANNUAL REPORT MAP BOOKS FOR 1918.

Cleveland-Cliffs Iron Company.
Ishpeming & North Lake Districts.

Cleveland-Cliffs Iron Company.
Negaunee, Iron River & Republic Districts & Mesabi Range.

Cleveland-Cliffs Iron Company,
Gwinn District.

Cleveland-Cliffs Iron Company.
Hydro Electric Systems.

These books contain the maps of the Company's mines. Two sets of them have been prepared, one for the Cleveland office, which I hand you, and the other to be kept in the vault in this office.

A special book has been prepared for the Lackawanna Steel Company containing the photographs and maps of the Negaunee mines. This also is handed you. Special books have been made for the superintendents giving them copies of the mine maps in the different districts and also an extra book of the hydro electric system has been made for the Mechanical department.

Mr. Carl Brewer, my assistant engineer, has written the following

pages covering the report on the force employed in the Engineering office.

Mr. C. H. Echler has written the notes on current work in the Abstract department and I have added a few remarks on various subjects.

Yours truly,

J. E. Jopling

Chief Engineer.

JEJ-LD.

REPORT OF THE ENGINEERING FORCE EMPLOYED DURING THE YEAR 1918,

AND A BRIEF OUTLINE OF THEIR WORK,

BY CARL BREWER, ASSISTANT ENGINEER.

- -

THE FORCE.

There has been only one permanent addition to the Engineering department of the Ishpeming office during 1918, namely, K. C. Pellow. Additional helpers were added during the summer for field and office work in connection with the proposed Dead River Water Power. These were C. Nichols, J. Fortier, C. Fellar, and W. Murray for field work and F. Christian in the office. P. Denn was employed as chauffeur. J. H. Rough, Jr. expected to stay in the department, having entered after giving up all hope of his application for Officers Training Camp being accepted. Shu Choe came after his graduation from Lehigh University to have several months experience in the Iron District.

The following table shows the personal of the department during the year, arranged in order of entrance:

NAME.	POSITION.	ENTERED.	LEFT.	SUBSEQUENT POSITION.
C. Brewer	Asst. Eng.	Entire year		
R.J.Chenneour	Engineer	" "		
H.O.Moulton	"	" "		
J.K.Osborne	"	" "		
A. Rock	Hepler	" "		
J.Trosvig	Engineer	" "		
T.A.Miller	"		March 18	Transferred to Gwinn District.
J.J.Heilala	Helper	" "		
S.Malmgren	"	" "		
W.F.H.Janzen	Engineer	" "		
A.Alanen	Draftsman	" "		
A.Minnear	Helper	" "		
M.C.Connolly	"		April 19	Engineer with Marquette County Road Commission.
K.C.Pellow	Engineer	January 3		
P. Denn	Chauffeur & Helper	April 1		
C.Nichols	Helper	June 1	Sept.26	University of Michigan.
J.H.Rough,Jr.	"	" 25	June 29	U. S. Army Officers Training Camp.
F.Christian	"	July 5	Sept.29	University of Michigan.
Joe Fortier	Chopper	June 4	Sept.30	McClure Plant.
Chas.Fellar	"	June 4	Oct. 21	McClure Plant.
Wm. Murray	"	July 10	Sept.30	McClure Plant.
Shu Choe	Hepler	Sept. 9	Dec.21	

All in the department except Sextus Malmgren, Joe Fortier, Charles Fellar and Wm. Murray were on a salary basis.

The following table shows days worked, days lost, percentages, etc, for all those on salary. The "Vacation" column shows time granted for regular vacations; all other time lost other than sickness is included under "Absent". Eight hours constitute a day. Over time is credited against days absent rather than vacation. There was no regular work Saturday afternoons except during January and February. Only the time reported from the Ishpeming office is considered:

NAME.	DAYS WORKED.	DAYS VACATION.	DAYS ABSENT.	DAYS ILLNESS.	TOTAL DAYS.	PERCENTAGE DAYS WORKED.
C. Brewer	261½	9	5	0	275½	94.9
R.J.Chenneour	275½	12	0	0	275½	100.0
H.O.Moulton	273½	0	1	1	275½	99.2
J.K.Osborne	262½	12½	0	½	275½	95.3
A. Rock	261½	11	3	0	275½	94.9
J.Trosvig	249	11	0	10	264½	94.1
T.A.Miller	65	0	5	0	65½	99.2
J.J.Heilala	264	5½	3	3	275½	96.2
W.F.H.Janzen	270	0	0	5½	275	98.0
A.Alanen	267½	0	25	5½	275½	97.1
A.Minnear	271½	0	0	4	275½	98.5
M.C.Connolly	90	0	0	0	90	100.0
K.C.Pellow	264½	0	6	4	274½	96.4
P. Denn	205½	0	1	0	206½	99.5
C.Nichols	88½	0	0	0	88½	100.0
J.H.Rough,Jr.	5	0	0	0	5	100.0
F.J.Christian	62½	0	0	0	62½	100.0
Shu Choe	77½	0	0	0	77½	100.0

The next table show the number of working days lost on account of sickness or absence by those now in the department during the last five years:

