

ACCIDENTS

Following is a list of the accidents which occurred at the Hill-Trumbull Mine during the past year and were of a nature serious enough to be reported:

NICK ERKENEFF

Injured----- January 5th, 1922.
Occupation----- Car Repairer.
Nationality----- Bulgarian.
Time Lost----- 8 Weeks.
Compensation Paid----- \$645.00.

Remarks: Erkeneff had delivered an arch bar, from a 20-yard car, to the blacksmith to have it straightened. The blacksmith placed the bar on the anvil of the steam hammer, and signalled the helper to strike. At the same time, Erkeneff, who was on the opposite side of the hammer and not in sight of the blacksmith, attempted to place a small piece of strap iron on the arch bar in order to help straighten it. The blacksmith did not know Erkeneff was placing the piece of iron, and when the hammer descended it caught Erkeneff's left hand, crushing it so badly that it was necessary to amputate the first finger at the second joint.

J. K. YOUNG

Injured----- June 16th, 1922.
Occupation----- District Electrician.
Nationality----- American.
Time Lost----- None.
Compensation Paid----- None.

Remarks: While Young was engaged in putting in the last of three 2300 volt fuses, on the switch-board at the washing plant pumphouse, one end of the fuse made contact on the lower clip and in pushing the opposite end of fuse into the upper clip, the fuse slipped back, striking the back of Young's hand. Young sustained burns on forefinger of right hand, back of left hand, and on knee cap of right leg. Young dropped to the floor and the fall slightly bruised and sprained his elbow.

HUGH HUGHES

Injured----- November 11th, 1922.
Occupation----- Teamster.
Nationality----- Irish.
Time Lost----- Still in Hospital.
Compensation Paid----- \$102.67 to January 1st.

Remarks: Hughes had taken a load of coal to the boarding house, and was in the act of getting down from the wagon, when his foot slipped from the wheel and wedged his leg between the wheel and wagon box. At the same time he lost his balance and fell backwards, breaking his right leg below the knee.

TONY MARICH

Injured----- November 21st, 1922.
Occupation----- Track Boss.
Nationality----- Austrian.
Time Lost----- 3 Days.
Compensation Paid----- None.

Remarks: Marich was picking frozen dirt from the bottom of a dump car, when the pick glanced and penetrated the bottom of left foot, causing a flesh wound.

Danmore
~~and~~ Bond

MADE IN U.S.A.

SHIPMENTS

Following are the cargoes of Hill-Trumbull ore shipped during the past season and the analysis of same as obtained at the Mine and by the Lower Lake Chemists:

NON-BESSEMER ORE

<u>NEGAUNEE</u> -----		5/23/22-----				6,207 Tons.
	<u>Fe.</u>	<u>Phos</u>	<u>Sil.</u>	<u>Mois.</u>	<u>Fe.Nat.</u>	
Mine-----	61.17	.080	4.73	----	----	
Cremer & Case-----	60.30	---	----	4.67	57.48	
<u>MARQUETTE</u> -----		5/29/22-----				7,363 Tons.
Mine-----	61.11	.082	5.02	----	----	
Crowell & Murray-----	60.80	---	----	5.78	57.29	
<u>ISHPEMING</u> -----		5/30/22-----				10,334 Tons.
Mine-----	60.98	.071	4.79	----	----	
Oscar Textor-----	60.98 60.48	---	----	5.65	57.06	
<u>NEGAUNEE</u> -----		6/2/22-----				6,085 Tons.
Mine-----	61.11	.060	5.10	----	----	
Oscar Textor-----	60.53	---	----	5.06	57.47	
<u>PIONEER</u> -----		6/3/22-----				8,878 Tons.
Mine-----	61.23	.061	5.12	----	----	
Cremer & Case-----	60.10	---	----	4.95	57.12	
<u>ISHPEMING</u> -----		6/7/22-----				10,046 Tons.
Mine-----	62.14	.064	4.61	----	----	
Oscar Textor-----	60.85	---	----	5.60	57.44	
<u>SHEADLE</u> -----		6/16/22-----				10,627 Tons.
Mine-----	61.10	.058	4.62	----	----	
Hughes-Guentzler-----	60.07	---	----	5.93	56.51	
<u>ISHPEMING</u> -----		6/16/22-----				3,878 Tons.
Mine-----	61.03	.054	7.50	----	----	
Oscar Textor-----	60.00	---	----	4.17	57.50	
<u>MICHIGAN</u> -----		6/21/22-----				6,496 Tons.
Mine-----	61.83	.063	5.47	----	----	
Cremer & Case-----	61.50	---	----	5.02	58.41	
<u>PONTIAC</u> -----		6/24/22-----				11,825 Tons.
Mine-----	60.21	.057	6.04	----	----	
Crowell & Murray-----	60.06	---	----	6.04	56.43	
<u>MICHIGAN</u> -----		6/29/22-----				10,499 Tons.
Mine-----	60.84	.062	6.79	----	----	
Oscar Textor-----	60.80	---	----	5.41	57.51	

