

When operations are started on the C. & N. W. Lease, $N\frac{1}{2}$ of the N.W. $\frac{1}{4}$ Section 29, the ore body can be attacked from the 5th level foot wall rock drift, which is now at the Section 29 boundary. The ore will be hoisted through the Stephenson Shaft.

The new pump station on the 5th Level was completed early in the year and electrical pumps put in commission during the month of May.

The sump for the pump station, below the 5th level, was finished early in the year and the pumps installed. This sump has a capacity of 660,000 gallons of water, which, figuring at a flow of 2,000 gallons per minute, would mean five hours. In the pump house are installed one Prescott Centrifugal pump and a Prescott Pole Pump, each with a rated capacity of 1500 gallons per minute.

The Pump House is on the 5th level, West of the shaft, but is arranged so that it can be shut off from this level; there is a rock raise extending to a point a few feet above the 4th level. In case of a rush of sand and water, the pumps could be operated even if the 5th level proper filled with water, as an arrangement has been made whereby the sumps can also be cut off and only a certain quantity of water allowed to flow into the suction.

The most expensive feature of this installation is the large sump capacity which permits a few hours storage in case of trouble on our transmission lines and pumping at times when there are no peak loads on the transmission line.

The water being pumped at the Stephenson Mine at the close of last year was 1720 gallons per minute. This amount increased up to April, the average for the month being 2317 gallons per minute since April the amount being pumped has gradually decreased. The water pumped during November averaged 1633 gallons per minute while the average for December was 1578 gallons per minute.

STEPHENSON SURFACE

WORK FOR YEAR

The new launder which was under construction at the close of last year was extended to the Escanaba River. This work was completed during the month of May.

A building was erected for Captains Office.

New caps and corbels were placed on Stephenson Coal Dock.

16 Bents were erected on East stocking trestle and West stocking trestle.was repaired.

A fill was made on the East side of the East stockpile ground. This new area being 55 feet wide by 750 feet long, giving an increased room for 95,000 tons of ore.

On the East side of the shaft four bents of the new permanent trestle were erected and 8 temporary bents to connect the above trestle with the ore pile. Three permanent bents for rock trestle were also erected.

Timbers were framed for two pockets and 7 bents for new permanent trestle on West side of Shaft and one ore pocket erected.

The pulley stand nearest the shaft was moved 13 feet to the West to make room for the new trestle.

A new cave broke through to surface on West side of Stephenson deposit during the month of November. This cave is about 160 feet South-west of the cave which occured in November 1912. The hole is about 125 feet in diameter and about 75 feet deep.

By the analysis of the cost sheet it will be seen that the cost of Top Landing and Trammig and stocking ore are very high at this mine. Also the Maintenance costs are extremely large. These costs are almost wholly explained from the fact that the Stephenson No. 2 grade of ore has not been shipped, leaving immense stockpiles on hand, which have filled our stocking grounds.

This has meant that the grounds have had to be increased largely by means of sand fills; that the ore has had to be trammed farther than it would ordinarily and has further meant side dumping from the cars instead of direct dumping, from the trestle. Where this latter method is used, a number of men are required on the dump to keep it in shape so the car will keep on the track and also to shift the track to new positions as the dumping progresses.

The physical properties of the Stephenson ore makes an extremely difficult product to handle where side dumping is used. The ore at times will leave the car in one large mass of putty-like consistency. Other times it is soft and wet and is more like a thin mud than anything else. When this wet ore is handled the tracks have to be cleaned constantly and the sides of the piles have to be shoveled down by men stationed along the tracks. The tracks also have to be continually leveled and straightened. On the other hand, if the ore could be handled directly from a stocking trestle, no one would be required on the dump.

Arrangements are being made whereby the Top Landing cars can approach the shaft from the side instead of from the end. This will permit the cars to be more evenly loaded and in case a stocking trestle is used the product should be handled without difficulty.

STEPHENSON MINE.

AVERAGE MINE ANALYSIS OF OUTPUT.

GRADE	IRON	PHOS.
Stephenson Bessemer	62.29	.054
Stephenson	62.28	.099
Stephenson #2	60.54	.674

AVERAGE ANALYSIS ON STRAIGHT CARGOES.

	MINE		LAKE ERIE	
	IRON	PHOS.	IRON	PHOS.
Stephenson Bessemer	All	Mixed		
Stephenson	"	"		
Stephenson #2	60.71	.638	60.04	

ORE STATEMENT - DECEMBER 31ST, 1913.

	STEPHENSON BESSEMER	STEPHENSON	STEPHENSON NO.2	TOTAL	TOTAL LAST YEAR
On hand Jan.1,1913,	66,781	0	113,907	180,688	185,792
Output for year	55,625	9,562	190,792	255,979	209,282
Total	122,406	9,562	304,699	436,667	395,074
Transferred to Lake stockpile at P.Isle			19	19	
Shipments	47,683	9,562	39,034	96,279	214,386
Balance on hand	74,723	0	265,646	340,369	180,688
Increase in Output 22%				46,697	
Increase in Ore on hand				159,681	

1913 - 2-8hr.shifts during year.

1912 - 2-10hr.shifts to Mar.11th; 2-8hr.shifts Mar.11th to Dec.31st.

SHIPMENTS FOR YEAR 1913.

	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Stephenson Bessemer	40,197	7,486	47,683	50,088
Stephenson	8,926	636	9,562	4,312
Stephenson #2	29,649	9,385	39,034	159,986
Total	78,772	17,507	96,279	214,386
Total Last Year	120,911	93,475	214,386	
Decrease 55 %			118,107	

STEPHENSON MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 3	1 9 1 2	INCREASE	DECREASE
<u>PRODUCT</u>	255,979	209,282	46,697	
General Expense	.144	.170		.026
Maintenance	.165	.159	.006	
Mining Expense	1.078	1.140		.062
<u>Cost of production</u>	1.387	1.469		.082
<u>DEPRECIATION</u>				
New Construction	.005		.005	
Plant	.289	.280	.009	
<u>Total depreciation</u>	.294	.280	.014	
Taxes	.043	.044		.001
Central Office	.069	.084		.015
Miscellaneous	.005		.005	
Sundry Expense	.084		.084	
<u>COST ON STOCKPILE</u>	1.882	1.877	.005	
Loading and Shipping	.009	.025		.016
<u>Total cost on cars</u>	1.891	1.902		.011
No.days operating	302	300	2	
No. of shifts and hours	2-8hr	2-10hr 2-8hr		
Avg.daily product	848	698	150	
<u>COST OF PRODUCTION</u>				
Labor	.972	1.072		.100
Supplies	.415	.397	.018	
<u>Total</u>	1.387	1.469		.082

STEPHENSON MINE.

STATEMENT OF COMPARATIVE WAGES.

	1 9 1 3	1 9 1 2	INCREASE	DECREASE
<u>SURFACE</u>				
Total number of days	20,921½	14,145½	6,776	
Average rate	2.50	2.38	.12	
<u>Amount</u>	51,870.25	33,608.77	18,261.48	
<u>UNDERGROUND</u>				
Total number of days	66,248½	67,597½		1,349½
Average rate	2.78	2.63	.15	
<u>Amount</u>	184,095.74	117,716.55	6,379.19	
Total days	87,169-3/4	81,743	5,426-3/4	
Average rate	2.71	2.59	.12	
<u>Total Amount</u>	235,965.99	211,325.32	24,640.67	
Labor cost per ton	.922	1.010	.088	
No. shifts and hours	2-8hr	2-10hr 2-8hr		

Mine changed from 2-10hr to 2-8hr March 11, 1912.

Increased wages for 1913:

SURFACE	.12	-----	5.04%
UNDERGROUND	.15	-----	5.70%
TOTAL	.12	-----	4.63%

STEPHENSON MINE

COMPARATIVE AVERAGE WAGES AND PRODUCT

PRODUCT ' 13 255,979 Tons	SURFACE		UNDERGROUND		T O T A L	
	1913	1912	1913	1912	1913	1912
PRODUCT ' 12 209,282 Tons						
Avg.number men working	70	48	220	225	290	273
Avg.wages per day	2.50	2.38	2.78	2.63	2.71	2.59
Avg. wages per mo.25 days	62.50	59.50	69.50	65.75	67.75	64.75
Avg. product per man per day	12.25	14.80	3.86	3.10	2.94	2.56
Labor Cost per ton	.203	.161	.719	.849	.922	1.010
Diff. in labor cost per ton	.042	.001	-.130	.140	.088	.141
Avg.product breakg.& tramng/			7.14	6.56		
Avg.wages for miners cont.			2.88	2.74		
Total avg.wages for cont.			2.88	2.74		

		TONS	%
Tons per man per day	SURFACE DECREASE	2.55	17.2
Tons per man per day	UNDERGROUND INCREASE	.76	24.5
Tons per man per day	SURF. & U.G.INCREASE	.38	14.8

Proportion Surface to Underground: 1913 - 1 to 3.13
 1912 - 1 to 4.69
 1911 - 1 to 4.18
 1910 - 1 to 4.03

STEPHENSON MINE.

TIMBER STATEMENT FOR YEAR ENDING DECEMBER 31, 1913.

KIND	LINEAL FEET	AVG. PRICE PER FOOT	AMOUNT	
			1 9 1 3	1 9 1 2
6" to 8" Timber	9,286	.02	185.72	104.01
8" to 10" "	83,641	.04	3,345.62	1,922.90
10" to 12" "	58,037	.06	3,482.22	3,122.08
12" to 14" "	25,341	.0834	2,114.27	2,118.76
14" to 16" "	96	.11	10.56	
Total 1913	176,402	.0518	9,138.39	
Total 1912	130,688	.0556		7,267.75

	LINEAL FEET	PER 100'		
			1 9 1 3	1 9 1 2
5" Lagging	437,740	.465	2,036.00	1,602.60
7" "	12,950	.556	75.00	52.51
8" "	289,320	.550	1,590.99	1,445.98
Poles	232,962	.950	2,213.16	1,528.98
Total 1913	972,972	.608	5,915.15	
Total 1912	779,949	.594		4,630.07

	1 9 1 3	1 9 1 2
Feet of timber per ton of ore	.689	.624
Feet of lagging per ton of ore	2.89	2.96
Feet of lagging per foot of timber	4.19	4.74
Cost per ton for timber, lagging and poles	.0588	.0568
Equivalent of Stull Timber to Board measure	412,636	354,140
Feet board measure per ton of ore	1.612	1.69
Total Product	255,979	209,282
Total cost of timber and lagging - 1913		15,053.54
Total cost of timber and lagging - 1912		11,897.82
Total cost of timber and lagging - 1911		9,696.65
Total cost of timber and lagging - 1910		7,855.24
Total cost of timber and lagging - 1909		5,428.62
Total cost of timber and lagging - 1908		4,918.31

STEPHENSON MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND	QUANTITY	AVERAGE PRICES	AMOUNT	
			1 9 1 3	1 9 1 2
40% Powder	1,850	.0900	166.50	337.50
30% "	30,775	.0829	2,556.36	2,838.51
60% "				47.25
50% "	33,975	.10	3,399.25	148.25
80% "	1,200	.135	162.00	
Total powder	67,800	.0927	6,284.11	3,371.51
Fuse	204,900	.383	785.54	462.97
Caps	52,200	6.40	334.08	216.05
Cap Crimpers	42	.25	10.50	15.00
Fuse lighters				.50
Total fuse, etc.			1,130.12	694.52
Grand Total			7,414.23	4,066.03
Product			255,979	209,282
Pounds powder per ton ore			.265	.190
Cost per ton for powder			.0245	.016
Cost per ton for fuse, caps, etc.			.0044	.003
Cost per ton for all explosives			.0289	.019
Avg. price per lb. for powder			.0927	.0848

Increase in average cost per pound for powder due to more 50% being used in 1913.

PRINCETON MINE

The product for the month of December, from Daily Reports, was as follows:

Cambridge, 121 tons,

The product for the year was as follows:

Princeton, 1,058 tons,

Cambridge, 73,190 "

Bessemer, 656 "

Total, 74,884 "

Rock, 344 "

Tot. Ore & Rock, 75,228 "

10,480 tons were shipped from Cambridge Stockpile.

21,943 tons were shipped from Princeton Stockpile.

593 tons were shipped from Bessemer Stockpile.

20,461 tons were shipped from Cambridge Pocket.

THE MINE

No mining was done at No. 1 Shaft.

At No. 2 Shaft mining and development work were carried on up to August 30th, at which time the mine closed down for an indefinite period.

The estimate of ore in sight shows:

No. 1 Shaft, 84,598 tons,

No. 2 Shaft, 868,738 tons,

Total, 953,336 "

as against 1,059,678 tons shown a year ago.

SUB. LEVELS ABOVE 5TH LEVEL

235 FOOT SUB.

WORK FOR YEAR

The following work was done on this Sub. Level during the year.

No. 4 Contract drifted Northeast from N₁ Raise to the foot and then drove foot wall drift Southeast to O Raise. It then mined all the ore between foot and its old hanging wall drift. The pillars between O and P Raises were removed by Contracts No's 24 A and 24 B, Contracts No's 6 A, 6 B, 21 A and 21 B developed and mined all the ore between Q and P raises, and Contracts No's 23 A, 23 B, 15, 10 A and 10 B mined all the ore between T and Q₁ Raises.

240 FOOT SUB.

No. 17 Contract removed ore that was left between foot and hanging West of V Raise.

No. 23 B Contract cut out on hanging side of T Raise and drifted Northwest 10 feet. Then from raise drifted Northeast 63 feet and holed to S Raise, then 31 feet Northeast of raise drifted Southeast 26 feet to foot and Northeast 63 feet along foot.

No. 15 Contract cut out on hanging side of S Raise and drifted Northwest 25 feet, thence North 30 feet to caved ground. It then extended its cross-cut 53 feet to hanging. It then repaired old drift of raise and extended it 10 feet North, thence Northwest 70 feet to hanging.

No. 24 B cut out on foot side of O Raise and drifted Southeast 100 feet along foot.

No. 6 A from the hanging side of Q Raise drifted Northwest 55 feet to hanging, thence Northeast 35 feet along hanging.

No. 4 Contract drifted Northwest 10 feet from N₁ Raise and holed to old workings. It then drove cross-cut 19 feet Northeast to foot, thence Southeast 52 feet along foot.

A drift was driven from the North side of O Raise by No. 24 A Contract. This drift was extended 10 feet North, thence Southeast 99 feet to hanging, thence Southerly along the hanging 23 feet.

No. 6 B Contract drove a cross-cut to Northeast 35 feet from foot side of Q₁ Raise.

No. 10 A Contract cut out on hanging side of R Raise and drove cross-cut 65 feet Northwest to hanging and then drifted 10 feet Southwest along the hanging.

260 FOOT SUB.

The work for the year on this Sub. Level consisted in developing and mining the ore from a point 140 feet Northwest of W Raise to a point just South of U Raise. This work was done by Contracts No's 29 and 17.

280 FOOT SUB.

No. 2 Contract removed the greater part of the ore that was left on this Sub. Level to a point about 150 feet Southeast of M Raise.

6TH LEVEL

The work for the year consisted in extending the foot wall drift to the Southeast by No. 20 Contract. It started 25 feet Northeast of its old breast and drifted Southeast along the foot 115 feet.

UNDERGROUND IN GENERAL

The principal work at No. 2 Shaft for the year consisted in developing and mining the ore on Sub. Levels above the 5th level in the South end of the deposit.

All the ore has now been mined on the 235' Sub. and drifts were driven to develop the ore on 240' Sub. between N and U Raises.

PRINCETON SURFACE

The 150 H.P. Motor at No. 2 Engine House was removed and a new motor of 200 H.P. installed in its place.

The controller and attachments at No. 1 Engine House were dismantled and sent to Ishpeming to replace those destroyed in Cliffs Shaft crusher building.

A cave occurred North and West of Princeton Timber Raise and Surface settled over quite a large area. This area was enclosed by a fence.

The land Northwest of Princeton Timber raise and beyond the dangerous area was cleared and seeded down for fire protection.

Four new bents were erected on South permanent trestle No. 2 Shaft to replace old bents which were badly decayed. The rock trestle was also repaired.

All the ore that remained in the stockpiles at No. 1 Shaft was shipped during the year.

Concrete piers were constructed for Head Frame at Princeton Timber Raise.

, PRINCETON MINE.

AVERAGE MINE ANALYSIS OF OUTPUT FOR 1913.

GRADE	IRON	PHOS.
Princeton Bessemer	60.70	.083
Princeton	62.00	.090
Cambridge	60.37	.694

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR 1913.

	MINE		LAKE ERIE	
	IRON	PHOS.	IRON	PHOS.
Princeton Bessemer	All	Mixed		
Princeton	59.75	.215	59.27	.183
Cambridge	60.18	.669	60.06	

ORE SHIPMENTS - DECEMBER 31ST, 1913.