	1914.		1915.		1916.		1917.		1918.	
	Absent.	Sick.	Absent.	Sick.	Absent.	Sick.	Absent.	Sick.	Absent.	Sick.
C. Brewer					0	0	1½	0	14	0
R.J.Chenneour	16	2	15	2½	2¼	2	26½	½	12	0
H.O.Moulton	14½	3	0	0	0	1	23½	0	1	1
J.K.Osborne	25½	3	1½	2	0	4½	0	15	12½	½
A. Rock	2	8½	12	6½	12	1	20	6	14	0
J.Trosvig	6	5½	0	0	0	0	6	0	11	10
J.J.Heilala							16	8½	8½	3
W.F.H.Janzen							0	0	0	5½
A.Alanen							5½	0	2½	5½
A.Minnear							1	0	0	4
K.C.Pellow									6	4
P. Denn									1	0

ENGINEERING DEPARTMENT.

The following table gives those employed in the office during the last five years, arranged in order of entrance, showing the months worked and the average number employed per month, excluding unskilled labor, such as choppers, etc:

	1914.	1915.	1916.	1917.	1918.
C.J.Stakel	12	12	4		
C. Brewer			8	12	12
J. F. Hanst	12	12	12	3	
R.J.Chenneour	12	12	12	12	12
H.O.Moulton	12	12	12	12	12
J.K.Osborne	12	12	12	12	12
A. Aas	9½				
A. Rock	12	12	12	12	12
F.G.Rockwell	7	8			
J. Trosvig	9½	1	12	12	12
E. L. Derby	12	12	8		
M.F.LaCroix	9	1			
J.E.Hayden	12	12	12	4½	
Ed. Ham	8				
T.A.Miller			11½	12	2½
J.J.Heilala			11	12	12
S.Malmgren			8	12	12
C.W.Nicolson			6	4½	
C.S.Stevenson				7½	
W.F.H.Janzen				9½	12
C.Nichols				6	4
A.Alanen				8	12
A.Minnear				6½	12
M.C.Connolly				3½	3½
K.C.Pellow					12
P. Denn					9
F.Christian					3
Shu Choe					3½
Average number of men	12 1/3	11 7/12	8 5/6	13 5/12	14 1/8

Each man's share of the work of the department is described below:

Carl Brewer has had charge of the office during the year. He has ordered the necessary supplies and directed the office work in general. Considerable time was spent early in the year on the annual report and finishing the mounted maps of the McClure Plant. He assisted in plotting the Dead River Storage Basin survey, finishing them and sub-dividing the sections. He collected the information for the Hydro Electric System map and worked on the transmission line maps. In the field he helped with the monthly surveys at the various mines and in other special work on surface. At the Negaunee mine he ran check surveys from the 10th to the 11th level and on the 11th level before holing. He directed the plumbing of the Athens shaft, assisted taking off the lines, ran check surveys on

the levels and took runner measurements in the shaft. He made a joint survey in Section 16 mine workings adjacent to the Holmes boundary, took elevations in the swamp on surface and did the preliminary work for the drainage ditch across Section 16. He prepared mine surface maps of the Ishpeming mines, showing relative elevations of railway tracks, for Mr. Eaton. At the Barnes-Hecker mine he checked the cutting out for the 1st level and investigated the drainage for the mine water. On the Dead River Storage Basin survey he ran the transit for several days on the contour lines and location of section corners, and at the dam site assisted in the survey and cross-sectioning. He gave elevations at the McClure Dam, lines for the culvert under the L. S. & I. Railway and assisted in the checking of the steel pipe survey. At the power house he made a contour map of the transformer house and ran the preliminary line for the straightening of the steel pipe over the hill. He located the section corners of Section 7, 48-25 and ran the stadia survey for the high land outlined on Section 18, 48-25. The quarterly surveys and estimate of ore mined at the Boston mine were made by him. He visited the Spies mine in July. At the Republic mine he made the profile and preliminary survey for the new engine house and staked it out. He did the work at the Au Train Plant relative to the 792' contour line.

Reginald J. Chenneour has been in charge of the engineering work at the Negaunee and South Jackson mines all the year, except during the six weeks he was on the Mesabi Range. At the Negaunee mine he kept up the underground surveys and geology and made recommendations for development work after studying the conditions from the cross-sections and maps. He made several surveys for holing the 11th level drift and supervised the installation of the pocket and concreting the shaft plat. At the South Jackson mine he located drill holes, gave lines for drifting, outlined the stripping, etc. He also made several estimates of the ore available and plans for mining. On March 17th he went to Nashwauk, Minnesota, to help Mr. Barber in connection with the opening of the Wade and Helmer mines. He returned on April 27th. Under the direction of Mr. Jackson

he investigated the oil tempering of underground drill steel. After a visit to the Gogebic Range, a small furnace was erected at the Cliffs Shaft mine under his direction, where experiments were carried out.