GRAND ISLAND - - - - - 6/24/22 - - - - - 2,864 Tons.
 Mine----- Fe. Phos Sil. Mois. Fe.Nat.
 Mine----- 61.24 .056 4.59 -----
 Hughes-Guentzler----- 60.33 --- --- 5.18 57.21

A. S. UPSON - - - - - 7/2/22 - - - - - 6,631 Tons.
 Mine----- 60.49 .063 5.43 -----
 Hughes-Guentzler----- 59.48 --- --- 5.19 56.39

PIONEER - - - - - 7/3/22 - - - - - 3,111 Tons.
 Mine----- 60.37 .061 5.73 -----
 Crowell & Murray----- 59.80 --- --- 6.53 55.90

W.G.MATHER - - - - - 7/7/22 - - - - - 8,480 Tons.
 Mine----- 60.17 .061 5.43 -----
 Hughes-Guentzler----- 58.95 --- --- 7.35 54.62
 Oscar Textor----- 59.20 --- --- 7.62 54.69

PONTIAC - - - - - 7/13/22 - - - - - 8,025 Tons.
 Mine----- 61.85 .066 4.87 -----
 Oscar Textor----- 60.82 --- --- 5.32 57.58

PIONEER - - - - - 7/20/22 - - - - - 6,247 Tons.
 Mine----- 61.30 .067 5.09 -----
 Crowell & Murray----- 60.80 --- --- 5.86 57.24

W. G. MATHER - - - - - 7/22/22 - - - - - 10,592 Tons.
 Mine----- 60.35 .062 4.82 -----
 Oscar Textor----- 59.10 --- --- 7.92 54.42

A. S. UPSON - - - - - 7/28/22 - - - - - 6,443 Tons.
 Mine----- 59.78 .052 6.32 -----
 Oscar Textor----- 58.10 --- --- 9.34 52.67

ISHPEMING - - - - - 7/31/22 - - - - - 6,582 Tons.
 Mine----- 61.20 .060 5.26 -----
 Hughes-Guentzler----- 60.90 --- --- 6.77 56.78
 Oscar Textor----- 60.80 --- --- 7.44 56.27

W. G. MATHER - - - - - 8/4/22 - - - - - 3,890 Tons.
 Mine----- 60.81 .057 5.39 -----
 Cremer & Case----- 60.00 --- --- 5.64 56.62

A. S. UPSON - - - - - 8/5/22 - - - - - 6,550 Tons.
 Mine----- 60.20 .062 6.03 -----
 Cremer & Case----- 59.70 --- --- 6.71 55.69

PONTIAC - - - - - 8/7/22 - - - - - 1,736 Tons.
 Mine----- 59.75 .069 6.13 -----
 Cremer & Case----- 59.30 --- --- 5.71 55.91