	PRINCETON BESSEMER	PRINCETON	CAMBRIDGE	TOTAL	TOTAL LAST YEAR
On hand Jan 1, 1913,	644	31,317	128,825	160,786	300,356
Output for year	636	1,058	73,190	74,884	22,567
Total	1,280	32,375	202,015	235,670	322,923
Shipments	593	21,943	30,941	53,477	162,137
Balance on hand	687	10,432	171,074	182,193	160,786
Increase in Output				52,317	
Increase in Ore on hand				21,407	

1913 - 1-8hr. shift Jan. 1st to Aug. 31st; mine idled Sept. 1st to Dec. 31st.
 1912 - Mine operated only from Sept. 23rd to Dec. 31st.

SHIPMENTS FOR 1913.

	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Princeton Bessemer		593	593	
Princeton		21,943	21,943	11,149
Cambridge	20,461	10,480	30,941	150,988
Total	20,461	33,016	53,477	162,137
Total Last Year	9,155	152,982	162,137	
Decrease 67%			108,660	

PRINCETON MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 3	1 9 1 2	INCREASE	DECREASE
<u>PRODUCT</u>	74,884	22,567	52,317	
General Expense	.114	.101	.013	
Maintenance	.102	.048	.054	
Mining Expense	.861	.977		.116
<u>Cost of production</u>	1.077	1.126		.049
<u>DEPRECIATION</u>				
Inventory		.052		.052
Plant	.101	.193		.092
New Construction	.009	.007	.016	
Cost of Mines	2200	.200		
<u>Total depreciation</u>	.310	.438		.128
Idle Expense	.159	1.011		.852
Taxes	.133	.178		.045
Central Office	.059	.049	.010	.0
Sundry Expense	.073		.073	
<u>COST ON STOCKPILE</u>	1.811	2.802		.991
Loading and shipping	.037	.240		.203
<u>Total cost on cars</u>	1.848	3.042		1.194
Number of days operating	198	75	123	
Number of shifts and hours	1-8hr	1-8hr		
Average daily product	378	301	77	
<u>COST OF PRODUCTION</u>				
Labor	.844	.855		.011
Supplies	.233	.271		.038
Total	1.077	1.126		.049

Mine closed Nov. 30, 1911; resumed #2 Shaft Sept. 23, 1912.
 Mine closed Aug. 31, 1913.

PRINCETON MINE.

STATEMENT OF COMPARATIVE WAGES.

	1 9 1 3	1 9 1 2	INCREASE	DECREASE
<u>SURFACE</u>				
Total number of days	5,525	3,042 $\frac{1}{2}$	2,482- $\frac{3}{4}$	
Average rate	2.51	2.55		.04
<u>Amount</u>	13,872.46	7,764.19	6,108.27	
<u>UNDERGROUND</u>				
Total number of days	18,023- $\frac{3}{4}$	7,266 $\frac{1}{2}$	10,757 $\frac{1}{2}$	
Average rate	2.80	2.77	.03	
<u>Amount</u>	50,451.42	20,152.55	30,298.87	
Total days	23,548- $\frac{3}{4}$	10308- $\frac{3}{4}$	13,240	
Average rate	2.73	2.71	.02	
<u>Total amount</u>	64,323.88	27,916.74	36,407.14	
Labor cost per ton	.859	1.237		.378
No. shifts and hours	1-8hr	1-8hr		

Average wages per day:

SURFACE	Decrease	.04	-----	1.57%
UNDERGROUND	Increase	.03	-----	1.08%
TOTAL	Increase	.02	-----	.738%

PRINCETON MINE.

COMPARATIVE AVERAGE WAGES AND PRODUCT.

PRODUCT '13 74,884 Tons	SURFACE		UNDERGROUND		TOTAL	
	1913	1912	1913	1912	1913	1912
PRODUCT '12 22,567 Tons						
Avg.no.men working	19	11	61	26	80	37
Avg.wages per day	2.51	2.45	2.80	2.77	2.73	2.71
Avg.wages per mo.25 days	62.75	61.25	70.00	69.25	68.25	67.75
Avg.product per man per day	13.55	7.42	4.15	3.11	3.18	2.19
Labor cost per ton	.185	.344	.674	.893	.859	1.237
Diff. in labor cost per ton	-.159	+.156	-.219	+.209	-.378	+.365
Avg. product breakg & trammg.			7.08	6.48		
Avg.wages for miners cont.			2.90	2.79		
Total avg.wages for cont.			2.90	2.79		

			Tons	%
Tons per man per day	SURFACE	Increase	6.13	82.6
Tons per man per day	UNDERGROUND	Increase	1.04	33.4
Tons per man per day	SURF. & U.G.	Increase	.99	45.6

Proportion of Surface to Underground men 1913 - 1 to 3.21
 1912 - 1 to 2.36
 1911 - 1 to 3.48
 1910 - 1 to 3.44

PRINCETON MINE.

TIMBER STATEMENT FOR THE YEAR ENDING DECEMBER 31, 1913.

KIND	LINEAL FEET	AVG. PRICE PER FOOT.	AMOUNT	AMOUNT
			1913	1912
6" to 8" Timber	1,120	.02	22.40	3.84
8" to 10" "	12,780	.04	511.20	163.84
10" to 12" "	14,402	.06	864.12	276.96
12" to 14" "	6,408	.0825	528.63	295.20
14" to 16" "	448	.0825	36.96	4.32
Total 1913	35,158	.0558	1,963.31	
Total 1912	11,534	.0645		744.16

	LINEAL FEET	PER 100'	1913	1912
5" Lagging	155,660	.465	724.00	211.00
7" "	85,870	.554	475.69	159.31
8" "	2,752	.508	13.98	33.00
Poles	14,426	.950	137.05	104.35
Total 1913	258,708	.00522	1,350.72	
Total 1912	93,235	.544		507.66

	1913	1912
Feet of timber per ton of ore	.469	.511
Feet of lagging per ton of ore	3.26	3.64
Feet of lagging per foot of timber	6.94	7.13
Cost per ton of timber, lagging and poles	.0442	.055
Equivalent of Stull timber to board measure	96,964	32,785
Feet board measure per ton of ore	1.295	1.45
Total product	74,884	22,567
Total cost of timber and lagging - 1913		3,314.03
Total cost of timber and lagging - 1912		1,251.82
Total cost of timber and lagging - 1911		4,918.36
Total cost of timber and lagging - 1910		7,154.58
Total cost of timber and lagging - 1909		6,654.30
Total cost of timber and lagging - 1908		5,281.08
Total cost of timber and lagging - 1907		8,730.49
Total cost of timber and lagging - 1906		5,814.24
Total cost of timber and lagging - 1906		2,042.93

PRINCETON MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND	QUANTITY	AVERAGE PRICES	AMOUNT 1 9 1 3	AMOUNT 1 9 1 2
40% Powder	14,485	.09	1,303.65	477.00
30% "	1,350	.083	112.05	
Total powder	15,835	.0894	1,415.70	477.00
Fuse	46,600	3,836	178.77	65.41
Caps	12,200	6,375	77.79	30.60
Cap Crimpers	9	.25	2.25	3.50
Total fuse, etc.			258.81	99.51
Grand total			1,674.51	576.51
Product			74,884	22,567
Pounds Powder per ton ore			.211	.235
Cost per ton for powder			.0189	.021
Cost per ton for fuse, caps, etc.			.0035	.005
Cost per ton for all explosives			.0024	.026
Avg. price per lb. for powder			.0894	.090

GWINN MINE

Work was resumed at the Gwinn Mine early in June. The work of unwatering the mine was started June 17th. The water in the shaft was lowered 80 feet by an injector and a bailer was then installed in skip compartment and water lowered to 1st level. Trouble was then had in lowering the water in the skip compartment and a second bailer was installed in the cage compartment. The two bailers were used up to the 15th of July at which time the water had been lowered to a depth of 634 feet below the collar of the shaft. On the morning of the 15th the second shaft gear tooth broke on skip hoist and put the hoist out of commission, an accident also occurred on the 23rd of July at which time the overwinding trip for air brake on cage hoist failed to work and hoist overwound, this broke the rope letting the bailer drop in the shaft. Another bailer was brought down from the Negaunee Mine and installed on July 24th.

The above accidents caused considerable delay in unwatering the shaft.

A Prescott Sinking Pump was installed on the 1st level July 16th and a No. 10 Cameron Pump in the shaft later in the month. A pump was also installed on the 4th level and started operating August 17th. The work of unwatering the mine was completed August 21st and a pump installed in the shaft below the sump level and started operating August 24th. The balance of the month was confined to cleaning up the 7th level and sumps level drifts. Development work was started early in September.

FIFTH LEVEL

WORK FOR YEAR

The work on 5th Level was started about the middle of November. The drift Northwest of the skip road was extended 59 feet and tail drift 28 feet to the Southeast. The above work being done by No. 7 Contract.

WORK FOR DECEMBER

No. 7 Contract,

No. 7 extended its drift Northwest off of shaft 43 feet and tail drift Southeast 23 feet making a total of 66 feet.

SIXTH LEVEL

WORK FOR YEAR

No. 5 Contract started work on 6th level early in October and extended its main drift off of skip way 51 feet to Northwest, then turned back and drifted Southeast 34 feet and holed into drift off of cage compartment. It then extended its drift to Northwest 87 feet. It also extended its tail drift 17 feet to Southeast.

WORK FOR DECEMBER

No. 5 Contract,

No. 5 extended its drift 87 feet to the Northwest.

SEVENTH LEVEL

WORK FOR YEAR

No. 2 Contract put up man safety raise from the Northwest corner of the pump room. It raised 50 feet and then from top of raise drifted North 27 feet and then put up a raise from the end of this drift raising 147 feet.

From a point 50 feet South of Pump Room two stub drifts were driven for winzes to sump, one drift being driven 7 feet to the West and one four feet to the East. This work being done by Contract No. 4. It then started 80 feet South of Pump Room and drifted West 14 feet. From the end of this drift No. 3 Contract put up water raise 46 feet above back of 7th level and then from top of its raise drifted Northwest 168 feet and from the end of its drift put up another raise, raising 15 feet.

The West foot wall drift was started by No. 4 Contract from a point 85 feet North of where the main drift turns North, and extended Northwest 195 feet, thence Southwest 65 feet. Two cross-cuts were also

driven from this foot wall drift. The first cross-cut started from a point 80 feet West of main drift and was extended Southwest 10 feet and second cross-cut started 70 feet Northwest of cross-cut No. 1 and extended Southwest 10 feet.

No. 6 Contract started in tail drift 13 feet Southeast of Shaft and stripped sides of drift for 45 feet making standard drift. It then drifted Northeast 121 feet.

212 feet of ditch was cut on 1st Level. This work was done by No. 1 Contract.

WORK FOR DECEMBER

No. 2 Contract,

No. 2 for greater part of month was up man safety raise from Pump Room. It raised 33 feet, then came down to pump room and filled in bottom with crushed rock preparatory for concrete floor.

No. 4 Contract,

No. 4 extended its foot wall drift 110 feet.

No. 6 Contract,

No. 6 continued to make turn to Northeast drifting 87 feet.

SUMP LEVEL

WORK FOR YEAR

No. 3 Contract enlarged the suction openings to pump room and extended suction sump under pump room 5 feet. It then started on Sump Level opposite cross-cut to East sump winze and stoped 5 feet from East side of main drift 44 feet to the North.

The drift around North end of Pump Room was extended Westerly 110 feet thence Southeast 20 feet, to the South 65 feet and Easterly 78 feet. This work being done by Contract No. 1 It also stripped five feet off the side of the North sump drift for a distance of 144 feet.

The cross-cut towards East winze was extended 39 feet and from end of this cross-cut winze was driven and holed to 7th level.

WORK FOR DECEMBER

No. 1 Contract,

No. 1 extended its drift South 45 feet, thence East 70 feet also sliced five feet for a distance of 46 feet.

UNDERGROUND IN GENERAL

The work of cleaning up the 7th level and sump level after unwatering the mine was completed early in September and a concrete dam was constructed on 4th level about 308 feet North of the Shaft.

A 12" discharge pipe was installed on the 7th level from shaft to Pump Room and 14 concrete piers were built under this pipe, a heavy timber floor was built in the pipe drift where the pipe crosses over the winze to sump level.

Concrete foundations were constructed for centrifugal pump in the Pump Room and Pump installed. This pump started operating November 30th.

A temporary concrete dam was constructed just inside of turn to East winze on sump level. This portion of the sump being used for a temporary sump until the entire sump is completed.

The concrete foundation for the Plunger pump was constructed.

A small concrete pier was constructed under the discharge pipe and a large pier under the T connection to the plunger pump.

There has been considerable trouble in getting sufficient air to operate the drills. The present 4" line from the Central Power Plant probably being too small to furnish air enough. A great deal of trouble has also been had with the air freezing in the pipes. The present air line being laid on surface.

It may be necessary to install a larger air line and if one is installed it should be buried to avoid the trouble that is now being had with freezing.

GWINN MINE SURFACE

The following work was done at the Gwinn Mine Surface during the year.

Shower baths, hoods over steam pipes and steel lockers were installed in the Gwinn Mine Dry.

Steam pipes and radiators were placed in the new office building and steel lockers in the change room of the Captains Office.

A concrete floor was laid in the Engine House and skip hoist installed.

Sheaves for skip hoist were placed on pulley stands and shaft house.

Herring Bone gears were installed on skip hoist.

The area at the Northeast end of the Southwest temporary trestle was moved to make room for the last two bents of permanent trestle.

Concrete piers were constructed for 17 bents of the permanent trestle.

Timbers were framed for 10 bents of the Northeast permanent trestle, and first three bents erected.

Two concrete foundations for top tram engine were constructed on the ground under the shaft house pockets and engines and motors installed and enclosed in corrugated iron buildings.

A brick building with concrete floor was constructed on landing floor. This building to be used for top tram controller house and landers shanty.

200 feet of stocking ground was graded on both the Southwest and Northeast side of shaft and solar plank partly laid.

A concrete floor was laid in machine shop and new pine floor in Carpenter Shop. The inside of Machine Shop was sided and outside of shop building painted.

The tar paper was removed from the old dry building and battens put on.

Iron racks were installed in the building.

A wood water line was laid from the Gwinn Mine and connected with the main near the Gwinn Depot on Section 21.

Lath dividing between the skips and cage compartments was put in from the dump plates in the shaft house to a point about 80 feet below the collar of the shaft.

Steam coils were placed in the cage compartment 3 feet below the tunnel on account of ice accumulating in the concrete portion of the shaft. The cage compartment has acted as a down cast and the skip compartment as up cast.

GWINN MINE.

ORE STATEMENT - DECEMBER 31ST, 1913.

	BESSEMER	NON-BESSEMER	TOTAL	TOTAL LAST YEAR
On hand Jan.1, 1913,	26	281	307	307
Shipments	0	0	0	0
Balance in hand	26	281	307	307

Mine idle during 1912 and 1913.

JOPLING MINE

There was no work done at the Jopling Mine during the year.

FRANCIS MINE

There was no work done at the Francis Mine during the year.

The Hoisting Engine bought for this mine was shipped to the Mackinaw Mine where it has since been installed.

MACKINAW MINE

In the early part of the year the land Southeast of the shaft was cleared and the timber cut and made into stulls, ties and poles.

The land at the site for mine buildings was cleared and the following buildings erected during the year.

Engine House.

The Engine House which accommodates the hoist for Mackinaw Shaft and air compressor for both Mackinaw and Gardner Mines. This is a frame building with concrete foundations and concrete floor. Concrete foundations for the hoist and compressor were also constructed and hoist is now being installed.

Sub Station.

A brick building for Sub. Station was erected Southwest of and adjoining the engine house.

The electric equipment was also installed in the Sub. Station.

Shop Building.

The shop Building was erected in line with and 40 feet Northwest of Sub. Station. This is a frame building with concrete foundation and concrete floor in machine shop and carpenter shop.

The office which is also a frame building was erected in line with and 35 feet Northwest of the shop building.

Warehouse

A frame building which will be used for temporary dry was erected parallel with and 35 feet from the Southeast end of the office building. This building will be used later to store hose cart, ropes, block and tackle, etc., Concrete foundations were also constructed for Captains Office just Northwest of Office building.

A barn is now being erected. This barn is located just East of the road at the North end of long corduroy.

Concrete piers for steel head frame were constructed at the Mackinaw shaft and head frame erected by the Worden and Allen Company.

A drainage ditch was excavated from a point just South of the Mackinaw Engine House to a point about 1800 feet Southwest of this Northwestern tracks, on Section 2 - 44 - 25. The object of this ditch being to lower the water level in the swamp adjacent to the Mackinaw Shaft and Mine Buildings. From elevations taken it was found that the water drains to the Southwest and that the water level in the swamp about 4000 feet Southwest of the Mackinaw Shaft is 6 feet lower than in the swamp just South of the Mackinaw Engine House. This ditch was excavated by blasting and the cost was very slight as compared with the ordinary method of excavating. The water level adjacent to the ditch, has now been lowered about 7 or 8 inches. By excavating laterals to connect with the main ditch a larger area can be drained and the present water level can probably be lowered considerably.

GARDNER MINE

The slashings that were left by the contractor on the S.E. $\frac{1}{4}$ of the S.E. $\frac{1}{4}$ Section 35 - 45 - 25, were piled and burned.

The site for Engine House and Pulley Stands South of the Gardner Shaft was cleared and Engine House erected.