Henry O. Moulton looked after the engineering work at the Maas mine all the year. The underground surveys and geology were kept up to date. With the aid of cross-sections he was able to direct the development of ore under the hanging. He devised a method of mining between the 3rd and 4th levels so as to leave sufficient support for the surface. He ran the survey for the ditch at the Section 16 mine and mapped part of the surface. In the spring he ran the survey at the McClure Plant over the steel pipe line according to the construction plans of the pipe. He also ran the survey around Sections 18, 48-25 and 13, 48-26 to locate section corners. He staked out and allotted the garden lots in the Negaunee district. He was in charge of the surveys of the Dead River Storage Basin and was in the field nearly all summer, running both the levels from Ishpeming to the Hoist and most of the contours and section corner surveys.

John K. Osborne has taken care of the engineering work at the Cliffs Shaft and Holmes mines. In the Cliffs Shaft mine he made the monthly surveys, located drill holes and gave lines as necessary. The Holmes mine required most of his attention. The development of the ore above the 1st level necessitated frequent surveys. He made several joint surveys in Section 16 mine close to the boundary and carefully watched for trespasses. He assisted the Geological department in keeping the geology posted and during the absence of Mr. Eaton consulted with Captain Rough concerning the development. After shaft sinking began he lined in sets. He tested the carbon before purchasing, made the carbon and drill outfit inventories.

Albert Rock has been helper, assisting in underground and surface surveys at all the mines at various times during the year. He was foresight for all the Dead River Storage Basin and McClure Plant surveys and spent several days looking for section corners in the field. In the office he made all the annual report prints, blue printed, assisted in filing plates, mounted maps, repaired tapes, etc.

John Trosvig has been the engineer for the North Lake District. At the Barnes-Hecker mine he made by-monthly shaft sinking reports, staked out engine house, reestimated the excavation and fill for stock-pile grounds, relocated transmission line, made surveys for mine water drainage away from North Lake, etc. He also staked out the school house in the location. He made the monthly surveys at the Morris-Lloyd mine, gave lines, assisted in geologizing, sampled underground workings, gave lines for development and located drill holes as necessary. He staked out the new houses in the location and gave grades for the improvements at the Club House. On the Dead River Storage Basin surveys he was transit man for several days, running contours and locating section corners, and at the Hoist made the survey and cross-sectioning for the proposed dam. In the office, besides plotting the work at the Hoist, he made the estimate of capacity of the storage basin. He also ran the survey to the McClure dam from the Maas mine. On September 18th he left the department but returned on October 3rd.

Tom A. Miller made the monthly surveys and did the engineering work at the Lake and Republic mines.until he was transferred to the Gwinn district on March 19th. In February he made a stadia survey at the Spies mine for the proposed mine water discharge and posted the mine maps monthly. He helped make the shaft measurements at the Athens mine. He located and surveyed the drill holes on Sections 2, 3 and 4, 47-27.

John J. Heilala has looked after the underground surveys and maps at the Salisbury mine. He has assisted on surveys at all the other mines, particularly at the Holmes, Lake and Negaunee mines, and in the field work, McClure Plant, Dead River Storage, etc. In the office he has helped with survey calculations and plotting field notes, blue printing, etc.

Sextus Malmgren has been employed as helper all the year. He has assisted with the mine surveys at all the mines, especially in the Ishpeming district. In the office he has blue printed, repaired tapes, etc.

William F. H. Janzen has attended to the engineering work at the Athens mine all the year and at the Lake mine since October. At the Athens mine he looked after all the construction work, both on surface

and underground, made all regular surveys, gave lines for drifts, raises, etc, staked out roads, improvements, fences, etc, as necessary. He prepared monthly written reports to Mr. Jackson upon the new construction, underground development, etc. He made what stripping estimates were required at the Angeline East End and Side Hill deposits and watched the drifting underground in "D" shaft. Very little was done by him at the Lake mine outside of the regular monthly surveys. During the absence of Mr. Chemneour he looked after the surveying at the Negaunee mine.

Arvid Alanen has been mostly in the office as draftsman. Most of his time has been spent on special work. The Hydro Electric System maps, AuTrain-Gwinn, Republic and McClure Plant transmission lines, Mesabi Range and annual report surface maps have been the principle tracings made by him. He assisted in the Dead River Storage Basin calculations, plotting and tracing as well as being rodman in the field for several days. He has also assisted in the mine work calculating, tracing, etc. Practically all the maps for miscellaneous outside matters, signs, placards for various purposes were made by him.

Archie Minnear has been helper for the North Lake district all the year, although he has also assisted at other mines. He has assisted in practically all the surveys, both surface and underground, at Barnes-Hecker and Morris-Lloyd mines. The Negaunee district mine surveys have also taken considerable of his time. In the office he has been occupied mostly with the Morris-Lloyd mine maps and tracings, although he has helped in survey calculations. He helped with the transferring of contour lines on the Dead River Storage Basin maps.

Michael C. Connolly was helper for the Negaunee and Maas mines until he left on April 19th. He also ran surveys in the mines and helped with the office work. He found section corners in Section 7, 48-25 and prepared a map showing the present and proposed Marquette County roads.

Kenneth C. Pellow entered the department on January 3rd and until the departure of T. A. Miller assisted on the Republic, Spies and Angeline surveys. He also plotted the surveys of the McClure Plant and Intake Basin.