J. H. SHADLE - - - - - 8/9/22 - - - - - 6,608 Tons.
 Mine----- 59.31 .071 6.46 -----
 Oscar Textor----- 58.85 --- --- 6.82 54.84

HILL-TRUMBULL MINE

ISHPEMING - - - - - 8/10/22 - - - - - 2,943 Tons.
 Mine----- Fe. Phos Sil. Mois. Fe.Nat.
 Mine----- 59.32 .062 6.71 -----
 Oscar Textor----- 58.52 --- --- 7.42 54.18

GRAND ISLAND - - - - - 8/14/22 - - - - - 1,816 Tons.
 Mine----- 59.93 .065 5.35 -----
 Crowell & Murray----- 58.80 --- --- 7.72 54.26

MICHIGAN - - - - - 8/15/22 - - - - - 4,521 Tons.
 Mine----- 60.48 .056 4.57 -----
 Gremer & Case----- 59.30 --- --- 10.64 52.99

A. S. UPSON - - - - - 8/18/22 - - - - - 6,604 Tons.
 Mine----- 60.11 .059 6.11 -----
 Crowell & Murray----- 59.52 --- --- 6.09 55.90

J. H. SHEADLE - - - - - 8/20/22 - - - - - 3,358 Tons.
 Mine----- 59.61 .068 6.03 -----
 Oscar Textor----- 59.20 --- --- 6.93 55.10
 Hughes-Guentzler----- 59.40 --- --- 6.38 55.52

PIONEER - - - - - 8/22/22 - - - - - 8,304 Tons.
 Mine----- 59.34 .065 6.00 -----
 Crowell & Murray----- 59.15 --- --- 6.61 55.24

MICHIGAN - - - - - 8/25/22 - - - - - 6,395 Tons.
 Mine----- 59.54 .061 5.68 -----
 Gremer & Case----- 58.60 --- --- 8.32 53.72

PONTIAC - - - - - 8/27/22 - - - - - 2,574 Tons.
 Mine----- 59.22 .056 6.10 -----
 Oscar Textor----- 58.87 --- --- 8.25 54.01

J. S. DUNHAM - - - - - 8/29/22 - - - - - 4,625 Tons.
 Mine----- 59.47 .057 6.06 -----
 Crowell & Murray----- 59.55 --- --- 6.72 55.55

CHRISTOPHER - - - - - 8/31/22 - - - - - 4,611 Tons.
 Mine----- 59.66 .061 5.65 -----
 Hughes-Guentzler----- 59.72 --- --- 8.91 54.40

MICHIGAN - - - - - 9/4/22 - - - - - 6,911 Tons.
 Mine----- 59.52 .057 5.75 -----
 Gremer & Case----- 59.20 --- --- 7.86 54.55

ISHPEMING - - - - - 9/11/22 - - - - - 10,448 Tons.
 Mine----- 59.50 .060 5.78 -----
 Oscar Textor----- 59.70 --- --- 8.73 54.49