The Engine House is a frame building with concrete foundations and concrete floor. Concrete foundations for hoist was constructed and hoist partly installed.

Concrete piers for pulley stands and head frame were constructed and steel head frame and pulley stands erected by Worden Allen Company.

A six inch air line was laid from air receiver at Mackinaw Engine House to the Mackinaw and Gardner Shafts.

GENERAL SURFACE

SECTION 20 - 45 - 25

The stand piping on Sections 20 and 29, started last year to test the depth of the water level and ledge between the Eastern end of the Stephenson deposit and the Escanaba River, was finished in January. Hole B, Section 20 - 45 - 25, located 2592.81 feet South and 3530.33 feet East of the W $\frac{1}{4}$ Post of Section 20 - 45 - 25. Material: Sand 0 - 3 feet, Gravel 3' - 20', Sand and Gravel 20' - 40', Sand 40' - 50' - Clay 50' - 52', Sand 52' - 67', Clay 67' - 71', Gravel 71' - 75', Gravel and Boulders 75' - 82', and Slate 82' - 92'. Water Level, 43 feet and ledge at 82 feet.

Hole W, Section 29 - 45 - 25, located 2944.02 feet South and 4420.16 feet East of the W $\frac{1}{4}$ Post, Section 20 - 45 - 25. Material 0 - 13' Sand, Clay 13' - 14', Sand 14' - 35', Gravel 35' - 55', Sand 55' - 93', Sand and Gravel 93' - 109', Gravel 109' - 111', Hard Pan and Broken Ledge 109' - 115', Slate 115' - 125', Water Level 20'6". Ledge 115'.

The water level has been measured several times during the year in the above holes, also in Hole "C" Section 20, which was put down last December.

The date obtained from the above measurements is as follows:

Hole "C" - Section 20 - 45 - 25:

DATE OF MEASUREMENT	ELEVATION WATER LEVEL
December 30th, 1912	1095.79
April 19th, 1913,	1093.54
August 9th, 1913,	1090.17
October 27th, 1913,	1088.63
December 31st, 1913,	1086.29

Hole "B" Section 2 - 45 - 25:

January 16th, 1913,	1097.53
April 19th, 1913,	1095.70
August 9th, 1913,	1093.26
October 27th, 1913,	1091.03
December 31st, 1913,	1087.70

Hole "W" Section 29 - 45 - 25

January 26th, 1913,	1093.42
April 19th, 1913	1094.17

August 9th, 1913,	1091.04
October 27th, 1913,	1084.26
December 31st, 1913,	1083.59

The above elevations show that the water level has changed over this area about 10 feet during the year.

TRANSMISSION LINE

The following work was done on the high voltage line to Section 35 - 45 - 25:

Poles were erected from the $S\frac{1}{2}$ of the N.E. $\frac{1}{4}$ Section 35 - 45 - 25 to Sub. Station at the Mackinaw Mine. Cross-arms were placed on poles and wire strung from main Sub. Station North of the Central Power Plant to Sub. Station at the Mackinaw Mine.

A pole line was also installed from the Mackinaw Sub. Station to Gardner Shaft.

CENTRAL POWER PLANT

The brick addition to Central Power Plant building was completed early in the year and motor installed to drive the large Allis-Chalmers Air Compressor.

The Air Compressor at Central Power Plant was wrecked on the night of April 21st due to eccentric slipping causing the ports in the cylinder to close. The Compressor was suppose to have been supplied with relief valves to act in a case of this kind but due to an oversight on the part of the manufacturers this was not done. The Compressor was repaired and put in commission on the 31st of May. While the big compressor was being repaired air was supplied from Princeton No. 2 Engine House and from a small compressor temporarily installed in the Boiler Room of the Central Power Plant.

For the past few years each winter we have had fire in our coal dock at the Central Power Plant. This not only entails a loss of a considerable quantity of coal, but also makes the Maintenance cost of the dock extremely high.

A coal dock of this construction, so near the Power Plant and Sub. Station, gives an element of danger which would be obviated if the dock were of different construction. If a fire occurred there, as at the Munising Paper Mill, might mean the destruction of the Central Power Plant, which would not only entail a very large loss in itself, but would practically suspend operations at the Stephenson Mine for some time.

GARDNER-MACKINAW LOCATION

Five double houses and Captains residence were erected in the early part of the year. These houses are all occupied and contract has been let for the erection of five more double houses.

A drainage ditch was excavated from Rice Lake to a point about 500 feet Southwest of the location. The object of the ditch being to lower the water level in the location. During the break up in the Spring the water level in some parts of the location being only about 2 1/2 feet below the surface of the ground.

A sewer system was installed in the location. The water level being so near the surface it was found impossible to get rid of the sewerage by means of cess-pools.

Trees and brush were cleared and stumps blasted on the streets in the location

GWINN LIGHTING SYSTEM

The lighting system was completed early in the year. There are now three circuits of nine lights each.

GWINN WATER SYSTEM

A great deal of trouble was experienced with frozen water pipes during the months of February and March 1913. Most of the supply pipes leading to the Company Houses froze, and the tenants obtained their water from open taps provided on each street.

A good many supply pipes leading to private residences also froze in most cases the water froze in the goose neck where it connects with the main.

BUILDINGS

A private residence was erected on Lot 9 of Block 19. This was the only building erected during the year.

There was one lot sold in 1913.

PLANTING

The grounds at the depot site were improved by the Railroad Department. The work consisted in constructing rock roads, seeding down the grounds, making beds and planting shrubs.

The above work has made a great improvement in the appearance of the town.

The grounds of the Gwinn Episcopal Chapel were enclosed by boundary fence, grounds graded and seeded down and shrubs planted around the building.

FIRES

Due to the extremely wet season no trouble was had with forest fires during the year.

GWINN CLUB HOUSE

The Gwinn Association Building is being appreciated more from year to year by the people in this District. It is being used generally as a place for gathering; more particularly among the young people, but with the advent of the moving pictures it will, unquestionably, attract a great many more who, at present, are not regular attendants, but will soon see the advantages there offered in the reading rooms, swimming pool, gymnasium, etc.,

Successful indoor Basket and Base Ball teams were organized during the year. During the winter months bowling and skating have been very popular, the latter at a small ice rink constructed on the tennis court.

FATAL ACCIDENTS

There was one fatal accident in the Gwinn District during the year 1913. This accident occurred at the Stephenson Mine on Tuesday afternoon December 30th at 4:25 P.M. at which John Jones, Top Lander, was killed. He was crushed between the dump and West car, death being instantaneous.

On the top landing at the Stephenson Mine they have been operating two cars by means of the endless rope system, one known as the West car handling the Bessemer Ore, the other the East car handling the Stephenson No. 2 Ore. The engineers that run this endless rope system are on the ground, not on the trestle. It has been the custom to stop the cars 25 feet from the shaft and never get under the dump until a signal is given from the top landers. A new permanent trestle was erected on the East side of the shaft and all the wet ore of No. 2 grade has been handled on this trestle in the rock car by means of gravity.

At the time the accident occurred Jones and Beltrame, Landers, had just started to push a car of this sticky ore away from the East dump. The West or Bessemer car was coming in towards the shaft house when it was noticed instead of stopping at the regular place it continued towards the dump. Beltrame noticed it and called. Gustafson, the Sample Man, also noticed it and called.

It is not known whether Jones saw it or not. He was seen to turn toward the West away from the car he was pushing and the next instant he was caught between the end of the car and the planking at the chute, his leg being crushed and leg broken.

The brakeman operating the car stated that his only means of knowing the car approaches the dump is a mark attached to the endless rope. This mark had become detached and he did not know the car was approaching the dump until it hit the shaft house.

J. R. Jackson

ANALYSIS OF COST SHEETS

Below is a comparison of the Cost Sheets for the years 1912 and 1913, for the operating mines in the Gwinn District:

AUSTIN MINE	1912	1913	INCREASE	DECREASE
Average Product per month,	9,661	6,826		
General Expense,	.164	.145		.019
Maintenance,	.064	.069	.005	
Mining Expense,	.974	.838		.136
TOTAL	1.202	1.052		.150

STEPHENSON MINE	1912	1913	INCREASE	DECREASE
Average Product per month,	17,440	21,331		
General Expense,	.170	.144		.026
Maintenance,	.159	.165	.006	
Mining Expense,	1.140	1.078		.062
TOTAL	1.469	1.387		.082

PRINCETON MINE	1912	1913	INCREASE	DECREASE
Average Product per month,	7,522	9,360		
General Expense,	.101	.114	.013	
Maintenance,	.048	.102	.054	
Mining Expense,	.977	.861		.116
TOTAL	1.126	1.077		.049

The Details making up these differences follow:

ANALYSIS OF COST SHEETS - For Years 1912 and 1913.

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In 1912 the Austin Mine operated double shift throughout the year, while in 1913 it operated double shift to April 1st and from April 1st to December 30th, day shift only. The mine closed down November 1st, making our comparison for 1913 for 10 months, as against 12 months in 1912.

	1913	1912	INC.	DEC.	REMARKS
COST OF PRODUCTION	1.052	1.202		.150	Detail of Decrease Below,
<u>GENERAL EXPENSE</u>					
Insurance,	.202	.001	.001		Very little change in cost.
Engineering,	.015	.015			No change in cost.
Analysis,	.053	.059		.006	Less cost for U.G. Sampling.
Mine Office,	.022	.017	.005		Higher cost account smaller product.
Personal Injury Expense,	.000	.004		.004	Higher cost in 1913 account Workmen's Compensation Law.
District Office,	.053	.068		.015	Lower cost in 1913 account of more mines operating.
<u>MAINTENANCE</u>					
Side Tracks and Yards,	.010	.006	.004		Higher cost account smaller product.
Docks, Trestles and Pockets,	.001	.005		.004	Additional stocking ground built during 1912.
Building,	.004	.003	.001		Very little change.
Hoisting Machinery,	.020	.016	.004		Higher cost per ton account smaller product.
Compressors and Power Drills,	.011	.002	.009		More Power Drills charged in 1913.
Pumping Machinery,	.002	.004		.002	Higher cost for repairs to steam pumps in 1912.

	1913	1912	INC.	DEC.	REMARKS
Top Tram Engines and Cars,	.002	.002			No change in cost.
Skips and Skip Roads,	.004	.001	.003		More repairs in 1913, also smaller product.
Underground Tracks and Cars,	.014	.020		.006	Less cost for extending tracks in 1913.
Telephones and Safety Devices,	.001	.005		.004	More Safety Devices installed in 1912.
<u>MINING EXPENSE</u>					
Air Pipes,	.004	.003	.001		Very little change in cost.
Compressors,	.043	.036	.007		Higher cost account of smaller product, proportion of C.P.P. expense is higher in 1912, but product shows larger decrease in 1913.
Hoisting,	.025	.032		.007	Lower labor cost after April 1st, 1913, account of operating only one shift.
Pumping,	.049	.055		.006	Smaller proportion of Stephenson Pumping Expense in 1913.
Sinking and Shaft Repairs,	.000	.021		.021	No sinking in 1913 and very small cost for repairs.
Rock Drifting,	.019	.072		.053	Less Rock Drifting in 1913.
Breaking Ore,	.384	.396		.012	Higher product per man when operating one shift.
Tramming,	.104	.106		.002	Very little change in cost.
Timbering,	.120	.176		.056	Less Re-Timbering,
Mining Captains and Bosses,	.038	.034	.004		Very little change in cost.
Dry House,	.013	.008	.005		Increase per ton account smaller product, also larger proportion of Dry House Expense.
Top Landing and Tramming,	.051	.030	.001		Very little change in cost.
Stocking Ore,	.005	.004	.001		Very little change in cost.
Sorting Ore,	.003	.001	.002		Very little change in cost.
Cave-In,	.000				No cost in 1912.

ANALYSIS OF COST SHEET - Explaining Increase and Decrease in
Various Accounts, between the months of November and December 1913.

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<u>GENERAL EXPENSE</u>	NOV.	DEC.	INC.	DEC.	REMARKS
Engineering,	303.68	208.45		95.23	This decrease is due to the fact that it was unnecessary to have as much engineering work done in December as in the previous month.
District Office,	1393.96	1819.41	415.45		In November this mine bore 59.7% as its proportion of the charge and in December 67.1%. Increase also due to contribution to the funds of Gwinn Association.
<u>MAINTENANCE</u>					
Tracks and Yards,	122.35	245.41	123.06		Increase due to cleaning surface and clearing snow.
Docks, Trestles, and Pockets,	1616.42	1069.82			In November there was a larger expenditure on the erection of the Northwestern Pockets and the erection of new Permanent trestles.
Buildings,	.61	40.03	40.03		Repairs to Mine Office.
Boiler Plant,		22.69	22.69		In November the foundations of the Boiler Plant was repaired.
Hoisting Machinery,	264.69	61.45		203.24	In November a steam line was placed in the Shaft to prevent ice accumulating therein.
Compressors and Power Drills,	386.59			386.59	Two new power drills charged out in November.
Top Tram Engines and Cars,	484.07	334.69		149.38	Less repairs to transfer engine and cars in December but considerable repairs were executed to the transfer engine and top tram cars, which accounts for the heavy expenditure under this caption.

<u>MAINTENANCE (CONT'D)</u>	NOV.	DEC.	INC.	DEC.	REMARKS
Electric Tram Plant,	944.12	862.33		81.79	Increase due to less repairs and less expenditure on main line tracks and cars.
<u>MINING EXPENSE</u>					
Air Pipes,	134.05	206.50	72.45		In December a new main air line was placed on the 5th level.
Compressors,	695.20	795.88	100.68		Increase due to the fact that there was an increased charge for current of \$223.60 in December over November.
Rock Drifting,	1451.40	1834.28	382.88		In November there was 203 feet of Rock Drifting and Raising and in December there was 279 feet.
Breaking Ore,	8492.56	8862.27	369.71		Increased expenditure due to larger production of ore in December.
Tramming,	2258.47	2427.25	168.78		Increase due to larger production of ore and more rock handled in December.
Timbering,	4541.04	4766.42	225.38		Increase due to the fact that more large timber was used in mine in December than in November.
Dry House,	431.82	375.32		56.50	Increase due to less water being used in dry House. The charge for November was \$90.51 and for December \$45.37.
Stocking Ore,	824.21	1020.29	196.08		Increase due to the fact that it is necessary to employ a large force of men on the No. 2 stockpile on account of side dump cars being used.

ANALYSIS OF COST SHEETS - For Years 1912 and 1913.

*** **

	1912	1913	INC.	DEC.	REMARKS
COST OF PRODUCTION	1.469	1.387		.082	Detail of Decrease below.
<u>GENERAL EXPENSE</u>					
Insurance,	.001	.000		.001	No change in cost.
Engineering,	.025	.015		.010	During 1912 2 Efficiency Engineers were employed most of their time in this mine, but in 1913 it has been found to have more general engineering work done. X
Relief Fund,	.003	.000		.003	No Relief Fund in 1913 account Workmen's Compensation Law.
Analysis,	.047	.049	.002		Increase due to the fact that there were a larger number of determinations in 1913 and also that in July and August 4 additional samplers were employed U.G. and additional on surface at the pockets on account of practically only one grade (Bess) of ore being shipped during the season and also that the Princeton and Austin Mines were operated during part of the year only.
Mine Office,	.016	.016			No change in cost.
District Office,	.078	.064		.014	While the expense for the year is practically the same as in 1913, there was a decrease in the cost per ton on account of the increased tonnage in 1913.
<u>MAINTENANCE</u>					
Tracks and Yards,	.002	.005	.003		More cleaning during the year 1913.

	1912	1913	INC.	DEC.	R E M A R K S
<u>MAINTENANCE (CONT'D)</u>					
Docks, Trestles and Pockets,	.001	.040	.039		In 1913 \$4303.63 was expended in the erection of a new rock trestle, framing timber for the new East permanent trestle and laying collar plank; \$2950.79 for grading additional stocking ground for No. 2 ore; \$1709.14 for the erection of new permanent ore trestles and \$1284.26 in erecting Northwestern pockets for operating Section 29, C & N W Lease.
Buildings,	.003	.006	.003		Increase due to the fact that \$1069.03 was spent in repairs to coal dock and trestle.
Boiler Plant,	.001	.000		.001	Very little change in cost.
Hoisting Machinery,	.008	.004		.004	Decrease due to less repairs to main hoist and less wire ropes used.
Compressors and Power Drills,	.005	.008	.003		In 1913, 16 Power Drills charged and in 1912, 9 were charged.
Pumping Machinery,	.045	.023		.018	In 1912, \$4337.28 was expended on new water launder. In 1913, only \$1865.48 was expended, but in 1913 considerable ditching was done in the mine. In 1912, \$292.03 was expended on diamond drill work to test ledge.
Top Tram Engines and Cars,	.010	.014	.004		In 1913, considerable repairs were executed to the transfer engine. A new car was also built for side dumping. A new take-up system was also installed during this year.
Skips and Skip Roads,	.003	.007	.004		The increase in 1913 over 1912 in this account is due to their charging the cleaning of the skip pit to this account for the months of February, March, April and May.
Underground Tracks and Cars,	.007	.008	.001		Very little change in cost.