Since March he has made the Republic and Spies mines surveys and looked after the engineering work at these mines, and at the Lake mine until October. During J. Trosvig's absence, he made the survey of the Morris-Lloyd mine and at the Athens mine looked after the surface landscaping during W. F. H. Janzen's absence. He gave grades and lines for the grading and sidewalk at the new Ishpeming Hospital. On the Dead River Storage Basin survey he ran levels from Braastad's Farm to the Boyce and Mulligan creeks. He also located and surveyed the drill holes on Sections 2, 3, 4 and 5, 47-27.

Peter Denn was chauffeur for the department all through the season. He put both cars in commission, looked after them and put them up in the fall. While the cars were operating, when not on the road, he was busy keeping them in repair. After the autos stopped running, he helped in the office tracing and blue printing and on the underground surveys. During December he collected drill core for the Geological department during the absence of Leif Erickson.

Cleland Nichols was employed as backsight on the Dead River Storage Basin survey. Practically all his time was spent in the field until the survey was finished, after which he helped in the office and in varied surface work at the mines. He returned to University of Michigan at the beginning of the college year.

James H. Rough, Jr. spent his four days tracing in the office. He came from the University of Michigan at the end of his Sophmore year, expecting to stay the summer, but was called to the U. S. Army Training Camp.

Francis Christian was at work almost all the time on the Dead River Storage Basin survey. He made all the mounted maps, helped with the calculations and plotted the surveys. Occasionally he helped with other calculations and made mine tracings. He left at the beginning of the college term for the University of Michigan.

Joe Fortier, Charles Fellar and William Murray were employed as shoppers on the Dead River Storage Basin survey. When that survey was finished, they cleared the proposed dam site at the Hoist.

Shu Choe was helper at the Maas and Negaunee mines. He assisted on the underground work and in the office made tracings, both of mine maps and section maps, of the Dead River Storage Basin. He also helped on open pit cross-sectioning at the Angeline mine and in Cliffs Shaft surveys.

OFFICE EXPENSES.

The next table shows the office expenses for 1918, as compared with 1917:

Item.	1917.	1918.
Travelling expenses and livery	$ 553.89	$ 492.61
Supplies (see below)	4,146.79	3,149.34
Office expenses	230.73	17.76
Insurance	22.08	22.08
Taxes	37.53	34.29
Operating automobile (see below)	931.37	1,548.54
	$5,922.36	$5,264.62.
Total salaries	21,443.89	24,866.53
Total	$27,366.25	$30,131.15.

The following table shows the detail of extraordinary charges included in Supplies, as compared with last year:

Item.	1917.	1918.
Annual report negatives	$ 306.32	$ 361.49
Tracing cloth, blue print paper, etc	735.51	776.82
Blue printing machine parts	42.50	35.00
Office Fixtures:		
3 Drawing tables		165.00
No.2 Vault fixtures	1,391.50	
Building partition	69.19	
Other Supplies:		
Mining transit	328.50	
Survey spads		91.50
Plumbing reel		32.50
72 Land markers		216.00

AUTOMOBILES.

The Ford touring car and truck were put into operation on April 1st and were operated continuously until December 1st when they were stored. During January, February, March and December, horses were used exclusively. The survey party on the Dead River Storage Basin survey used one of the cars, principally the truck, for transportation. Without the car it would have been impossible to do the work except by camping on the job. The other car, usually the touring car, was driven by the chauffeur and carried parties to and from the various mines, and when not thus engaged, was used by the Geological department for collecting drill cores. The amount of time saved by the use of the cars cannot be estimated but there is no doubt that the

efficiency of the department has been increased 40% thereby.

A comparative statement follows showing the livery and automobile expense:

	1916.	1917.	1918.
Company horses -	$901.54	$436.94	$353.72
Livery hire -	130.50	11.00	6.00
Auto hire - -	45.50	21.00	54.00
Company auto:			
Salaries - -	[illegible]	220.05	453.75
Expenses - -		711.32	1,094.79
Total	$1,085.54	$1,400.31	$1.962.26

The operating cost of the automobiles is as follows:

	1917.	1918.
Chauffeur's salary -	$211.69	$453.75
Gasoline, oil, etc -	154.35	262.53
Tires and tools - -	159.69	208.72
Repairs - - -	76.22	231.86
Miscellaneous - -	22.16	231.67
Depreciation - -	164.48	160.01
Building garage - -	143.08	
Total	$931.37	$1,548.54

DISTRIBUTION OF TIME.