<u>GRAND ISLAND</u>		- 9/17/22 -					8,962 Tons.
	Fe.	Phos	Sil.	Mois.	Fe.Nat.		
Mine-----	60.52	.059	5.67	---	---		
Cremer & Case-----	60.60	---	---	7.32	56.16		
<u>WM. G. MATHER</u>		- 9/22/22 -					-10,823 Tons.
Mine-----	60.53	.056	6.44	---	---		
Cremer & Case-----	59.80	---	---	6.22	59.80		
<u>GRAND ISLAND</u>		- 9/28/22 -					9,089 Tons.
Mine-----	60.75	.056	5.54	---	---		
Oscar Textor-----	60.20	---	---	6.33	56.39		
<u>MUNISING</u>		- 9/28/22 -					6,549 Tons.
Mine-----	60.43	.058	5.19	---	---		
Crowell & Murray-----	59.50	---	---	7.26	55.18		
Oscar Textor-----	60.10	---	---	6.89	55.96		
<u>NEGAUNEE</u>		- 10/9/22 -					6,267 Tons.
Mine-----	60.87	.056	5.71	---	---		
Crowell & Murray-----	60.15	---	---	7.67	55.53		
Cremer & Case-----	59.90	---	---	7.64	55.32		
<u>GRAND ISLAND</u>		- 10/10/22 -					8,946 Tons.
Mine-----	60.61	.058	4.97	---	---		
Oscar Textor-----	59.80	---	---	6.90	55.67		
<u>MICHIGAN</u>		- 10/17/22 -					4,825 Tons.
Mine-----	60.86	.062	5.03	---	---		
Hughes-Guentzler-----	59.92	---	---	5.97	56.34		
Oscar Textor-----	59.65	---	---	5.98	56.08		
<u>ANGELINE</u>		- 10/18/22 -					6,677 Tons.
Mine-----	60.51	.068	5.47	---	---		
Oscar Textor-----	59.60	---	---	5.94	56.06		
<u>MARQUETTE</u>		- 10/22/22 -					7,333 Tons.
Mine-----	60.89	.064	5.42	---	---		
Oscar Textor-----	59.55	---	---	6.09	55.92		
<u>PETER WHITE</u>		- 10/26/22 -					9,147 Tons.
Mine-----	59.17	.074	8.09	---	---		
Crowell & Murray-----	58.80	---	---	8.20	53.98		
<u>J. H. SHEADLE</u>		- 11/3/22 -					5,044 Tons.
Mine-----	59.81	.058	7.27	---	---		
Cremer & Case-----	58.70	---	---	6.85	54.68		
<u>NEGAUNEE</u>		- 11/3/22 -					2,812 Tons.
Mine-----	58.85	.059	7.65	---	---		
Oscar Textor-----	58.25	---	---	5.53	55.03		

<u>PONTIAC</u>						
			-11/8/22-			6,129 Tons.
	<u>Fe.</u>	<u>Phos</u>	<u>Sil.</u>	<u>Mois.</u>	<u>Fe.Nat.</u>	
Mine-----	60.13	.063	5.27	----	----	
Crowell & Murray-----	58.25	---	----	5.47	55.06	

BESSEMER ORE

<u>ISHPEMING</u>						
			-6/16/22-			6,521 Tons.
Mine-----	60.31	.044	5.96	----	----	
Cremer & Case-----	59.20	.055	----	5.53	55.93	
Oscar Textor-----	59.42	.053	----	5.55	56.12	

<u>PONTIAC</u>						
			-7/13/22-			1,389 Tons.
Mine-----	60.35	.045	5.91	----	----	
Oscar Textor-----	58.65	.048	----	9.64	53.00	
Hughes-Guentzler-----	59.00	.047	----	8.92	53.74	

<u>ISHPEMING</u>						
			-7/31/22-			3,753 Tons.
Mine-----	59.79	.045	5.74	----	----	
Oscar Textor-----	59.50	.049	----	10.43	53.29	

<u>ISHPEMING</u>						
			-8/10/22-			867 Tons.
Mine-----	59.77	.045	4.73	----	----	
Oscar Textor-----	58.43	.051	----	10.97	52.02	
Hughes-Guentzler-----	58.75	.049	----	11.12	52.22	

<u>MICHIGAN</u>						
			-8/15/22-			5,881 Tons.
Mine-----	59.47	.044	6.61	----	----	
Cremer & Case-----	58.90	.046	----	11.73	51.99	
Crowell & Murray-----	59.20	.044	----	12.06	52.06	

<u>PANAY</u>						
			-9/16/22-			1,784 Tons.
Mine-----	59.53	.044	5.05	----	----	
Cremer & Case-----	59.80	.048	----	9.75	53.97	

<u>MICHIGAN</u>						
			-10/17/22-			769 Tons.
Mine-----	59.40	.044	4.90	----	----	
Oscar Textor-----	59.45	.050	----	9.16	54.00	
Hughes-Guentzler-----	59.32	.049	----	9.53	53.67	