	1912	1913	INC.	DEC.	REMARKS
<u>MAINTENANCE (CONT'D)</u>					
Electric Tram Plant,	.071	.047		.027	In 1913 Mine locomotives cost \$426.54, more spotting engines \$44.77 and Generator \$172.76, whilst main line cars show a decrease of \$644.28, wiring \$681.00 and main line tracks \$2200.00.
Telephones and Safety Devices,	.007	.003		.004	More safety devices installed in 1912.
<u>MINING EXPENSE</u>					
Air Pipes,	.007	.008	.001		More air piping in mine in 1913 on account of extension of 5th level.
Compressors,	.060	.042		.018	The decrease for the year is due principally to a smaller charge for electricity in operating Compressor than the charge for steam in 1912.
Hoisting,	.032	.039	.007		Owing to the installation of electric pumps, hoisting had to bear a larger proportion of Boiler Room Expense. In 1912 this amount was \$3147.66 whilst in 1913 it amounted to \$5857.04.
Pumping,	.057	.082	.025		In 1912 the total Boiler House charge for pumping for the Austin and Stephenson Mines was \$15113.35, while in 1913 the Boiler House expense against these mines was \$5050.49, electric current was \$14202.57, Total \$19253.06. In 1912 the fixed charge against the Austin Pumping by the Stephenson Mine was about 425.00, while in 1913, when the Austin operated 10 months, the charge averaged \$285.00 per month. The increase was borne by the Stephenson Mine. In addition to this a larger quantity of water was pumped per minute and at a height of 60 Ft. greater when the electric pumps went into commission.
Sinking and Shaft Repairs.	.075	.002	.074		In 1912 the shaft was sunk 149'. The charges for 1913 are for Shaft Repairs except \$223.62 which was expended in removal and repairs to puffers used in sinking.

	1912	1913	INC.	DEC.	REMARKS
<u>MINING EXPENSE</u> <u>(CONT'D)</u>					
Rock Drifting,	.109	.085		.024	In 1912 there was 3833' Rock Drifting and Raising, whilst in 1913 there was 3178 feet.
Breaking Ore,	.402	.389		.013	Decrease account larger production in 1913.
Tramming,	.093	.097	.004		Cleaning Skip Pit, \$1300. charged in 1913.
Timbering,	.198	.213	.015		Increase due to more large timber used in mine and the opening of and developing 5th level.
Captains and Bosses,	.051	.045		.006	Decrease account of larger tonnage.
Dry House,	.008	.014	.006		Increase due to a smaller charge against the Austin Mine, which operated one shift most of the year and closed down November 1st. Owing to the use of electricity for Pumping, the Boiler House charge was increased in 1913 to \$1509.71 from \$597.33 in 1912.
Stocking Ore,	.010	.025	.015		Increase due to erection and repairs to Portable trestles and also to the fact that owing to the small quantity of No. 2 ore shipped last season it was and is necessary to employ a large force of men on the No. 2 stockpile where the ore is dumped with a side dump car.
Sorting Ore,	.001	.002	.001		More expense for picking rock during 1913.
Cave-In,	.000	.000			No change in cost.

ANALYSIS OF COST SHEETS - For Years 1912 and 1913.

*** **

In the Year 1912 the mine operated only three months, that is, October, November and December, while in 1913 it operated eight months, that is, January to August inclusive. The costs, therefore, are not on the same basis and are entirely different than if the operations extended over the same period for each year. On this account I have not gone into the details on this cost sheet as I have on the others.

	1913	1912	INC.	DEC.	REMARKS
COST OF PRODUCTION	1.077	1.126		.049	Detail of Decrease below.
<u>GENERAL EXPENSE</u>					
Engineering,	.017	.008	.009		Efficiency engineers charged in 1913, none in 1912.
Analysis,	.521	.525		.004	More analysis per ton mined in 1912 than in 1913.
Mine Office,	.020	.021		.001	Very little difference in cost.
Personal Injury Expense,					No charge in 1912 acct. Workmen's Compensation Law.
District Office,	.053	.043	.010		In 1913 8 months were charged against District Office, whereas during 1912 only two. The charge per month is based on the pay roll of the previous month.
<u>MAINTENANCE</u>					
Side Tracks and Yards,	.012	.009	.003		Increase in 1913 account higher cost for cleaning surface.
Hoisting Machinery,	.020	.009	.011		One new gear and two new pinions put in during 1913, also motor repaired.
Top Tram Engines and Cars,	.009	.010	.019		Top Tram puffer sold in 1912 and credited to this account.
Skips and Skip Roads,	.008	.000	.008		Mine cage bought in 1913, \$301.46

	1913	1912	INC.	DEC.	REMARKS
<u>MAINTENANCE (CONT'D)</u>					
Underground Tracks and Cars,	.019	.012	.007		More expended on tracks and cleaning.
Electric Tram Plant,	.024	.017	.007		New armature bought and repairs to armature.
<u>MINING EXPENSE</u>					
Air Pipes,	.003	.007		.004	Large charge in 1912 account of starting to operate.
Compressors,	.036	.042		.006	Decrease due to cost of operating Compressor less in 1913 than in 1912.
Hoisting,	.017	.021		.004	Decrease due to decreased tonnage in 1913.
Pumping,	.033	.051		.018	Decrease in 1913 due to increased tonnage.
Breaking Ore,	.400	.409		.009	Decrease due to more drifting in opening mine after idle period.
Tramming,	.117	.113	.004		More chutemen employed during 1913.
Timbering,	.148	.177		.029	Extra timber used in opening mine after shut down.
Mining Captains and Bosses,	.044	.052		.008	Decrease account larger tonnage.
Dry House,	.029	.036		.007	Benefit of Summer months 1913, In 1912 more winter months.
Top Landing and Tramming,	.018	.025		.007	No shipping - no pocketmen.
Stocking Ore,	.012	.039		.027	Operating more during stocking season.
Cave-In,	.003		.003		Cave occurred near No. 3 Shaft in 1913.

ANNUAL REPORT
OF THE (1913)
IMPERIAL MINE.

The Imperial Mine was closed throughout the year 1913. It is full of water up to the second level. The only work done at the plant was in connection with the new construction covered by E. and A. No. 238, a few necessary repairs, and shipment of ore from stock-pile.

PRODUCTION AND SHIPMENTS.

No ore was produced from the mine, but 37,543 tons were shipped from the west stock-pile, leaving a shortage of 5,134 tons, which has accumulated since the mine was reopened in 1906. Of this 5,134 tons probably 1000 tons can later be recovered by careful hand loading. The ground on which the ore was dumped was so uneven that clean loading by the steam shovel was impossible, and it was also impossible to clean this ore up at the end of the season on account of frost.

ESTIMATE OF ORE RESERVES. Jan. 1, 1914.

Level	Shaft Pillars Tons	Available Ore Tons	Total Tons	Partly Developed Ore Tons	Total Tons
First	12,000	2,000	14,000		14,000
Second	23,000	28,000	51,000		51,000
Third	24,000	178,000	202,000		202,000
Fourth	45,000	200,000	245,000	80,000	325,000
Total	104,000	408,000	512,000	80,000	592,000

E. and A. No. 238.

STEEL CRUSHER BUILDING AND NEW EQUIPMENT.

The steel work of the crusher building has been completed, the floors, rooms and stairways built, the pockets lined, the crushers and their engines set up, the head-sheaves put in place, and the steam-line connected to the boiler-house. The turn-sheaves have been set up and the pulley-stands built, but the ropes have not been put on. The skip-road has been completed, rails laid, and a rock dump and a loading sollar built at the elevation of the railroad tracks. The screen bars are not

completed, nor have the belts for the crushers been purchased.

The steam and water piping for the dry has been finished, the air-compressors connected up to the receivers, a floor laid in the compressor room, and the building repaired. Construction work was completed in November.

There was no work on this E. and A. in May, June, July, August and December.

The expenditures are shown in the following table:-

E. and A. No. 238.

No.	Account	Total Expense	Estimate
<u>Master Carpenter's Division</u>			
1	Steel Crusher Building, Pockets, etc.	\$ 12,884.63	\$ 13,500.00
2	Double skip-roads	1,873.10	2,000.00
3	Pulley stands and turn sheaves	895.73	500.00
4	Boiler and Engine-house changes	559.76	2,000.00
5	Office Building	1,771.19	1,800.00
6	Addition to Dry-house - 50 feet	791.94	1,000.00
7	Addition to Coal-Dock - 150 feet	738.21	1,500.00
	Total	19,514.56	22,300.00
	Add 10% for contingencies		2,230.00
	Grand total	19,514.56	24,530.00
<u>Master Mechanic's Division</u>			
8	Engine, Belts, etc. complete	5,428.64	5,500.00
9	Chain block	141.67	100.00
10	Additional Boiler - 150 H.P.	1,162.50	1,800.00
11	One Air Compressor	1,582.10	4,000.00
12	Breeching and Stack	544.81	800.00
13	Steam-line, Boiler and Engine-house	511.38	400.00
14	Steam-line to East shaft	777.23	1,200.00
15	Air-line to East shaft	237.94	500.00
	Total	10,386.27	14,300.00
	Add 10% for contingencies		1,430.00
	Grand total	10,386.27	15,730.00

E. and A. No. 238 (continued)

No.	Account	Total Expense	Estimate
<u>Superintendent's Division</u>			
16	Widening shaft	\$ 17.60	2,000.00
	Add 10% for contingencies		200.00
	Total	17.60	2,200.00
<u>Miscellaneous</u>			
17	Mechanical Engineering	77.50	
18	Timber-hoist	400.00	
	Total	477.50	
<u>S U M M A R Y</u>			
	Master Carpenter's Division	19,514.56	24,530.00
	Master Mechanic's Division	10,386.27	15,730.00
	Superintendent's Division	17.60	2,200.00
	Miscellaneous	477.50	
	Grand Total	30,395.93	42,460.00

The excess of expenditure over estimate in Account No. 3 is due to the fact that the head-sheaves, which belong in Account No. 1, were charged out with the turn sheaves by error.

Lucien Eaton

IMPERIAL MINE.

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR 1913.

	Mine		Lake Erie	
	IRON	PHOS.	IRON	PHOS.
Imperial	50.12	.345	49.87	

ORE STATEMENT AND SHIPMENTS DECEMBER 31ST, 1913.

	IMPERIAL	LAST YEAR
On hand Jan.1st,1913,	42,677	96,730
Stockpile shortage	5,134	
Total	37,543	96,730
Shipments	37,543	54,053
Balance on hand	0	42,677

Mine idle in 1912 and 1913.

IMPERIAL MINE.

STATEMENT OF COMPARATIVE WAGES.

	1 9 1 3	1 9 1 2	INCREASE	DECREASE
<u>SURFACE</u>				
Total number of days	1,523	1,719 $\frac{1}{2}$		196 $\frac{1}{2}$
Average rate	233	2.50		.17
<u>Amount</u>	3,753.90	4,301.21		547.31
<u>UNDERGROUND</u>				
Total number of days	312	312		
Average rate	4.23	4.23		
<u>Amount</u>	1,320.00	1,320.00		
Total days	1,835	2,031 $\frac{1}{2}$		196 $\frac{1}{2}$
Average rate	2.76	2.77		.01
Total amount	5,073.90	5,621.21		557.31

During 1913 there were 30,887 tons of ore loaded by steam shovel and 6,666 tons loaded by hand.

Mine closed October 7, 1911.

COMPARATIVE AVERAGE WAGES AND PRODUCT.

PRODUCT '13 None Tons	SURFACE		UNDERGROUND		TOTAL	
	1913	1912	1913	1912	1913	1912
PRODUCT '12 None Tons						
Avg. number men working	5	6	1	1	6	7
Avg. wages per day	2.33	2.50	4.23	4.23	2.76	2.77
Avg. wages per mo. 25 days	58.25	62.50	105.75	105.75	69.00	69.25

CROSBY MINE.
ANNUAL REPORT FOR 1913.

S U R F A C E.

PRODUCTION:

The production for 1913, covering the period from January 1st to November 13th, amounted to 201,772 tons. Operations were confined to the underground workings until the latter part of April, when most of the force was transferred to the open pit. The bulk of the product came from the open pit during the balance of the season, operations from November 13th to the end of the year being confined to new construction work, general repairing and removing sand and broken taconite from the open pit.

Following are the tonnages mined from each of the two forties during the year 1913:

West Forty	(Open Pit	142,492 tons.
	(Underground	37,444 "
East Forty	(Underground	21,836 "
Total		<hr/> 201,772 tons.

The total product for the seven months that the mine operated during 1912, was 115,505 tons, but as about 115,000 tons of this amount came from the open pit, where milling operations were carried on to the greatest advantage, the figures for the two years do not afford a good comparison. When working a full crew, the output from the open pit during August, September, and October, 1912, was 63,429 tons, the mine operating day shifts only, compared to a pproduction of 63,898 during the corresponding period of 1913, when double shifts were worked. Owing to the small ore sales at the beginning of the 1912

shipping season, but a comparatively small force was employed in the open pit. No underground work was undertaken during 1912 until the shipping season closed, whereas in 1913 the Mine operated underground until shipments began and mining activities were discontinued with the close of navigation

The ore and rock hoisted by months during 1913, together with the average analysis of the ore, is given below.

	<u>TONS</u> <u>ROCK</u>	<u>TONS</u> <u>ORE</u>	<u>IRON.</u>	<u>PHOS.</u>	<u>MANG.</u>	<u>SILICA</u>
January	288	10,020	55.93	.029	.68	16.22
February	268	10,388	56.21	.029	.73	15.34
March	206	11,145	56.11	.032	.75	15.34
April	630	10,047	56.21	.032	.72	15.34
May	1,972	28,117	55.83	.036	.75	15.96
June	2,348	24,380	55.07	.033	.70	17.34
July	2,148	25,845	54.85	.039	.70	17.16
August	1,888	23,752	55.43	.046	.74	15.70
September	894	22,035	55.05	.044	.83	15.81
October	1,684	17,642	55.12	.044	.81	15.45
November	2,640	8,454	55.79	.051	.87	13.27
December	2,218					
Overrun		9,947				
Total and average	17,184	201,772	55.46	.038	.75	15.98

Since mining operations were discontinued on November 13th, 4,636 tons of rock have been removed from the pits and hoisted. This work will be taken up under the caption "New Construction."

Owing to the scarcity of the high grade ore available in the underground workings, the output during the first four months of the year was restricted. The grade of the material hoisted during this period was very satisfactory, especially the Iron content, and as the loading samples showed higher Iron than the stocking, it was used to sweeten the pit product when necessary. During 1912 the stockpile ore had to be sweetened by the pit product, and it was very fortunate that the 1913 stockpile grade held up, as the pit ore averaged little better than 55 per cent in Iron content and the Phosphorus ran very high during the latter half of the season.

Milling operations had been carried well back from the Main Level raises at the close of 1912 season and consequently it was necessary to tram most of the product to these chutes during 1913. The lean character of the

material and the quantities of taconite encountered also served to make difficult the extraction of a shipping-grade from the open pit. Seams of high grade ore, from 4 to 10 feet in width, were followed into the open pit working faces for a considerable distance in several cases. The high Phosphorus content of the ore caused a restriction to open pit operations during the last six weeks of the season.

The average daily product, considering the period that the Mine operated, was 710 tons.

STOCKING:

When steam shovel operations were started on April 20th there were 54,424 tons of ore in stock. The north trestle had been completely filled and the south trestle about half filled. No side dumping was resorted to and the ore was not crowded back against the top tram puffer shanty, as was the case in 1912.

In making the piles, the dump/stick was moved twice each shift in order to lessen the strain on the trestle legs and at the same time spread the material hoisted during any 24 hour period over a considerable area. Should the grade run off at any time, this method of dumping would avoid concentrating the material and but a small ^{pro}portion would be loaded into any one railway car by the steam shovel.

The top tram cable was not run out over the rock trestle when stocking ore. As the rock tram requires over 2,000 feet of cable and the handling of rock may be confined to certain days, the saving in cable wear and power to the top tram engine becomes quite an item. It takes but a few minutes to change over from one system to the other, as desired.

There was considerable frost in the bottom and along the north side of the stockpile, and on several occasions it was necessary to blast ahead of the shovel in order to load to advantage. As it was, the manganese lip on the shovel dipper was worn down over five inches during the season, and in order to complete operations the dipper was rigged with manganese teeth.

As no ore stocking is contemplated in the future, the trestle

timber was sorted and all of the 32 foot stringers and such of the legs as were in good condition were piled along the edge of the stocking ground. The poor material was cut into eight foot lengths and used in the new shaft sub-level workings, while the sound pieces were reserved for a rock trestle to be erected on the old stocking ground. This rock dump will not be utilized until the wash ore is attacked.

The rock trestle had been filled 600 feet out from the shaft when open pit operations were started in April, and owing to the length of this tram and the fact that the quantity of rock to be handled was comparatively large, necessitating more rapid trips with the car, it was deemed advisable to resort to side dumping. The saddle back car was blocked on one side and rigged for side dumping and the pile was fanned to the east from a point adjacent to the boiler house, thus utilizing all available space and cutting down the length of the tram for a given tonnage.