The distribution of time in number of shifts at the various properties is shown in the next table, together with a comparison of labor cost with last year. The salaries were greatly increased during the year, which accounts for the difference. Several shifts might be charged against the Gwinn district on account of the annual report, but when distributed against the various mines made so small a charge that no separate account was kept. Carbon account was charged against drilling and not engineering:

MINES:	1916. Time.	%	Labor.	1917. Time.	%	Labor.	1918. Time.	%
Angeline	61.0	1.76	$ 693.48	125.5	3.04	$422.79	53.0	1.30
Athens)								
Bunker Hill)	156.0	4.53	2268.47	309.5	7.50	2532.44	336.0	8.38
Barnes-Hecker			402.16	82.5	2.00	755.67	128.5	3.27
Boston	6.0	0.17	81.14	115.0	2.79	124.42	16.0	0.40
Cliffs Shaft	311.0	8.98	2360.40	385.0	7.34	1899.87	273.5	6.82
Holmes	298.0	8.53	1269.67	212.0	5.14	1504.49	212.5	5.30
Lake	275.0	7.94	1218.29	220.5	5.33	998.79	161.0	4.02
Lloyd	285.0	8.23	(with Morris)	346.5	8.40	1080.70	206.0	5.14
Maas	331.0	9.56	2686.28	382.5	9.28	2662.04	344.0	8.58
Morris	132.0	3.82	2676.82	227.5	5.51	829.09	135.0	3.37
Negaunee	472.0	13.59	3006.94	460.5	11.17	3174.56	393.0	9.83
Republic	129.0	3.72	810.80	172.5	4.18	1086.74	179.0	4.46
Salisbury			734.80	134.5	3.26	796.94	160.00	4.00
South Jackson	18.0	0.52	387.78	61.0	1.48	352.11	34.0	0.85
Spies	82.0	2.36	367.54	72.5	1.74	459.07	219.0	5.46
WATER POWER:								
Au Train						114.90	26.0	0.65
Carp River	7.0	0.20	45.08	6.5	0.16	138.32	45.5	1.14
Dead River Storage						4619.43	864.5	21.52
McClure Plant			1798.38	528.0	12.80	1058.20	145.0	3.62
MISCELLANEOUS:								
Carbon & Drill Inventory				15.0	0.36			
Ishpeming Hospital			64.69	9.0	0.22	80.81	14.5	0.36
Mesabi Range	3.0	0.09		6.5	0.16	48.34	38.0	0.95
Drill locations	15.0	0.43		78.5	1.89	127.09	23.5	0.58
Miscellaneous			691.81	190.0	4.46			
Total			$21,443.89	4132.0	100.0	$24866.53	4007.5	100.0

MINES.

ANGELINE MINE.

As long as stripping operations continued at the East End open pit, monthly reports of material removed were made. After shipping season closed the final cross-sections were taken. Drill holes were located and surveyed. The milling operations in the Side Hill open pit required no attention until the end of the year when cross-sections of the pit were posted. Underground in "D" shaft the raise on the 4th level was located and the drifting on the 1318' sub-level surveyed.

ATHENS & BUNKER HILL MINES.

Continuous drifting in the Athens on all the four levels with the crosscuts and raises required constant attention for lines and grades. The drifting on both ends of the 9th level was carefully watched and holed. The installation of pockets, pump house, sump, etc, necessitated personal supervision by the engineer in charge. Four separate plumbings were made in the shaft from surface to all the levels. The last plumbing checked the average of the first three exactly on the 4th, 9th and 10th

levels and by one minute on the 8th level and was taken as the final survey. The surveys on all levels were resurveyed twice. The runners in the shaft were gauged and reported. The underground geology was kept up to date. On surface the finishing of the grading, roads, installation of sewer and water pipes, and landscaping called for frequent supervision. Monthly reports on construction progress were made by the engineer.

No separate division for the work on the Bunker Hill property was made.

BARNES-HECKER MINE.

Plans were made for the shaft concreting mixing plant and the installation supervised. Forms for the concreting were designed and the progress of shaft sinking and concreting were looked after very closely. Lines were given for setting the bearers. By-weekly reports of the sinking were turned in. Measurements down the shaft for cutting out the 1st level were checked twice. On surface the piers for the shaft house were set and lines given for engine house and hoists. The location of the transmission line to the Republic mine past the shaft were surveyed. Estimates of the stockpile excavation and fill were reported. In the location the new houses and the school house lot were staked out.

BOSTON MINE.

Quarterly estimates of the ore removed and map reports were made in January, April and July. On September 1st the maps were turned over to Pickands, Mather & Company, who in the future will make these estimates.

CLIFFS SHAFT MINE.

No special work was done during the year. The monthly surveys were made and drill holes located as necessary. The development of the 11th and 13th levels required some attention.

HOLMES MINE.

The development of the sub-levels above the 1st required constant attention, both for surveying and for geology. All the work was carefully mapped and watched, especially near the Section 16 boundary. Fre-

quent surveys were run in Section 16 mine where the workings were adjacent. The mine water problem towards the end of the year required some attention. On surface levels were run in February on the railroad tracks relative to possible surface subsidence.

LAKE MINE.

Very little attention was required at the Lake mine outside of the monthly reports and the surveying of the sub-levels under development. The diminishing size of the sub-levels as the mine gets deeper requires much less surveying.

LLOYD MINE.

Most of the underground operations were confined to the open pit milling, which required no attention from this department. Several contracts, however, were developing and mining under the hanging, which necessitated frequent surveys and lines. Considerable time was spent in the office making maps as on the development work many new sub-levels were opened. On surface the only work necessary was fences near the Section 6 pit around caved ground and stockpile trestles.

MAAS MINE.