The Bessemer Ores were shipped as Hill Bessemer and delivered in seven cargoes, the total tonnage and analysis of which follows:

	<u>Tons</u>	<u>Fe.</u>	<u>Mois.</u>	<u>Phos</u>	<u>Sil.</u>	<u>Fe.Nat.</u>
Mine Analysis-----	20,964	59.86	----	.044	5.93	----
Lower Lake Analysis-----	20,964	59.20	9.01	.049	----	53.87

The Non-Bessemer ores were all shipped as McCook grade, with the exception of 3,340 tons, which was forwarded as Crosby Non-Bessemer. The McCook grade was delivered to Lower Lake ports in 49 cargoes, the total tonnage and analysis of which follows:

	<u>Tons</u>	<u>Fe.</u>	<u>Phos</u>	<u>Sil.</u>	<u>Mois.</u>	<u>Fe.Nat.</u>
Mine Analysis-----	325,710	60.48	.062	5.64	----	----
Lower Lake Analysis-----	325,710	59.87	----	----	6.56	55.95

HILL-TRUMBULL MINE.

HILL-TRUMBULL MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1922.

GRADE	IRON	PHOS.	SILICA
Hill Bessemer Concts.,	58.97	.044	9.37
Hill Non-Bessemer Concts.,	61.17	.061	5.34
Hill Direct,	56.82	.066	14.38
Trumbull Bessemer Concts.,	59.84	.045	5.78
Trumbull Non-Bessemer Concts.,	59.78	.064	5.59

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1922.

GRADE	Mine			Lake Erie		
	IRON	PHOS.	SILICA	IRON	PHOS.	MOIST.
Hill Bessemer Concts.,	59.21	.045	7.57	58.80	.046	9.03
Hill Non-Bessemer Concts.,	(All Mixed)					
Hill Direct,	(All Mixed)					
Trumbull Bessemer Concts.,	(All Mixed)					
Trumbull Non-Bessemer Concts.,	(All Mixed)					

HILL-TRUMBULL MINE

ORE STATEMENT - DECEMBER 31ST, 1922.

	HILL CRUDE	HILL BESS. CONCTS.	HILL NON-BESS. CONCTS.	HILL BESS. DIRECT	HILL NON-BESS. DIRECT	TRUMBULL CRUDE	TRUMBULL BESSEMER CONCTS.	TRUMBULL NON-BESS. CONCTS.	TOTAL	TOTAL LAST YEAR
On hand Jan. 1, 1922,	-	-	-	-	-	-	-	-	-	-
Output for Year,	270,744	4,136	175,147	-	3,084	259,114	16,828	150,820	350,015	299,899
Total,	270,744	4,136	175,147	-	3,084	259,114	16,828	150,820	350,015	299,899
Shipments,	270,744	4,136	175,147	-	3,084	259,114	16,828	150,820	350,015	299,899
Balance on Hand,	-	-	-	-	-	-	-	-	-	-
Percentage of Recovery,	66.2%					64.7%				
Output Last Year,	437,871	85,877	192,077	4,130	17,815	-	-	-	299,899	
Increase in Output,									50,116	

1922 -- Began producing May 10th; ceased Oct. 31st, 1922.

1921 -- No production, Jan. 1st to May 12th, 1921.
 1-10 Hour Shift, May 12th to July 11th, 1921.
 1-12 Hour Shift, July 11th to July 20th, 1921.
 1-14 Hour Shift, July 20th to Aug. 1st, 1921.
 1-12 Hour Shift, Aug. 1st to Aug. 7th, 1921.
 2-10 Hour Shifts, Aug. 7th to Sept. 24th, 1921.
 Mine closed Sept. 24th, 1921.