The sampling of the ore stocked during 1913 was done very thoroughly and such discrepancy as there was between it and the shipping analysis was in favor of the latter. All samples were taken diagonally across the cars, using a rope knotted at foot intervals. These samples were taken on the top tram cars, motor cars at the shaft pocket, and on the motor cars as they were being filled at the several chutes. The chute samples were run for Iron only, unless the Phosphorus, Manganese, or Silica in the general sample were high. In this way, should any gang of miners dump lean material, it was readily detected and the necessary changes were made promptly.

SHIPMENTS.

The steam shovel was given a thorough over hauling the fore part of April, including the riveting of new bands on the dipper, a water line was laid from the main boiler house and loading operations were started on the 20th. As the stockpile ore was used to sweeten the pit product, the

shovel worked intermittently during the season, loading what was considered the necessary amount for each cargo. The stocking ground will be utilized in the future for a rock dump, so that the bottom of the pile was scraped, considerable hand-work being necessary in places to clean up the ore and avoid getting it mixed with the clay.

Hard frost was encountered in the first and second cuts, also in the bottom of the pile, and it was necessary to do more or less blasting. This made progress slow and combined with the poor service on the part of the Great Northern Railway, made the average day's loading fall below that of the previous season. A broken rod and intermediate shaft on the switching engine caused delays of short duration.

The stockpile ore was all loaded by November 13th, and the shovel was moved back near the coal dock spur and dismantled for the winter.

Following is the tonnage loaded from the stockpile, the average analysis of same and of the pile in making:

		<u>IRON</u>	<u>PHOS.</u>	<u>MANG.</u>	<u>SILICA.</u>
Pile in loading,	64,479 tons	56.59	.029	.79	15.20
Pile in making,	54,424 tons	55.89	.029	.81	15.83

The stockpile overrun shows an increase of 19 percent over the skip tally, considering the entire pile, or a 28 per cent increase against that part of the pile stocked during 1913.

It was very fortunate that the pile showed better Iron in loading than in making, as it was necessary to use this ore to sweeten the pit product and with the exception of the comparatively small tonnage, which was scraped from the bottom, this ore held uniformly at our guarantee figure or better, both as regarded the Iron and Phosphorus content.

The pit product was at times unsatisfactory, especially during the latter part of the season, when the Phosphorus ran up to .050 per cent. The heavy rains during the summer made the loading operations at the shaft pocket very difficult and at times it was necessary to employ three men in

order to handle the wet product and sort the coated taconite from the railway cars.

Three samples were taken from each railway car as it was being loaded at the pocket, one-third full, two-thirds full, and full. A rope knotted at foot intervals was stretched diagonally across the car and a full scoop sample taken under each knot. This gave a large sample for a given tonnage and a great deal of attention was put on this work in the nature of check sampling.

Following is the average analysis of the product shipped from the shaft:

	<u>IRON</u>	<u>PHOS.</u>	<u>MANG.</u>	<u>SILICA.</u>
201,772 tons	55.46	.038	.75	15.98

Below is a list of the cargoes shipped during 1913 with the analyses as determined by Lerch Brothers and the Lower Lake Chemists:

<u>VESSEL.</u>	<u>DATE.</u>	<u>TONNAGE.</u>		<u>IRON</u>	<u>PHOS.</u>	<u>MANG.</u>	<u>SILICA.</u>	<u>IRON NAT.</u>
Boland	4-28	6,191	Mine	56.48	.029	.82	14.34	
			C.&M.	56.05	.028		50.47	
			Rattle	57.10	.031		51.68	
Price	5-11	4,742	Mine	56.39	.033	.62	15.34	
			Texter	55.30	.032		49.56	
			C.&C.	55.10	.032		49.35	
Ishpeming	5-17	7,263	Mine	56.40	.034	.61	15.30	
			C.&M.	56.00	.032		50.74	
			Rattle	56.00	.033		50.87	
Taylor	5-22	6,427	Mine	55.81	.035	.82	15.65	
			C.&M.	56.20	.033		50.68	
Michigan	5-27	6,427	Mine	55.81	.034	.81	15.93	
			C.&C.	55.50	.031		49.88	
			Texter	55.25	.032		49.73	
Franz	5-29	5,657	Mine	55.60	.033	.81	15.84	
			C.&M.	55.30	.031		50.00	
Taylor	6-5	5,496	Mine	55.37	.032	.73	16.18	
			C.&M.	55.15	.028		50.00	
Waldo	6-14	7,129	Mine	55.46	.032	.71	16.43	
			Rattle	55.20	.030		50.34	
			C.&M.	55.10	.028		50.32	

<u>VESSEL.</u>	<u>DATE.</u>	<u>TONNAGE.</u>		<u>IRON</u>	<u>PHOS.</u>	<u>MANG.</u>	<u>SILICA.</u>	<u>IRON MAT.</u>
Franz	6-16	5,709	Mine	55.89	.033	.93	16.20	
			C.&M.	55.95	.029			49.78
Taylor	6-21	5,631	Mine	55.38	.032	.76	16.50	
			C.&M.	55.30	.029			49.46
Taylor	6-26	5,629	Mine	55.04	.031	.72	16.65	
			C.&M.	55.80	.029			50.49
Taylor	7-1	5,628	Mine	55.48	.031	.67	16.67	
			C.&M.	55.30	.029			50.07
Zimmerman	7-2	8,976	Mine	55.38	.030	.76	16.57	
			C.&C.	54.70	.031			50.13
			Textor	54.25	.031			49.45
Taylor	7-7	5,639	Mine	55.47	.032	.63	17.00	
			C.&M.	55.20	.030			49.64
Michigan	7-11	7,400	Mine	55.03	.031	.81	16.50	
			C.&M.	54.60	.028			49.34
			Rattle	54.60	.027			49.52
Taylor	7-17	5,595	Mine	55.38	.031	.74	15.85	
			C.&M.	55.45	.030			49.98
Franz	7-24	5,642	Mine	55.72	.033	.71	15.69	
			C.&M.	55.40	.032			49.39
Taylor	8-1	5,699	Mine	55.03	.037	.72	16.38	
			C.&M.	54.75	.035			48.72
White	8-6	7,535	Mine	55.97	.038	.77	15.53	
			C.&C.	55.70	.035			50.45
			Textor	54.55	.039			48.76
McGean	8-12	4,031	Mine	55.73	.037	.75	16.01	
			C.&C.	56.70	.037			52.02
			Rattle	55.40	.037			50.47
Caldera	8-19	3,625	Mine	55.70	.037	.76	15.47	
			C.&M.	55.60	.036			50.38
			C.&C.	55.30	.037			50.06
Angelirte	8-30	3,410	Mine	55.86	.038	.74	15.17	
			C.&C.	54.20	.035			48.69
Michigan	8-31	10,580	Mine	55.64	.041	.74	14.90	
			Rattle	55.80	.037			51.22
			C.&C.	55.30	.037			50.25
Taylor	9-6	5,569	Mine	55.71	.039	.73		
			C.&M.	56.65	.036			51.12
Caldera	9-7	3,444	Mine	55.04	.044	.68		
			Rattle	54.00	.039			48.95
			C.&M.	53.75	.041			48.08

<u>VESSEL.</u>	<u>DATE.</u>	<u>TONNAGE.</u>		<u>IRON</u>	<u>PHOS.</u>	<u>MANG.</u>	<u>SILICA.</u>	<u>IRON NAT.</u>
Taylor	9-13	5,564	Mine	55.37	.038	.81	15.60	
			C.&M.	56.15	.088			50.77
Mather	9-16	6,691	Mine	55.29	.039	.69	16.04	
			Rattle	55.10	.036			49.70
			C.&M.	54.90	.037			49.39
Franz	9-20	5,716	Mine	55.23	.039	.68	16.08	
			C.&M.	55.95	.040			49.71
Franz	9-27	5,729	Mine	55.68	.038	.74	15.83	
			C.&M.	55.25	.041			49.77
Weston	9-30	6,999	Mine	55.70	.038	.78	15.44	
			Rattle	56.20	.038			51.09
			C.&M.	56.55	.038			51.23
Franz	10-9	5,503	Mine	55.93	.039	.84	14.68	
			C.&M.	55.15	.049			48.87
Michigan	10-15	10,330	Mine	55.47	.040	.78	15.22	
			Rattle	56.00	.040			50.23
Franz	10-16	5,503	Mine	55.83	.039	.81	14.74	
			C.&M.	56.30	.043			50.36
Penobscot	10-28	1,578	Mine	55.02	.045	.82	15.32	
			Rattle	54.80	.045			49.36
Taylor	11-6	5,346	Mine	55.07	.042	.91	15.95	
				54.10	.043			49.18
Mack	11-9	3,990	Mine	55.41	.045	.85	14.43	
			C.&C.	55.20	.045			49.54
			Rattle	55.60	.047			50.02
Cornelius	11-19	5,036	Mine	55.38	.053	.95	13.75	
			Rattle	54.90	.054			48.86
			C.&C.	55.90	.057			50.15
Stackhouse	11-22	1,297	Mine	54.88	.053	.84	15.01	
			C.&M.	54.60	.054			48.86
			C.&C.	54.40	.053			48.55
Verona	11-27	1,548	Mine	56.08	.052	.91		
			C.&C.	55.10	.053			49.36
				<u>IRON.</u>	<u>PHOS.</u>	<u>MANG.</u>	<u>SILICA.</u>	<u>IRON NAT.</u>
Average Analysis			Mine	55.59	.036	.76	15.69	
Average Analysis			Lower Lake	55.41	.036			49.95

A comparison of the above tabulation shows that although the Iron content of several cargoes did not check satisfactory, the average for the season was close. The Mine sampling was done very carefully by standard methods as described before.

The fact that but one part stockpile ore to three parts of the pit material went into each cargo, made the sampling at the Lower Lake Ports somewhat difficult. The sweetening ore was usually dumped into one part of the boat and the general sample might easily be lacking in the proper proportion of this material.

GENERAL SURFACE.

Considerable cleaning has been done during the past summer, such as carting away the ashes which had accumulated at the boiler house, and piling and burning the timber bark and chips from the timber yard.

The surface drainage ditches were inspected at frequent intervals and cleared of all material likely to form dams.

The shaft was cleaned of all pieces of rock and ore, which had fallen back from the dump, and the head frame timbering was strengthened where necessary.

The engine and boiler rooms were cleaned at least once a month, pipe and boiler covering renewed where necessary and given a fresh coat of white wash. An effort was also made to keep the dry, machine, carpenter, and blacksmith shops in a cleaner condition.

While the Mine was idle, due to hoisting engine repairs, the pit force dug 200 feet of new ditch from the southwest corner of the property along the Hawkins line. The ground to the southwest of the pit had caved back to within a few feet of the old ditch and it was deemed advisable to carry the ditching back some distance from the caved area.

Besides a number of heavy showers, there were several cloud-bursts during the summer months, which caused serious delays to pit and underground operations. The emergency pumps were drowned on four occasions and there was considerable delay in cleaning the underground tracks so as to permit of tramming. Each heavy rain washed quantities of sand and ore through the milling chutes and the underground ditches and tracks had to be cleaned at considerable disadvantage.

On April 16th the hoisting engine was put out of commission, due to a broken crosshead. The front ends of the shaft bearing on each wing

casting were cracked and had to be strengthened by bolting on malleable plates. This repair work was not satisfactory. The steel straps or plates, placed on the wing castings, made these parts stronger than ever, but owing to a slight spring when hoisting, the gears meshed imperfectly and a number of teeth points were broken. Workmen from the Duluth Boiler Company welded the castings by the Oxygen-Acetylene process on May 23rd and no trouble was experienced during the balance of the year.

The following is a list of the serious delays occurring during the past year and the resulting shrinkage in the production:

<u>DATE.</u>	<u>HOURS DELAY.</u>	<u>TONNAGE LOSS.</u>	<u>CAUSE.</u>
4/16/13	60	2,080	Repairs to Hoist.
5/23/13	16	1,000	Repairs to Hoist.
5/31/13	4	300	Heavy rains.
6/5/13	39	3,050	Mine flooded.
8/7/13	16	900	Mine flooded.
9/10/13	14	800	Mine flooded.
10/15/13	22	1,000	Fatal Accidents.
10/24/13	28	1,150	Repairs to electric engine
11/12/13	136		Electric Engine wrecked.

ACCIDENTS:

About ten o'clock on the night of October 15th, a slab of lean ore and taconite, weighing in the neighborhood of 40 tons, fell away from the 25 foot working face 15 feet to the east of No. 97 chute. Six men were working in the vicinity of this bank, Joe Delao - pocketman, Nick Yovetich - blaster, Mike Lakovich, Mike Kokich, Chris Matinovich, and Eli Martich as pit laborers. Lakovich escaped without a scratch, Delao and Yovetich were badly, although not seriously, injured and Kokich, Matenovich and Martich were killed.

The ore had been removed to within two feet of the motor haulage level, westward from the bank and No. 97 chute and two drift sets were removed, preparatory to mining the ore down to the sill floor. The captain was in-

structed, on the morning of the 14th, to uncover and start blasting along the sides of the drift from 12 to 15 feet back from the bank. He spent some time here on the afternoon of the 15th, following out these instructions. There was no evidence of any cracking along the face of the bank and no amount of material had dropped during the two months since the pit was stoped up to this point.

The regular blaster, Velisha Wuskokovich, did not report on the night shift and contract miner Nick Yovetich, whose partner did not report, was brought here to do the blasting. Yovetich was thoroughly familiar with the Crosby ore in a general way, was an intelligent miner, and could understand and speak English. He was instructed to drill a hole some five feet back from the bank and to give it a light charge of powder. Instead of doing this he drilled a three foot hole into the bottom of the bank just above the motor drift and blasted with four sticks of powder, as he states. The ore was somewhat softer than that in the drift or higher up on the bank and as a result even the small charge made a considerable opening. Yovetich trimmed the ground immediately surrounding the blasted bank and was still engaged here when the material slabbed from above,

Yovetich, who had a rib fractured and was badly bruised about the head and body, and Lakovick, who was not injured, were working along the bank bottom above the motor drift. Kokick, Martich and Delao were filling a motor car in the drift. Matunovich, working on top of the drift near No. 97 chute, jumped into the drift when he saw the material slabbing. He would not have been even injured if he had not gone into the drift. The dead bodies of Kokick and Matunovich were recovered about an hour and a half after the accident occurred and Martich a half hour later. Delao was imprisoned for three hours.

Delao, who was badly bruised about the head and suffered a fractured clavicle was confined to the hospital but a few days. He is still under the doctor's care and it will probably be at least two months before he is discharged. Yovetich is doing nicely and should be in shape to work

within a short time.

It was deemed advisable to change the time of the shifts, so as to allow the night men to start work while there was still daylight and to allow the captain an opportunity to go over the shift's work with the foreman. Starting with October 26th, the day shift worked from 7 A.M. to 4 P.M. and the night shift from 4 P.M. to 1 A.M.

On the 3rd of October Steve Glubosich, one of the pitmen, was injured by being struck on the back by a piece of ore. The blaster at chute No. 80 had fired a hole and after picking down all the loose material that could be detected, the pitmen started to shovel the broken ore. A small chunk of ore slabbed from the bank and in falling struck Glubosich on the back and head. The attending physicians reported a lacerated cut about one inch long above his ear, but they were unable to locate any injury to the back. Glubosich was confined to the Hibbing Hospital for several weeks and is still reporting daily at the Nashwauk Hospital. He is to be discharged within a short time.

D. Green, who sustained a broken ankle while repairing a building on the 17th of October, 1912, did not report for work until the following April.

A list of all the 1913 accidents involving the payment of club benefits, in addition to the above, follows:

<u>DATE.</u>	<u>NAME.</u>	<u>NATIONALITY.</u>	<u>OCCUPATION.</u>	<u>REMARKS.</u>
1/3/13	P. Mosato	Italian	Miner	Fall of ground from back of drift caused slight scalp wound. Lost 7½ days.
1/9/13	B. Martire	Italian	Miner	Finger lacerated by being caught between box and truck of tram car. Lost 21½ days.
2/12/13	J. Klunn	Austrian	Miner	Struck head against drift cap. Bruised forehead. Lost 36 days.
2/10/13	V. Wuskovich	Montenegrin	Miner	Piece of dirt from back of drift fell into eye. Lost 7 days.