Weekly trips underground through the developing sub-levels were made throughout the year. The geology, especially under the hanging wall, was carefully watched and with the aid of sections, the sub-level development was materially assisted. The monthly surveys were made as usual during the year. Considerable time was spent planning a method of mining between the 3rd and 4th levels to secure the largest extraction without danger to surface. The raising and stripping of the shaft between the 3rd and 4th levels was watched and the design and installation of the 4th level pocket was supervised.

MORRIS MINE.

The development of the 6th level, together with the raises to the 4th level, required constant attention. The main level and sump of the subs above were sampled. Drill holes were located and surveyed and the monthly reports made. The shaft stripping and the location of the bearers between the 4th and 6th levels were attended to. A sump cleaning raise

under the 4th level was designed and put through. On surface the rock trestle was extended and grades for the stocking trestles given. A new location for the Carp river around the underground workings was run. Twelve new houses were staked out in the location. The position of the transmission line to the Barnes-Hecker mine was surveyed.

NEGAUNEE MINE.

The sub-level development under the hanging above the 9th level was laid out and watched. In No.2 shaft pillar the workings were frequently surveyed as the lack of information as to the size of the stopes above the old 3rd level endangers the men. The mining along the boundary in the railroad pillar was watched with special attention to the Maas workings and the driving of connecting drifts. On the 11th level three check surveys were run for holing the main drift to the shaft and the crosscuts required constant attention for lines and grades. The construction of the pocket and the concreting of the shaft plat on the 11th level was supervised. Considerable time was spent designing the pump house, sumps, and connecting raises with the approval of the Mechanical department. The drift to the Athens mine on the 11th level, was also surveyed. Monthly reports were made and the regular mining places were frequently surveyed. On surface the extensions of the caved ground were located.

REPUBLIC MINE.

Check surveys were run on the 2170' and 2270' levels Pascoe shaft. The monthly surveys were made and surveys into stopes were run as requested by the Superintendent. Lines were given for sinking the Pascoe shaft. On surface the new engine house was staked out, profiles for pulley stands prepared and the new hoist foundations set. The new transmission line from Ishpeming was located across the mine. In the office, the plotting of the outcrops was continued, the surveys having been made in 1917.

SALISBURY MINE.

The rapid opening up of the various sub-levels on the South side required frequent visits. The main part of the mine was taken care of during the usual monthly surveys.

SOUTH JACKSON MINE.

During the year several estimates of ore were prepared for the Superintendent and also methods of mining the deposit were worked up and submitted. In the field the drill holes were located and surveyed as necessary. Lines were given in the underground drift and grades for the steam shovel cut.

SPIES MINE.

Since May visits were made to the mine every other month before posting the underground maps. The analyses maps were kept up to date from data received from the Superintendent. In February a survey was run on surface relative to a proposed route for the disposal of the mine water. In the office new mounted maps and tracings were made to bring the information up to date.

WATER POWER.

AU TRAIN.

One day was spent running out the 792' contour on the NW¼ of the NW¼ of Section 5, 45-20. In the office the mapping 200' to the inch of the transmission line to Gwinn required considerable time. This information was taken from data supplied by the Mechanical department.

CARP RIVER.

No field work was done during the year. All the time was spent in the office in preparing a set of six maps showing the entire hydro electric system with tables of various kinds giving volume of storage basins, power plant and sub-station data. Transmission line maps were made of the new lines to Republic and the McClure plant 200' to the inch.

DEAD RIVER STORAGE BASIN.

By far the biggest work done by the department during the year was the surveys in connection with the proposed Dead River Storage Basin. This work was started by running a profile and cross-sections of the proposed dam site at the Hoist. From this a contour survey was run along both the North and South sides of the basin from the Hoist to Mulligan creek. Tie-ins were made across the basin and the surveys adjusted at each one. Side loops were run up the little Dead and Boyce creek and

frequent stadia surveys around swamps and gulleys. The 1355', 1350' and 1345' contours were taken at every station with such intermediate points as were necessary to insure the accurate location of the flowage lines. The contour surveys started on June 4th and were finished on August 5th, having taken 45 days field work in running 38 miles of survey line. After August 5th the surveys were run from the contour line surveys to all the known section corners adjacent to the basin and standard brass-topped pipe set. The Land department assisted in the finding of the corners. Several corners were set after the surveys were calculated and plotted, outside the basin where adjacent corners would be flooded.

The survey party consisted of an instrument man, foresight, backsight, rodman and three choppers. The roads in the vicinity of the basin were so good that no camp was established but the party was transported in the department's automobile. During May levels were run from the bench mark at the L. S. & I. station Ishpeming North along the road to the little Dead river. From there one line of levels was run along the road to the junction of the little and big Dead rivers and thence to the Holyoke dam site and then along the road to the Hoist, tying in with the McClure plant survey by 1.14'. The other line was run to the big Dead bridge, branching there again one line going to the Boyce creek and the other to the Mulligan creek. The levels for the contours were run on the McClure plant elevations and tie-ins were made across the basin with the surveys. No tie-in was greater than 0.30'. When the party was unable to be in the field, the choppers were sent to the Hoist and cleared the dam site. The lengths of the survey lines for the basin are shown as follows:

Dam site - - -	.79	miles
South side of basin	14.98	"
North side of basin	16.03	"
Little Dead river -	4.00	"
Boyce creek - -	.78	"
Tie-ins - - -	2.25	"
Corner sections -	14.04	"
Total	53.25	miles.

In the office a special man was employed in laying out the mounted maps and calculating and plotting the surveys. Other members of the force assisted in this work. The office and field work were carried on simultaneously so that the contours were completed shortly after the field

work was finished. The plotting of the section corners and the subdividing of the various sections took considerable time afterwards. Five foot interior contours of the basin were plotted from maps of Mr. Charles Cummings and the area determined on each contour on every forty. From these areas the capacity of the basin will be calculated.

MC CLURE PLANT.

Comparatively little work was required of this department during the construction of the plant. Lines for the pipe line crossing of the L. S. & I. Railway and an occasional grade along the pipe line and power house were all that was done during construction. The line of the steel pipe was run according to the manufacturers plans as a final check before the grading of that part of the line was started. During May a survey was run from the power house South along the transmission line to the South line of Section 18, 48-25; thence West to the L. S. & I. track; thence North to the pipe line and the section corner along the line surveyed. In Section 18 from this line a stadia survey was run to locate the edge of the high ground along the Dead river. The section corners of Section 7, 48-25 were also located during the year.

MISCELLANEOUS.

ANNUAL REPORT.

During January and February considerable time was occupied in finishing the annual report for 1917. The new tracings were made and preliminary work for the 1918 report was started in November. During the summer and fall photographs were taken of the McClure plant and at some of the mines.

CARBON AND DRILL INVENTORY.

The carbon purchased during the year was tested and the annual inventory of the diamond drill equipment was made.

DRILL HOLE LOCATIONS.

The drill holes on Sections 1, 2, 3, 4 and 5, 47-27 were located and surveyed from time to time as necessary. These holes were plotted on the maps and the locations reported to the Geological department.

ENGINEERING DEPARTMENT.

DRILL STEEL.

Under the supervision of Mr. Jackson, tests were made at the Negaunee and Cliffs Shaft mines on oil tempering of drill steel. A trip was made to the Gogebic Range for information regarding furnaces for heating the steel and a trial furnace was erected at the Cliffs Shaft mine. The time spent on this work was divided between the Maas, Negaunee, Lake and Morris-Lloyd mines.

ISHPEMING HOSPITAL.

Grade stakes were required for the grading of the lawn, driveway and sidewalks while the work was under construction. The garage was also staked out.

MARBLE SURVEYS.

Mr. Charles Cummings set 48 iron pins on his survey lines in Sections 29, 30, and 31, 48-27 and Section 36, 48-28. These pins replaced wooden stakes and were put in to preserve the work.

MESABI RANGE.

Although one member of the department spent a month on the Mesabi Range in connection with the new properties, his time was reported from there, This office made a tracing of several maps which were loaned the department. Also, the work in connection with the annual report was charged against the mines.

TAX COMMISSION MAPS.

During January and February the maps and estimates for the Michigan State Tax Commission were prepared.

REPORT ON THE ABSTRACTS FILED IN THE MINE DEPARTMENT FOR THE YEAR 1918, BY C. H. ECHLER.

REGISTER OF DOCUMENTS.

In this book have been listed the documents originating from this department and also several documents which have not been executed. A record of these is kept in order to secure copies of these later so that the files of the Abstract department may be complete. Twenty eight documents were entered in this book during the year.

OPTIONS FOR MINING LEASES.

There still remains in force three options, two of these being on the Spies land, on which a renewal was secured during the year, and a perpetual option with the Michigan Mineral Land Company. No options were acquired or relinquished during the year.

MINING LEASES.

No leases were surrendered during the year. The following leases were acquired:

Helmer mine No.47, St. Louis County, Minnesota, Assignment January 2, 1918, of State Lease No.402, Swallow & Hopkins to C.C.I.Company. Term of 50 years from November 28, 1900, 40 acres, description NE¼ of NE¼ of Section 14, 58-19.

Wade mine No.48, St. Louis County, Minnesota, dated February 1, 1918, North Star Iron Company to C.C.I.Company. Term of 30 years, 320 acres, description N½ of SE¼, N½ of SW¼ and SE¼ of SW¼ of Section 12 and SE¼ of NW¼ and N½ of NW¼ of Section 13, all in 58-19.

Fowler mine No.45, St. Louis County, Minnesota, Margaret B. Fowler et al to C.C.I.Company.On December 2, 1918 an extension of this lease for a period of ten years was executed.

The following table shows the leases in force during the past 7 years:

	1912.	1913.	1914.	1915.	1916.	1917.	1918.
Leases in force January 1st,	34	34	32	33	34	35	35
Leases acquired during year,	2	0	2	2	1	0	2
Leases surrendered " "	2	2	1	1	0	0	0

LAND OFFERS & LAND OFFER PLAT BOOK.

The land offers received during the year embrace Nos.1106 to 1165 inclusive. These offers have been recorded in the loose-leaf books entitled "Land Offer Plat Books". Township plats showing these offers have been sent monthly to the Cleveland office.