<u>DATE.</u>	<u>NAME.</u>	<u>NATIONALITY.</u>	<u>OCCUPATION.</u>	<u>REMARKS.</u>
2/18/13	C.Scallise	Italian	Rock Picker	In breaking chunk of taconite a piece flew into eye. Lost 34 days.
2/27/13	S.Jurovich	Montenegrin	Miner	Rock fell on foot when cutting hitch for timber. Lost 30 days.
3/6/13	F. Ciccio	Italian	Trackman	Motor hit a piece of timber beside track, pushing it against Ciccio's ankle. Lost 14 $\frac{1}{2}$ days.
3/7/13	P.Hutena	Finn	Miner	Cut thumb while making wedge. Lost 8 days.
5/23/13	P. Hutena	Finn	Miner	Chunk of taconite fell from breast of drift and struck leg, causing simple fracture. Did not return to work.
6/3/13	G. Nuro	Italian	Trackman	Motor car jumped the track and broke drift leg. This loosened a chunk of ore above lagging, which fell upon Nuro's shoulder and caused severe strain. Lost 58 days.
6/13/13	T. Maki	Finn	Miner	Rock fell from pit bank injuring foot. Lost 22 $\frac{1}{2}$ days
6/25/13	D.Korhonen	Finn	Chuteman	In filling motor car a rock from chute struck hand. Lacerated fingers. Lost 10 days.
7/16/13	P.Peakovich	Montenegrin	Miner	Finger nail torn off while putting motor car on track. Lost 14 days.
7/24/13	Y.Gairlainen	Finn	Miner	Bruised shoulder and back caused by ore falling from open pit working face. Lost 7 days.
7/28/13	C.Bachlund	Finn	Chuteman	When loading motor car with rock, a piece jammed hand against door. Lost 13 $\frac{1}{2}$ days.
8/25/13	J. Lippo	Finn	Top Lander	Hand squeezed between two chunks of taconite. Lost 7 days.
8/29/13	C. Morano	Italian	Miner	Trimming back in drift and a small chunk of ore fell striking wrist. Lost 11 days.

<u>DATE.</u>	<u>NAME.</u>	<u>NATIONALITY.</u>	<u>OCCUPATION.</u>	<u>REMARKS.</u>
9/1/13	M. Lock	Montenegrin	Miner	Trimming back of drift and dirt fell in eye. Lost 5 days.
9/16/13	M. Rado	Montenegrin	Miner	In dumping wheelbarrow stumbled and fell against the side of the drift. Bruised shoulder and arm. Lost 14 days.

It is very noticable that aside from the semi-serious accidents there have been no cases requiring the payment of compensation since the new State Law went into effect on October 1st. A comparison of the time lost through accidents of a similar nature, between the years 1913 and 1914, should be very interesting in this connection. There is no doubt but that the majority of the accidents included in the above list will be avoided during 1914.

O P E N P I T M I N I N G .

Open pit operations were started on April 14th, but owing to the hoisting engine trouble, very little ore was mined until the 22nd. A number of the men were retained while the mine was idle, cleaning sand and boulders from the banks in the neighborhood of Nos. 97, 108, and 134A chutes and handling taconite from the pit bottom. Open pit mining was discontinued on November 13th, 142,492 tons of ore and 15,803 tons of rock having been dumped through the milling chutes during the season. Rock work in the old pit was continued to the end of the year. Following are the tonnages of rock and ore as divided between the several months.

<u>MONTH.</u>	<u>ROCK.</u> tons	<u>ORE.</u> tons	<u>AVERAGE NO. MEN ON ORE.</u>
April	353	5,694	28
May	1,785	26,773	94
June	2,193	24,053	94
July	2,148	23,789	78
August	1,888	20,507	59
September	894	19,046	50
October	1,684	15,287	37
November	2,640	7,343	16
December	2,218		
Total	15,803	142,492	

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CROSBY MINE.

The average grade of the pit ore was disappointing, the Iron content being little better than 55 per cent and the Phosphorus running over .044 during the last four months of the season. During 1912 the ore gained from the pit was used to sweeten the stockpile shipments and the grade was held well above the guarantee figure of Iron. This worked more or less of a hardship to the past season's operations in that it cut off a considerable amount of lower grade material, which had always been included in the estimates of 56 per cent ore and otherwise could have been mined with it.

In many cases it was necessary to follow narrow seams into the lean ore banks and at the east end of the pit the taconite capping was so extensive that the underlying ore was removed by underground operations. In places the capping was stripped and piled in the pit, or dumped through the chutes, and the ore was milled down to the back of the haulage level.

At the beginning of pit operations, milling chutes Nos. 108, 114, 115, 133, 183 and 186 were opened and within a month Nos. 73 to 77 inclusive, 133A, 134A, 186, and 195 were added to the list. Chutes Nos. 70, 71, 72, 115A, and 185 were opened in June and Nos. 97, 139, 188, 189, 199 and 202 during July and August. The bulk of the pit product came from Nos. 72, 73, 74, 75, 76, 97, 115A, 188 and 195. As the ore surrounding the chutes was exhausted, milling operations being carried down to the back of the haulage level, the openings were lagged over. When operations were suspended in November, the product was coming from Nos. 73, 74, 75, 76 and 97 chute workings at the north end of the pit. This is the only part of the pit where the high grade ore makes down to the main level and the deposit was being worked from the sill floor.

The 60 per cent ore surrounding chutes Nos. 115 and 115A was exhausted early in the season and the pit bottom to the north was taken down to the lean ore. The ground along the Hawkins boundary was caved from underground operations and the sand cleaned from the pillars so formed was dumped into the openings. These pillars were then gained from open pit

operations and assisted materially in holding up the grade of the pit product during August and September. All of the high grade ore has now been removed from this part of the pit.

The working faces from Nos. 139 to 185 chutes were carried south to the Hawkins boundary and northward to the stripping limits. With the exception of several pillars of wash material, the ore body within this area has now been mined down to the lean ore, ten feet above the back of the haulage level. Owing to the quantity of rock encountered in these stopes, the ore product per day was not large. While the Iron was not very satisfactory, averaging about 54 per cent, the Phosphorus was low and helped to hold the high Phosphorus material mined at the north end of the pit. Besides a large quantity, which was piled in the pit, fully 50 per cent of the rock hoisted during the shipping season was hauled through No. 185 chute. The rock piled in the pit can be transferred to the surrounding workings, when they have been mined down to the solid taconite, and the wash material under these rock piles may then be gained.

It was necessary to hoist rock and sand each day in order to keep the milling chutes clear. The mornings of the day and the evenings of the night shifts were devoted to the handling of rock, one skip being used for this purpose while the second remained on ore. The top tram equipment would take care of but a limited amount of rock.

Because of the quantity of rock encountered in the stopes adjacent to Nos. 186, 187, 188 and 189 chutes, the better grade of ore was gouged out and in several cases narrow seams were followed for short distances into the banks.

Very little work was done in Nos. 191, 199, and 202 pits, owing to the lean character of the ore and the heavy taconite capping.

A force^{of}/from four to six men was engaged during the greater part of two months, working day shifts only, cleaning sand and boulders along the Hawkins boundary adjacent to No. 195 pit workings. This material was dumped into No. 194 chute and handled by the night shift force before the pockets

became filled with ore. The stripping made available for open pit extraction 5,000 tons of 58 per cent ore. When the working face had been carried to the new stripping limits, the bottom of the pit, which was 18 feet above the haulage level, was attacked and carried down 15 feet, or to the solid taconite. This ore was exhausted by the latter part of October and several timbermen were engaged during the balance of the season cribbing along the banks, so as to prevent the sand from washing down into the pit.

At the north end of the pit, the ore was milled down to the back of the motor level between Nos. 71 and 76 chutes and a force of sixteen men were employed during the last four weeks of the season attacking the ore from the sill floor. This lower ore averaged .060 in Phosphorus and should have been taken in limited quantities, but owing to the fact that the various working faces throughout the pit encountered wash material, it was necessary to concentrate the force here in order to maintain the desired output and hold the Iron content above 55 per cent. When shipments were suspended, an area 120 feet long and 40 feet wide had been mined down to the level. When this ore body is attacked next summer, the lower Phosphorus wash ore, constituting the upper half of the bank, will be mixed with the higher Iron and Phosphorus ores near the bottom and should furnish a desirable concentrating material.

Such surface material as was left along the Platt Mine boundary from stripping operations, was dumped into the old caves to the south or hauled to the shaft, and the ore body was mined down to the main level between Nos. 97 and 80 chutes. This ore also ran high in Phosphorus, but as the Iron was not especially satisfactory, operations here were carried on in a very limited manner throughout the season. The fatal accidents of October 15th occurred in these workings.

The old pit rock work will be taken up under the caption "Preparing for Wash Ore Extraction."

U N D E R G R O U N D.

NEW SHAFT WORKINGS:

The shaft was bottomed 68 feet below the main level, inclined measurement, at the end of 1912. The level plat was cut 50 feet vertically below the main level and the shaft sunk an additional 10 feet for a pump sump. A pump room was then excavated and timbered and the No. 4 Knowles pump, used in the shaft since the water level was reached and the No. 9 Cameron, from the main shaft pumping equipment, were installed. Two drifts have been pushed ahead from the shaft, one to the west for 190 feet and the second to the east for 380 feet. During the shipping season it was inadvisable to work these rock drifts, as the ore from the sub-level workings above was handled on this level, consequently but five months' operations can be charged against the above footage.

The east drift has cut through decomposed taconite and lean painty ore. The ore, which was in the back near the shaft, is now within a foot of the bottom and the grade of the material is improving. This drift will progress for 550 feet before reaching a point under the main shaft, for which it is headed.

The west drift has been in hard taconite with seams of soft slabby ore in the back and considerable trouble has been experienced in keeping the back at the drift height. Blasting is confined to the bottom four feet, but even then the back works up several feet before the sets are placed in position and it is necessary to use quantities of lagging for blocking. This drift, which has been turned, will progress to the north for over 300 feet and two raises will be put through to the open pit.

Four gangs have been employed during the shipping season, mining out and caving the unstripped area along the Hawkins boundary. An ore body approximately 50 x 100 feet has been gained from the 1450 Foot Sub-level to an elevation of 1421 feet, and the settlement has brought the surface material to a level with the open pit workings to the north. The 1421 Foot

Sub was driven on the solid taconite and when the open pit bottom has been carried down to this elevation, the ore body at this end of the pit will have been exhausted, with the exception of a small amount of wash material surrounding the caved area. When the open pit ore is mined down to the taconite, it is the intention to dump the waste rock from the mine into this opening and thus do away with the difficulty of hoisting and surface tramming. It may be possible to handle some rock in this manner by the close of next season's operations.

OPEN PIT SUBS: Two gangs were engaged during the first four months of the year slicing and caving along the Platt Mine boundary. The ore here was not cleaned by stripping operations during 1910 and as the workings were exposed, it was possible to remove the ore during the cold weather without the use of much timber. While the ore was frozen, requiring constant blasting, and it was very cold for the men, the deposit could be worked up to the sand without the use of timber and all of the ore drawn off without its becoming mixed with the surface material. The ore from these workings averaged 58 per cent in Iron.

A force of six company account men, working under the taconite capping and unstripped area, at the southwest corner of the property, gouged and sliced out rooms approximately 60 x 100 feet in extent. These workings, at an elevation of 1484 feet, exhausted the deposit here with the exception of some wash ore to the west. The ore averaged above 56 per cent in Iron and the Manganese about 2 per cent. The Phosphorus and Silica were comparatively low.

WEST DEPOSIT.

1500 FOOT SUB-LEVEL: Contracts Nos. 10 and 13 spent the first three months of the year slicing and caving back the pillars towards 204 chute. This ore ran 55 per cent in Iron, but was high in Phosphorus and Manganese.

1485 FOOT SUB-LEVEL: A company account gang cut out and drifted in rock for 80 feet from No. 306 chute. It was the intention to tap the 1500 Foot ore body at this elevation, but raises from the drift showed the ore to be

of low grade and the work was abandoned.

Nos. 15 and 17, trammig into No. 3 chute, just north of the shaft, gouged out several pillars of 55 per cent ore adjacent to the track pillar during February and March. It will be inadvisable to take any more ore in this locality until the track and shaft pillars are robbed.

E A S T D E P O S I T.

1462 FOOT SUB-LEVEL: At the beginning of the year eight gangs were employed here, Nos. 4,6,7,8,9,12,16, and 18, but this force was cut down week by week until at the end of April only two contracts remained, Nos. 6 and 7.

This sub was opened during the winter of 1911 and this year's operations consisted in pushing the northerly workings to the wash ore zone and in slicing and caving back towards No. 16 crosscut. As this sub was driven on the solid taconite bottom and there was an average back of but a few feet to the old lagged workings above, the timber cost was comparatively high for the amount of ore extracted. The grade of ore was very satisfactory, however, at all times and assisted materially in holding the Mine's product up to the guarantee figures. The Phosphorus, Manganese, and Silica were noticeably low, while the Iron averaged above 57 per cent. The caving extended to within a few feet of No. 16 crosscut, which it was not deemed advisable to wreck at this time.

Test drifts driven to the south from No. 16 crosscut failed to disclose any bodies of high grade ore. Several pockets of wash ore were encountered, however, and it may be advisable to explore here more extensively next season.

N O R T H E A S T D E P O S I T.

1470 FOOT SUB-LEVEL: During January, February, and a part of March, Nos. 11 and 15 scammed and robbed through the old workings along the north Property line. The ore gained was of fair grade only, the workings being largely in wash material.

1462 FOOT SUB-LEVEL: Contract No. 5 drifted south from the back of the Main Level for 150 feet, where a holeing was effected with No. 16 crosscut

workings. This drift passed through a concentrating material, averaging 48 per cent in Iron, for the entire distance and was driven for the purpose of furnishing a second outlet for the high grade ore developed from No. 16 crosscut. During March and April a considerable product was trammed through this drift.

A considerable tonnage of wash ore has now been developed in this area, but owing to the proximity of the old caves above, it will not be advisable to handle it on the main level. When the bottom, or second, level, has been pushed out under the old pit, a crosscut can be driven under this body and the ore extracted at a much less cost.

MAIN LEVEL WINZES.

Nine winzes were sunk from the Main Level, "West Deposit" from 10 to 20 feet in depth. These winzes were put down for the purpose of determining the bottom of the wash ore and to govern the direction and extent of the northerly workings of the Second Level. Taconite was reached in all of the winzes.

Following is the analysis of the material cut:

		<u>IRON</u>	<u>PHOS.</u>		<u>IRON</u>	<u>PHOS.</u>
No. 535.	0'- 5' ...	53.96	.099	No. 540.	0'-5 ' 45.89	.038
	5'-10' ...	43.04	.031		5'-10' 47.81	.077
	10'-13' ...	Taconite.			10'-15' 41.93	.044
					15' -20' Taconite.	
No. 536.	0'- 6' ...	56.54	.068	No. 541.	0'- 5' 49.01	.040
	6'-11' ...	51.40	.075		5'- 8' 47.61	.075
	11'-15' ...	Taconite.			8'-12' Taconite.	
No. 537.	0'- 5' ...	54.60	.053	No. 542.	0'- 3' 54.60	.077
	5'-12' ...	46.42	.060		3'-10' Taconite.	
	12'-014' ...	Taconite.		No. 543.	0'- 6' 49.60	.061
No. 538.	0'- 5' ...	53.20	.036		6'-11' Taconite.	
	5'-10' ...	50.75	.081			
	10'-13' ...	49.08	.036			
	13'-16' ...	Taconite.				
No. 539.	0'-17' ...	Taconite				

ESTIMATE OF ORE, JANUARY 1, 1914.

Following is the estimate of ore in sight at the Crosby Mine on January 1, 1913, the tonnage mined during 1913, and the balance from these figures. The basis for this estimate was an average Iron of 56 per cent and .040 Phosphorus:

	<u>JANUARY 1, 1913.</u>	<u>MINED IN 1913.</u>	<u>BALANCE.</u>
East Forty	110,000 tons	21,836 tons	86,164 tons
West Forty	<u>320,000 "</u>	<u>179,936 "</u>	<u>140,064 "</u>
Total	, 430,000 tons	201,772 tons	228,228 tons
Estimate - January 1, 1914			208,000 tons

The 20,228 ton shrinkage in the estimated figure of January 1, 1914, compared to the balance derived by deducting the 1913 shipments from the estimate of January 1, 1913, was due to the ore in the North end of the new pit not holding up in grade. Only the higher grade material could be extracted, and this resulted in throwing out some of the lean ore, which was included in the estimate of January 1, 1913.

Of the 208,000 tons estimated as in sight January 1, 1914, 107,000 tons comprises shaft and track pillars. The remaining 101,000 tons is scattered throughout the mine, by far the larger portion of it lying below the main level.

The following is an estimate of the wash ore in sight at the Crosby Mine as of January 1, 1914. This estimate is based on an average Iron of 50 per cent and .045 Phosphorus:

Stripped and above the main level,	850,000 tons
Stripped and below the main level.	480,000 "
From Underground operations	<u>900,000 "</u>
Total	2,230,000 "

Assuming that the contemplated washing plant is in shape to begin operations by June 15, 1914, and would be run continuously to October 15, 1914, the production of concentrates for next season is estimated at 120,000 tons, which would mean an output of 200,000 tons of crude ore from the Mine. This

would be at the rate of 50,000 tons per month, and the estimate was based on the assumption that the Mine would be prepared for the handling of such increased tonnage.

PREPARING FOR WASH ORE EXTRACTION.