OUTSIDE EXPLORATIONS.

A new register for outside explorations has been started but has not been posted beyond No.880.

AUTHORIZATIONS.

During the year no authorizations for drilling were placed on record, the last number being 115.

DEEDS & MISCELLANEOUS DOCUMENTS.

During the year twenty six documents were filed in this book, the last number being 657. These documents include deeds, rights of way (not affecting the Cleveland-Cliffs Iron Company's Estate), leases, land contracts, etc.

EASEMENTS.

Twenty seven easements were secured by the Company during the year, twenty one of these being for the new transmission line from North Lake to Republic which was built during the summer and fall of 1918. Four easements were granted to the Company by railroad companies giving permission to cross their tracks and two easements were secured from the Michigan Railroad Commission to cross the above mentioned tracks.

RIGHT OF WAY DEEDS.

During the year one right of way deed has been listed in this book, the last number being 163.

WATER RIGHTS.

No water rights were granted during the year.

FARM & LOT LEASES.

During the year 184 farm and lot leases were entered in the "Record of Sales" book, the last number being 1419. Several renewals were also posted. These leases, which are sent to this office from the Land department for initials, embrace parcels of land on the iron formation.

APPLICATIONS FOR SALE.

During the year there were recorded eight applications for sale, the last one being No.31. These applications for sale are sent from the Land department to this office to be initialed in order to prevent the sale of lands considered valuable for mining purposes. These documents are posted in the "Record of Sales" book.

SALES.

There were 29 sales of Company lands entered in the "Record of Sales" book during the year, the last number being 130. The descriptions of land and reservations contained in these deeds and land contracts are carefully considered before being approved by the Mining department.

TAX HISTORIES.

Thirty one tax histories were filed during the year, the last number being 503. These tax histories cover lands included in the Ayer & Longyear lease of water power lands.

LEGAL OPINIONS.

During the year fifteen legal opinions were placed in the files, the last number being 133.

DOCUMENTS RECORDED.

The following list of documents is a summary of those placed on the records or in the files during 1918:

	Number Recemved.	Last File Number.
Land Offers - -	59	1165
Authorizations -	0	115
Deeds - - - -	25	656
Easements - -	27	125
Water Rights - -	0	9
Surface Leases -	184	1419
Applications for Sale	8	31
Sales - - -	29	130
Tax Histories - -	31	503
Legal Opinions -	15	133

INDEX PLAT BOOK.

The following documents are entered in the Index Plat Book; abstracts, tax histories, options, leases, easements, water rights and deeds. This plat book has been posted up to date.

ENGINEERING DEPARTMENT.

UNRECORDED PLATS, FARM LEASES, ETC.

This book was revised and several new maps were added during the year.

LAND OWNERSHIP PLAT BOOKS.

Considerable information has been entered in these books during the past year.

U. S. GOVERNMENT PLAT BOOKS.

The U. S. township plats are filed in two large post binders. No new maps have been added this year.

MISCELLANEOUS.

In vertical file marked "Miscellaneous" there have been added some expired leases and a copy of a will. In this file are a number of documents for which a place could not be found in the regular files.

ATHENS MINING COMPANY ABSTRACTS.

A small amount of new work has been done on these abstracts during the year, but this has not been typewritten. A change has been made in two of the abstract maps in this book in order to show later acquisitions of surface and a more comprehensive map defining the mineral rights of the Athens Mining Company.

MAAS-NEGAUNEE ABSTRACTS.

A small amount of new work has been done on these abstracts during the year but this has not yet been typewritten.

C. C. I. COMPANY ABSTRACTS.

During the year many additional entries have been made to the above abstracts but these have not been typewritten. Four new abstracts have been made and typewritten and all this information will be entered in the abstract books which are on file in the Cleveland office, Land department and Mine department.

HYDRO-ELECTRIC ABSTRACTS.

All abstracts and maps in connection with the transmission line from the Carp river water power plant to the Pioneer Furnace were completed during the year and a copy of the HydreElectric book sent to the Cleveland office and the Land department. The abstracts have been made and typewritten and maps

ENGINEERING DEPARTMENT.

have been made covering all lands crossed by the new transmission line running from North Lake to the Republic mine. A part of the abstracts covering the land embraced in the Ayer & Longyear lease have been typewritten but the maps have not yet been made. This work will soon be completed and entered in the Hydro-Electric books. A new index map has been made for this book showing in four colors all lands which have been abstracted.

SUMMARY.

During the year the abstracter spent 45 days working in Marquette, 41 days work being done on the abstracts, 3 days in copying field notes for the Engineering department and one day in Mr. Longyear's office on tax matters. Three trips were made to the Land department office at Negaunee on various matters. Several visits were made to Mr. Berg's office for the purpose of discussing complications which were met in making abstracts. The balance of the abstracter's time was spent in the mine office doing current work and about 20% of this time was taken in assisting the Chief Engineer with his work. Considerable time was spent in helping with the filing of the General Manager's correspondence throughout the year. On November 12th, Miss de Leury entered the department as stenographer and started work typewriting and comparing abstracts which occupied her time during the balance of the year.