The following is an estimate of the cost of preparing the Mine for the handling of the wash ore, the charges under the several headings for the months of November and December and the amounts of the estimated figures remaining:

<u>1. GENERAL EXPENSE:</u>	<u>ESTIMATE.</u>	<u>EXPENDED TO</u>	<u>BALANCE.</u>	<u>REMARKS.</u>
		<u>Jan. 1st.</u>		
A. Engineering,		30.82		No estimate.
B. Mine Office,		505.64		No Estimate.
<u>2. BUILDING EQUIPMENT:</u>				
A. Rebuilding Shaft House	4,500.00	205.38	4,294.62	Covers excavating rock pile and cribbing for new head frame.
B. Repairing Mine Buildings	500.00	175.59	324.41	Includes building pipe rack and shed for storing old machinery.
<u>3. GENERAL REPAIRS:</u>				
A. Repairing Water Heater,	50.00	31.41	18.59	This charge was for 12 new brass tubes.
B. Motors,)		92.04		These costs include the replacing of broken parts and such minor repairs as were necessary to put the equipment in shape for operation.
C. Motor Cars,)		210.63		
D. Top Tram Engine,)				
E. Pumps,)	1,000.00	2.75	621.39	
F. Hoist,)		10.51		
G. Steam Shovel,)		62.18		
H. Electric Engine,	250.00	7.37	242.63	This charge covers minor repairs to the old electric engine before it was discarded.

<u>4. MACHINERY EQUIPMENT:</u>	<u>ESTIMATE.</u>	<u>EXPENDED TO</u>	<u>BALANCE.</u>	<u>REMARKS.</u>
		<u>Jan. 1st.</u>		
A. No. 10 Cameron Pump	600.00	50.04	549.96	This item covers the expense preparatory to starting the raise, through which the discharge lines from the pumps will be carried.
B. Hoist	2,000.00	43.63	1,956.37	Changes to the steam line were responsible for this charge.
C. Compressor and Drills.	3,000.00	424.07	2,575.93	Covers installation of compressor received from Ishpeming.
D. Two Motors and Five Cars.	4,500.00			
E. Lathe	300.00			
F. Steam Shovels	8,200.00			
G. Electric Engine		486.25		At the time of making the estimate the intention was to use the old engine, since discarded. The charge covers the cost of installing an "Ideal" Engine.
<u>5. SHAFT AND UNDERGROUND:</u>				
A. Retimbering Shaft	1,200.00			
B. Moving 19,000 tons Rock.	5,700.00	1,430.69	4,269.31	A total of 2,403 tons of rock have been moved at a cost of \$.595 per ton, compared with an estimated cost of \$.30 per ton. This has been high on account of having to do considerable dead work in order to open and repair chutes. The costs will be within the estimate from this time forward.
C. Moving 2,000 tons Rock.	1,000.00	833.40	166.40	At a cost of \$.476 per ton, 1,750 tons of rock have been handled. The estimated figure was \$.50 per ton.
D. Moving 4,000 Cy. Yds. of Sand	1,800.00			

<u>5. SHAFT AND UNDERGROUND.</u>	<u>ESTIMATE.</u>	<u>EXPENDED TO</u> <u>JAN. 1st.</u>	<u>BALANCE.</u>	<u>REMARKS.</u>
E. Cleaning Sumps	200.00			
F. Cutting Packet and Sump	1,500.00			
G. Retimbering Main Level	1,500.00	553.75	946.25	Over 400 feet of main level drifts have been retimbered. This work is progressing in a satisfactory manner.
H. Extending Bottom Level.	4,690.00	1,179.94	3,510.06	This drift was extended for 145 ft. at a cost of \$8.13 per ft., compared with an estimated cost of \$7.00. While the electric engine was out of commission it was necessary to employ extra trammers at the new shaft landing and a considerable share of the shift bosses time was charged against this account. The cost during the succeeding months should be below \$7.00 per foot.
I. Exploring and Raising.	5,000.00	1,428.43	3,571.57	The cost of this drifting to date has been \$8.92 per ft. compared to the estimated cost of \$10.00 per ft. The same extra charges went against this account as was the case with the other drift and in consequence this work should be completed for considerably less than was estimated.
J. Pumping		910.00		No estimate.
K. Cribbing Shaft Pillar		51.06		No estimate.
Totals	\$ 52,294.00	\$ 8,725.91	\$ 43,568.09	

The 10 per cent added to the original estimate of \$47,540.00, making a total of \$52,294.00, should be more than ample to take care of all items not included in the estimate, such as "General Expense," "Pumping," and "Cribbing Shaft Pillar."

ANALYSIS OF COST SHEET.

Mining activities were carried on during 1912, from May 20th to the end of the year, whereas 1913 operations extended over a period from January 1st to November 13th. For comparative purposes the costs covering these periods will be considered. Underground mining was carried on for six weeks during 1912, against sixteen weeks in 1913. This in part explains the relatively high costs of 1913, the unfavorable weather conditions together with the mining of scattered and inaccessible ore bodies in the open pit during the year, being the other more important cost factors.

	<u>1 9 1 3 (284 Days)</u>		<u>1 9 1 2 (194 Days)</u>	
	<u>AMOUNT</u>	<u>PER TON</u>	<u>AMOUNT</u>	<u>PER TON</u>
General Expense	12,150.21	.060	8,619.78	.075
Maintenance	9,004.00	.045	4,112.91	.036
Mining Expense	<u>142,520.02</u>	<u>.706</u>	<u>52,914.94</u>	<u>.458</u>
Cost of Production	163,674.23	.811	65,647.63	.569

The production for 1913 was 201,771 tons, compared to 115,505 tons during 1912, and the mine operated most of the Sundays during the shipping season of 1913. The total amounts under the several headings are consequently higher for the year 1913 and for comparative purposes, the cost per ton will be analyzed.

GENERAL EXPENSE: The General Expense for 1913 was \$.015 per ton lower than for the previous year, this increase being divided among the several items under this heading as follows:

"Insurance" was \$.001 per ton lower for 1913, which is explained by the increased tonnage of this year.

"Engineering" was the same for the two years considered, namely, \$.006 per ton. Although more engineering work was done during 1913, the increased production offset it.

"Analysis" shows a decrease of \$.006 per ton compared with the previous year, due largely to the running of silica and manganese on daily, instead of car, samples. The silica and manganese content of the ore is very uniform and while the sampling was more thorough than previously, a considerable saving was effected in the analytical work. Lerch Brothers, who did the analytical work during the two years considered, made a reduction of 5 cents per determination in the 1913 rate and this was also a factor effecting the above decrease.

"Personal Injury Expense" also showed a decrease of \$.005 per ton. The rate paid the Insurance Company was the same, but this insurance was dropped on October 1st, 1913, when the Minnesota State Compensation Act became effective, and but a few of the accident claims, arising between that time and the end of the year, were settled. The settlement of the fatal and serious accidents, which occurred during October, would have raised the cost per ton materially. The \$1,001.00 settlement during 1912 in the John Johnson case was also an important item effecting the cost per ton under this caption. Johnson was injured during April, 1910, or before the mine was insured with the Manley-McLennan Agency.

There was a decrease of \$.003 per ton in the item "Mine Office," which was due to the increased tonnage for 1913. The clerk's salary and traveling expenses were higher during 1913, but were more than offset.

MAINTENANCE: The cost per ton for 1913 was \$.009 higher under this caption, the greater part of the increase coming under the headings "Pumping Machinery" and "Electric Tram Plant."

The item "Tracks and Yards" was \$.002 per ton higher for 1913, caused by the excessive trams in the open pit and the resulting amount of track work necessary. The car repairing was nominal during each year considered.

The costs under "Docks, Trestles, and Pockets," "Buildings," "Hoisting Machinery," "Top Tram Engine and Cars," and "Skips and Skip Roads"

showed a slight decrease for 1913, due to the larger ore tonnage handled compared with the amount of repair work done. With the exception of the repairs to the hoisting engine, the maintenance charges during 1913 were nominal for these items.

The charges to "Boiler Plant" were very light during 1912, amounting to \$16.35, while in 1913 the feed pump was thoroughly overhauled and new tubes were placed in one of the boilers. The 1913 charge amounted to \$222.51 or \$.001 per ton.

"Pumping Machinery" showed a decided increase for 1913, or \$.007 per ton. The new shaft pumping equipment was installed during 1913 and the main level ditching, which had previously been charged under the caption "Pumping," was carried under this heading.

The item "Electric Tram Plant" also showed an increase of \$.007 per ton, compared to the previous year. This was due to the extensive repair work on the underground motors and motor cars during 1913. Owing to the heavy rains, which washed considerable material through the open pit chutes into the main level, the wheels on the cars and motors were badly worn and in many cases had to be replaced. The motor armatures were burned out, as a result of being soaked with water, and had to be re-wound.

MINING EXPENSE: The "Mining Expense" for 1913 was \$.248 per ton higher than for the previous year, due to the comparatively large amount of underground work done during the winter months and the long trams and difficulties encountered gaining the open pit ore during the past shipping season. Weather conditions were also very unfavorable during 1913.

"Hoisting" showed an increase of \$.013 per ton for 1913, which was caused by the rather extensive operation at the new shaft and the fact that the Mine was worked during the severe winter months with the heavy fuel charge resulting.

"Pumping" was \$.002 per ton lower for 1913, due to the increased tonnage and the additional time worked during the winter, when the pumping item is nominal.

The charge to "Rock Drifting" was less by \$.001 per ton during 1913 and is explained by the better footage obtained in the second, or bottom, level workings.

The item "Breaking Ore" showed a decided increase, being \$.147 per ton higher than for 1912. This is explained by the fact that a greater tonnage was gained from underground workings in 1913 and the open pit product was mined from widely scattered and in many cases comparatively inaccessible stopes. A large part of the 1912 output from the open pit was milled directly into the chutes.

"Tramming" was \$.038 per ton higher during the year 1913, because of the increased length of the trams on the haulage level and the widely scattered workings.

The increase of \$.012 per ton in the "Timbering" item was due to the comparatively large amount of underground work undertaken during 1913.

No shift bosses were employed during the shipping season of 1912, whereas in 1913 two bosses worked the entire year with the result that the item "Captain and Bosses" showed an increase cost of \$.005 per ton.

In spreading the rock pile, it was necessary to employ extra men on the dump, which was responsible for the increase of \$.007 per ton shown in "Top Landing and Tramming."

"Stocking Ore" was \$.006 per ton lower for 1913. The amount of ore stocked during 1912 was small compared to the charges for preparing the trestles and explains this decrease in the 1913 figure.

The item "Sorting Ore" showed an increase of \$.033 per ton for 1913, due to the excessive amount of rock handled from the open pit during the past shipping season.

The total "Loading and Shipping" cost per ton during 1913 was \$.021, against \$.023 per ton for 1912.

While the cost per ton in 1913 for "Steam Shovel Loading" was \$.022 per ton higher than for the previous year, due to the difficulty encountered in handling the frozen ore, the comparatively large tonnage loaded at the

pocket during this period brought down the average cost. It was necessary to do more rock sorting at the pocket during 1913 with the result that the cost per ton for "Loading at Pocket" showed an increase of \$.003. The costs per ton for loading with shovel and at pocket during 1913 were \$.048 and \$.007 respectively.

Wm. H. Barber
Supt.

CROSBY MINE.

AVERAGE MINE ANALYSIS OF OUTPUT.

GRADE	IRON	PHOS.	
Crosby	55.41	.038	

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR 1913.

GRADE	MINE		LAKE ERIE	
	IRON	PHOS.	IRON	PHOS.
Crosby	55.59	.036	55.41	.036

ORE STATEMENT - DECEMBER 31ST, 1913.

	CROSBY	LAST YEAR.
On hand Jan.1st, 1913,	17,293	90,156
Output for year	201,771	115,505
Total	219,064	205,661
Shipments	219,064	188,368
Balance on hand	0	17,293
Increase in Output 75%	86,266	

1913 - 2-8hr.shifts to Nov.13th; mine not producing after Nov.13th.
 1912 - Mine idle Jan.1st to May 20th; 1-10hr.shift to Nov.11th;
 2-8hr.shifts Nov.11th to Dec.31st.

SHIPMENTS FOR 1913.

	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Crosby	154,693	64,371	219,064	188,368
Last Year	97,726	90,642	188,368	
Increase 16%			30,696	

CROSBY MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 3	1 9 1 2 8 Months	INCREASE	DECREASE
<u>PRODUCT</u>	201,771	115,505	86,266	
General Expense	.060	.075		.015
Maintenance	.045	.036	.009	
Mining Expense	.706	.458	.248	
<u>Cost of production</u>	.811	.569	.242	
<u>DEPRECIATION</u>				
Equipment	.002	.003		.001
Miscellaneous	.001	.001		
Plant	.329	.301	.028	
<u>Total Depreciation</u>	.332	.305	.027	
Idle Expense		.041		.041
Taxes	.017	.039		.022
Central Office	.049	.026	.023	
<u>COST ON STOCKPILE</u>	1.209	.980	.229	
Loading and shipping	.021	.023		.002
<u>Total cost on cars</u>	1.230	1.003	.227	
Number of days operating	263	194	69	
Number of shifts and hours	2-8hr	1-10hr 2-10hr 2-8hr		
Avg. daily product	767	596	171	
<u>COST OF PRODUCTION</u>				
Labor		.401		
Supplies		.168		
Total		.569		

Increase in mining expense:
 Breaking ore - Increase .147
 Hoisting - " .013
 .160
 Nearly all accounts generally higher.

CROSBY MINE.

STATEMENT OF COMPARATIVE WAGES.

	1 9 1 3	8 months 1 9 1 2	INCREASE	DECREASE
<u>SURFACE</u>				
Total number of days	8,871	4,928	3,943	
Average rate	2.67	2.72		.05
<u>Amount</u>	23,666.50	13,406.02	10,260.48	
<u>UNDERGROUND</u>				
Total number of days	39,300-3/4	14,252½	25,048¼	
Average rate	2.60	2.47	.13	
<u>Amount</u>	102,349.67	35,215.70	67,133.97	
Total days	48,171-3/4	19,180½	28,991¼	
Average rate	2.61	2.53	.08	
<u>Total amount</u>	126,016.17	48,621.72	77,394.45	
Labor cost per ton	.624	.421	.203	
No. shifts and hours	2-8hr	1-10hr 2-10hr 2-8hr		

Mine closed June 30,1911; reopened May 20,1912;closed Nov.13,1913.

Rate Per Day:	Surface	Decrease	.05	-----	1.84%
	Underground	Increase	.13	-----	5.26%
	Total		.08	-----	3.16%

CROSBY MINE.

COMPARATIVE AVERAGE WAGES AND PRODUCT.

PRODUCT '13 201,771 Tons PRODUCT '12 115,505 Tons	SURFACE		UNDERGROUND		TOTAL	
	1913	1912	1913	1912	1913	1912
Avg. number men working	27	16	119	45	146	61
Avg. wages per day	2.67	2.72	2.60	2.47	2.61	2.53
Avg. wages per month 25 days	66.75	68.00	65.00	61.75	65.25	63.25
Avg. product per man per day	22.74	23.44	5.13	8.41	4.19	6.02
Labor cost per ton	.117	.116	.507	.305	.624	.421
Diff. in labor cost per ton	+0.001	-0.077	+0.202	-0.322	+0.203	-0.399
Avg. product breakg. & trammg.			8.46	13.97		
Avg. wages for miners contract			2.73	2.59		
Avg. wages for trammers contract			# 2.64			
Total avg. wages for contract			2.73	2.59		

Trammers Contract 2.64 is for new shaft only; therefore, have not averaged "Total average wages contract."

		Tons	%
Tons per man per day	Surface	.70	2.99
	Underground	3.28	39.
	Surf. & Undg.	1.83	30.4

Proportion Surface to Underground men: 1913 - 1 to 4.41
 1912 - 1 to 2.81
 1911 - 1 to 3.26
 1910 - 1 to 3.9.

CROSBY MINE.

TIMBER STATEMENT FOR THE YEAR ENDING DECEMBER 31, 1913.

KIND	LINEAL FEET	AVG. PRICE PER FOOT	AMOUNT 1 9 1 3	AMOUNT 1 9 1 2
6" to 8" Timber	30,938	.0438	1,355.60	632.10
8" to 10" "	10,313	.0438	451.87	126.42
10" to 12" "	4,125	.0438	180.75	84.28
12" to 14" "	3,681	.0441	162.47	59.68
14" to 16" "	2,597	.0438	112.97	30.90
16" to 18" "				15.96
Total 1913	51,636	.0438	2,263.66	
Total 1912	21,914	.0433		949.34

	LINEAL FEET	PER 100'	1 9 1 3	1 9 1 2
6" Lagging	467,400	.386	1,805.00	369.50
Trestle Timber				249.16
Total 1913	467,400	.386	1,805.00	
Total 1912	99,808	.620		618.66

	1 9 1 3	8 Months 1 9 1 2
Feet of timber per ton of ore	.256	.190
Feet of lagging per ton of ore	2.31	.830
Feet of lagging per foot of timber	9.04	4.38
Cost per ton for Timber, lagging, and poles	.020	.011
Equivalent of Stull timber to board measure	175,982	44,236
Feet board measure per ton of ore	.872	.381
Total product	201,777	115,505
Total cost of timber and lagging - 1913		4,068.66
Total cost of timber and lagging - 1912		1,568.00
Total cost of timber and lagging - 1911		3,550.21
Total cost of timber and lagging - 1910		5,090.20
Total cost of timber and lagging - 1909 (13 months)		5,034.18
Total cost of timber and lagging - 1908		4,848.19

CROSBY MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND	QUANTITY	AVERAGE PRICES	AMOUNT	
			1 9 1 3	1 9 1 2
40% Powder	86,150	.09	7,756.50	3,235.50
Total Powder	86,150	.09	7,756.50	3,235.50
Fuse	113,500	3.84	435.62	160.67
Caps	36,300	6.14	222.71	87.09
Cap Crimbers	20	.25	5.00	
Total fuse, etc.			663.33	247.76
Grand Total			8,419.83	3,483.27
Product			201,771	115,505
Pounds powder per ton ore			.427	.311
Cost per ton for powder			.038	.028
Cost per ton for fuse, caps, etc.			.003	.002
Cost per ton for all explosives			.041	.030
Avg. price per lb. for powder			.09	.090

CLIFFS SHAFT MINE

Very little new construction work was done at this mine during the year.

The hoist was coupled to a motor through "Wuest" herringbone gears. The electric controller for this is connected so that the motor is operating during hoisting periods only. The Wuest gear is connected direct to the engine shaft. The general dimensions of the gear are: 121 teeth; $1\frac{3}{4}$ " diametrical pitch; outside diameter 69.973; pitch circle dia. 69.059; root diameter 67.915; width of face 18"; diameter of shaft at hub 12"; length of hub 18". The pinion which drives this gear and which is coupled to the motor has as follows: 17 teeth; $1\frac{3}{4}$ " diametrical pitch; outside diameter 10.713; pitch circle diameter 9.799; root diameter 8.655; width of face 18"; bore 7.031". The motor was manufactured by the General Electric Company. It is a wound rotor, 500 H.P., induction motor, Type I, Class 12-500-600, Form M, 60 cycles, 117 amperes, 2200 volts; speed at no load 600, at full load 585. This hoist was first operated electrically Sept. 22.

A new 3" steam line was run from the engine house to the General Office to replace the old line which was in very poor condition. This new line is enclosed in a tin lined wood casing.

The electric pumps are on hand and will be installed as soon as the pump house and sump are ready.

HARD ORE SHOPS

No additions or changes were made to the equipment in these Shops. All equipment operated satisfactorily.

LAKE MINE

Two new pumps, one a centrifugal and one a geared reciprocating, were installed and put in operation on the 5th level. These pumps were put in operation on May 27th.

The reciprocating pump was manufactured by the Fred M. Prescott

LAKE MINE

(Cont'd)

Steam Pump Company and has the following specifications: Diameter of water plungers 6"; stroke 18"; capacity 400 gallons per minute at 600 ft. head; plunger speed 141 ft. per minute. It is driven through a Wuest gear by a General Electric, 75 H.P., induction motor, Type 1-12-75A-600, Form L, which runs at 600 R.P.M.

The 5" 4-stage centrifugal pump was also manufactured by the Fred M. Prescott Steam Pump Company. This pump has a 5" discharge and a 6" suction. The capacity is 500 gallons per minute against a 600 ft. head. Pump runs at 1720 rev. per minute. It is driven by a 125 H.P. General Electric induction motor.

The economizer was completely dismantled and the headers shipped to the Green Fuel Economizer Company, who fitted new tubes in all the headers. This work was very necessary as the tubes were continually bursting.

Extensive repairs to the brick work in boilers and stokers are being made. This brick work has not been thoroughly overhauled since the plant was erected.

SALISBURY MINE

No new machinery was installed at this mine during the year.

The electric air compressor, which was put in service in January, has operated very satisfactorily. The motor which drives this compressor originally operated the Princeton No. 2 hoist. It was manufactured by the Westinghouse Electric & Manfg. Co. It is nominally a 150 H.P., but actually 120 H.P., induction motor and runs at 435 R.P.M. The diameter of its pulley is 29".

The new electric equipment has given good service during the year.

ATHENS MINE

The shaft house, pulley stands and engine house have been erected at this mine. The shaft house and pulley stands were built by the Wisconsin Bridge & Iron Company and are of our standard construction. The engine house is of the same design as that at the Negaunee Mine. It has a floor area of 70' x 80'.

ATHENS MINE (Cont'd)

A geared electric cage hoist is being installed. It was manufactured by the Lake Shore Engine Works. The drum is 10 ft. dia. by 9 ft. long, keyed to the shaft which is driven by a Wuest gear which meshes with a pinion which is driven by the motor.

A 15" - 25" x 32" 2-stage tandem Nordberg air compressor, similar to the one at the Negaunee Mine, is on hand and will be installed to furnish air for shaft sinking purposes.

LUCY MINE

This mine has been idle during the entire year.

MAAS MINE

No new machinery was installed at this mine during the year and the plant operated with very few breakdowns and small repairs.

The electric pumps, together with motors to drive them, are on hand and will be installed as soon as the pump station is completed.

NEGAUNEE MINE

The hoisting plant has operated very satisfactorily during the year, without any delay for repairs. The top tram plant, however, has caused more or less delay due to the burning out of the motors. It now appears that this trouble was due to faults in the brake mechanism which would at times lock itself and stall and burn out the motor.

A tandem two stage air compressor, manufactured by the Nordberg Manfg. Company and driven by a 325 H.P. Westinghouse synchronous motor, was installed at this mine. The capacity of this machine is 2100 cu. ft. per minute. The diameter of the high pressure cylinder is 15", diameter of low pressure cylinder 25", and the stroke is 32". The speed is 120 R.P.M. The total weight of the machine is 68,000 lbs.

The work of installing the 10th level electric pumps has been carried on. This station contains two high speed reciprocating pumps whose suction are fed by two low head centrifugal pumps, and one 7-stage high head

NEGAUNEE MINE

(Cont'd)

centrifugal pump, the latter being used as a relay for the other two.

The reciprocating pumps were manufactured by the Fred M. Prescott Steam Pump Company. The plungers are 5" in diameter, with a 24" stroke. Pumps run at 120 R.P.M. and have a capacity of 1000 gallons per minute against 1000 ft. head. These are driven by 300 H.P. General Electric synchronous motors. The two centrifugal pumps which pump to the suction of the reciprocating pumps were manufactured by the Alberger Pump & Condenser Company. These have a capacity of 1200 gallons per minute against a head of 30 ft. They are driven by 15 H.P. General Electric induction motors.

The high head centrifugal pump was manufactured by the Alberger Pump & Condenser Company and has a capacity of 1000 gallons per minute against a head of 1000 ft. It is driven by a 350 H.P. General Electric induction motor which runs at 1800 R.P.M.

When the electric pump station is completed this mine will be operated entirely by electricity.

SOUTH JACKSON CRUSHER PLANT

The crusher operated during most of the shipping season with very few delays.

The plant is ready to be operated electrically, with the exception of a few small details which have not been finished.

A 300 cu. ft. Ingersoll-Rand, single stage, belt driven, compressor was purchased for this mine. It is driven by a 50 H.P., 900 R.P.M., General Electric induction motor.

The hoist has been connected up to a 75 H.P. Westinghouse induction motor which drives the drum through a set of Wuest gears. The controller is to be placed in the crusher building so that the hoisting engineer can see the skips operate.

The crusher has been belted to a 150 H.P., 720 R.P.M., General Electric induction motor.

CHASE MINE

A 300 gallon Gould triplex pole pump was installed on the 3rd level and most of the water is drained to this point.

A small centrifugal water supply pump was installed and started up in August and has given no trouble.

Some coils burned out in both the compressor and hoist motors. The rotor of the hoist motor was rewound, while some new coils were put in the compressor motor. Both are now in good shape.

The transformers were removed from the engine house and placed on poles outside as a safety precaution.

LLOYD MINE

The present equipment has given very little trouble during the year.

A new butterfly was installed in the shaft house.

The rawhide pinion bearings on the Gould triplex electric pump on the 2nd level were re-babbitted.

Tests were run on the underground pumps. The Gould triplex pole pump showed an efficiency of 91%, while the Alberger centrifugal pump efficiency was 58%.

Preparations are in progress for the equipping of the pockets on the 600 ft. and 800 ft. levels when the shaft is completed to these points. The chute closers for these pockets are finished, the new cage and skip ropes are on hand, as are also the herringbone gears to increase the speed of the skip, and there will be no delay when the proper time comes to change to the lower level.

MORRIS MINE

The engine house was given a general overhauling during the summer. An addition, 28' x 44' in size, was built on the east side. One of our standard General Electric motor-generator sets and a Nordberg compressor were installed in this addition.

The compressor has a capacity of 2100 cu. ft. per minute. The

general dimensions are as follows:

L. P. air cylinder - dia.	25"
H. P. " " "	15"
Stroke	32"
R. P. M.	120

While the Nordberg compressor is the last machine installed it has given more trouble than the others combined. It seems to be a design not yet tried out and is not proving satisfactory.

In the old part of the engine house the switchboards were removed from along the east side and set up in a line on the south side. The pump switchboards were removed from the building and set up in the pump station underground.

An overwind device made up by the electrical department was installed on the skip hoist and works to the satisfaction of the Safety Committee. The other hoists will be equipped as soon as the overwind devices are made up.

A plate shear that cuts 1/2" plate was added to the Blacksmith Shop equipment. A tool room was built in the Machine Shop.

In April electric haulage was started on the 2nd level. This equipment consists of a six ton General Electric locomotive and 10 tram cars. The equipment has given first class service.

The blower fan located on the 2nd level near the pump house was moved into the Lloyd drift close to the Lloyd shaft. The A.C. motor was replaced with a direct current machine and power is now taken from the trolley line. The suction on this fan is of 10" pipe, 1900 ft. long, while the discharge is over 2000 ft. long.

The spur gears purchased with the Prescott 1000 gallon pumps on the 2nd level did not stand up to the work and had to be replaced with cut herringbone gears. While these latter gears give better satisfaction, to judge from the amount their teeth have worn, it seems on future installations of this size the face of the gears should be increased allowing less pressure per sq. inch on the line of contact. A series of tests run on these pumps show an over-all efficiency of 84%. These tests also proved that with one

MORRIS MINE

(Cont'd)

valve leaking the efficiency was lowered over 2%. The pot valves in these pumps have given trouble since the pumps were started. Several new types have been made up and are now being tested.

AUSTIN MINE

Practically all the trouble occurring to equipment at this mine was with the hoist motor. None of the accidents caused much delay. Other equipment operated satisfactorily. This mine closed on November 1st.

FRANCIS MINE

No work was done at this mine.

GARDNER-MACKINAW MINES

Work was started at these mines during the summer. The transmission line from the Central Power Plant was completed together with the Substation equipment. Current comes into the Substation at 6600 volts and is stepped down to 2300 volts. The transformers on this line were furnished by the General Electric Company, and the switchboard and control apparatus by the Westinghouse Company.

The head frames were erected by the Worden-Allen Company.

The compressor for these mines is a 2-stage motor driven machine of 2100 cu. ft. capacity and was furnished by the Nordberg Manfg. Company. It is driven by a 325 H.P. Westinghouse synchronous motor.

The hoist at the Mackinaw Mine was taken from the Francis Mine. It was built by the Wellman-Seaver-Morgan Company, and has a drum 10 ft. in diameter by 7 ft. face. It is driven by a 400 H.P. General Electric motor.

The hoist at the Gardner Mine was furnished by the Lake Shore Engine Works, and has a drum 10 ft. in diameter by 7 ft. face. It is also driven by a 400 H.P. General Electric Company motor. Compressor and hoists were in course of erection at the end of the year.

A heating plant was installed at the Mackinaw Mine.

The Shops have been equipped, and in the Machine Shop a power driven pipe machine and drill press were installed.

GWINN MINE

This mine was unwatered and work resumed on the installation of the permanent pumps. Bailers were used in unwatering the mine. The pumping equipment at this mine consists of a Prescott centrifugal pump and a Prescott power driven plunger pump.

The centrifugal pump is driven by a 400 H.P. General Electric motor and has a capacity of 1000 gallons per minute against 1000 ft. head. This pump was put in operation November 30th.

The plunger pump is driven by a 350 H.P. General Electric motor and has a capacity of 1000 gallons per minute against 1000 ft. head.

Switchboards and control apparatus was furnished by the General Electric Company.

Room has been provided in the pump station for a third pump when needed. This pump room when completed will be the same as at the Stephenson Mine, that is, it will be cut off entirely from the 7th level with a raise to the 5th level for use as a man way. Sumps with a storage capacity of 1000 gallons per minute for 10 hours have been provided.

The skip hoist was installed and put into commission. This hoist is driven by a 400 H.P. General Electric motor. The hoist was furnished by the Wellman-Seaver-Morgan Company.

The only serious accident to equipment occurred to the cage hoist motor which had its coils wrecked by overspeed when lowering the cage.

The Dry was fitted up and the heating plant in connection with it was put into commission.

The main boiler plant was shut down as soon as the electric pump was put into service.

The water system at this mine was connected with the Central Pumping Station system.

JOPLING MINE

No work was done at this mine.

PRINCETON MINE

A 200 H.P. General Electric motor was connected to the hoist in January, taking the place of the 150 H.P. Westinghouse motor which was sent to the Salisbury Mine.

A new General Electric controller was installed on the top tram plant, replacing the Cutler-Hammer controller which had given so much trouble. No trouble was experienced after the change.

Two pinions were broken on the hoist during the year, causing most of the delays on account of accident to equipment

The steam driven compressor at this mine was operated about a month on account of compressor at the Central Power Plant being out of commission.

The electric mine pump operated satisfactorily during the year.

A cage was put on to operate in balance with one of the skips.

Underground haulage equipment operated without any serious delays.

This mine was shut down September 1st.

PRINCETON CENTRAL POWER PLANT

The air compressor was changed to electric drive in March and April. The compressor is driven by a General Electric 625 H.P. synchronous motor by means of a rope drive. On starting up after the change to electric drive was completed a serious breakdown occurred due to the failure of the relief valve to operate on the low pressure air cylinder when the eccentric, which drives the valve gear on this cylinder, slipped. Investigation showed that their failure to operate was due to the Allis-Chalmers Company not providing discharge ports for these valves.

The compressor has operated very satisfactorily since. Regulation of the amount of air needed is controlled by a valve on the suction, the compressor operating either in full load or no load.

The Substation equipment in connection with the 6600 volt line to the Gardner-Mackinaw Mines was installed and tested out. Two circuits on a pole line serve these mines.

PRINCETON CENTRAL POWER PLANT

(Cont'd)

The underground haulage motor-generator set was moved from the basement into the new addition built for the compressor motor.

The steam-electric plant was in operation a few times during the year for short intervals on account of storms and line repairs. A few interruptions in service from the water power occurred on account of lightning during the summer.

PRINCETON CENTRAL PUMPING STATION

The equipment at this station operated without any trouble during the year.

STEPHENSON MINE

New electric driven mine pumps were installed on the 5th level and put into commission on April 3rd. This plant consists of two pumps, with room for a third. One pump is an Allis-Chalmers centrifugal capable of handling 1500 gallons of water per minute against 500 ft. head. The other is a Prescott power driven plunger pump with a capacity of 1500 gallons per minute against 500 ft. head. Both pumps are equipped with General Electric motors and control apparatus.

All entrances into the pump house from the 5th level have been blocked with concrete, making it possible for the mine to fill as far as the 4th level before the pumps will be covered. A raise extends from the pump room to the 4th level for use as a man way. The steam pumps on the 4th level are held as a reserve. A large sump on the 5th level permits of a five hour shut down of the pumps. These pumps have operated during the year without any trouble.

Most of the delay at this mine has been caused by accident to top tram equipment.

Work is in progress towards changing the trestle so as to do away with the reverse curves on each side of the head frame

Hoisting equipment operated very satisfactorily during the year.

Underground haulage operated much better this year than last as there is not so much trouble on account of water on the tracks.

CROSBY MINE

The engine which drives the underground haulage generator was wrecked and was replaced by the Ideal engine formerly in service at the Negaunee Mine.

The compressor which was formerly used at the Iron Belt Mine was installed.

No other change was made to equipment.

IMPERIAL MINE

The steel shaft house and crusher building was completed. Two #6 McCully gyratory crushers are installed, each driven by a small high speed engine. One of these engines was formerly in the Maas Mine shop and the other in the Princeton Shop. One boiler was added to boiler room equipment, and the compressor was taken from the Lucy Mine and installed in the engine room. All these improvements are practically complete.

No ore was hoisted at this mine during the year.

ELECTRICAL DEPARTMENT

The electrical installation as a whole has given most excellent service during the past year, with as little trouble as could be reasonably expected.

No additions were made to generating equipment or high tension transmission lines.

One 590 K.V.A. high tension transformer was purchased for the Brownstone Substation. This has not been connected up, but will be used in case of accident to any of the others.

A 2300 volt, 3 phase, line consisting of 300000 C.M. stranded copper was built from the Maas Substation to the Athens Mine, a distance of 6,436 ft., and a #2 copper line was built from the Athens Mine to the South Jackson Mine, a distance of 5,156 ft. These lines are standard construction, with 40 ft. Cedar poles and one 7 ft. cross arm.

The entire high tension plant was gone over and thoroughly inspected and repaired. This work consisted of placing new guard wire and new ties, tightening bolts on towers and cutting trees along the right-of-way.

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MECHANICAL DEPARTMENT