HILL-TRUMBULL MINE

COMPARATIVE MINING COSTS FOR YEAR

	1922	1921	INCREASE	DECREASE
PRODUCT				
Direct Shipping	3,084	21,945		18,861
Concentrates	346,931	277,954	68,977	
Total Production	350,015	299,899	50,977	
<u>DIRECT SHIPPING ORE</u>				
Labor	.184	.134	.050	
Supplies	.236	.115	.121	
Total	.420	.249	.171	
<u>CRUDE ORE - CONCENTRATED BASIS</u>				
Labor	.098	.201		.203
Supplies	.074	.128		.054
Total	.172	.329		.257
<u>MISCELLANEOUS GROUP</u>				
Superintendence	.006	.005	.001	
Concentrating	.143	.205		.062
Stripping	.560	.560		
Insurance	.001	.001		
District Office	.012	.003	.009	
Central Office	.018	.014	.004	
Special Expense	.002	.001	.001	
Taxes	.337	.487		.150
Winter Expense	.146	.295		.149
Cost Adjustment	.003	.020		.017
Depreciation	.200	.200		
Total Cost on Cars	1.603	2.114		.511
Misc. Debits & Credits	.010	.004		.006
Grand Total Cost	1.593	2.110		.517
DIRECT SHIPPING				
No. Shifts & Hours	1-10-7	2-10-26		
Avg. Daily Product	440	844		404
<u>CRUDE ORE - CONCENTRATED BASIS</u>				
No. Shifts & Hours	1-10-147	1-10-60 2-10-48		
Avg. Daily Product	2.360	2,573		213

HILL-TRUMBULL MINE

COMPARATIVE WAGES AND PRODUCT

	1 9 2 2	1 9 2 1	INCREASE	DECREASE
PRODUCT	350,015	299,899	149,884	
No.Shifts & Hours	1-10hr	1-10; 2-10		
AVG.NO.MEN WORKING	79	148		69
AVG.WAGES PER DAY	4.40	4.61		.21
PRODUCT PER MAN PER DAY	27.40	15.37	12.03	
LABOR COST PER TON	.161	.300		.139
TOTAL NO.OF DAYS	12778-3/4	19510-1/2		6731-3/4
AMOUNT PAID FOR LABOR	56281.01	89937.37		33656.56

In 1921 Production from May 12th to Sep.24th.

In 1922 " " May 10th to Oct.30th.

HILL-TRUMBULL MINE

STATEMENT OF EXPLOSIVES FUSED FOR BREAKING ORE.

KIND.	QUANTITY	AVERAGE PRICE	AMOUNT 1922	AMOUNT 1921
60% Powder	605	.1467	88.79	320.05
40% "	5,100	.1471	750.28	2,987.55
30% "				203.12
20% "	1,500	.125	187.50	
17% "	2,900	.123	356.70	
Black "	9,525	.1056	1,006.50	2,499.00
Hercules Special #1	4,500	.1475	663.75	
Total Powder	24,130	.1265	3,053.52	6,009.72
Cap Crimpers	2	.545	1.09	3.22
Fuse	300'	.760	2.28	7.83
#6 Blasting Caps	300	1.460	4.38	22.60
Electric Exploders	3,114	.0797	248.40	248.52
Connecting Wire	13#	.4261	5.54	10.98
#1 Blasting Machine				45.00
Total Fuse, Etc.			261.69	338.15
Total Explosives			3,315.21	6,347.87
	1922 CRUDE & DIRECT	1922 CONCTS. & DIRECT	1921 CRUDE & DIRECT	1921 CONCTS. & DIRECT
Product	532,942	350,015	459,816	299,899
Lbs. Powder Per Ton of Ore	.0452	.0689	.1116	.1711
Cost Per Ton for Powder	.0057	.0087	.0131	.0200
" " Fuse, Etc.	.0004	.0007	.0007	.0011
" " All Explosives	.0062	.0094	.0138	.0211
Avg. Cost per Lb. for Powder	.1265	.1265	.1171	.1171

COMMENCED OPERATING May 10, 1922, and suspended operations Oct. 30, 1922.

BOEING MINE

ANNUAL REPORT FOR 1922.

Mining activities at the Boeing property during 1922 consisted in shipments from the shaft stockpile and open pit and in stockpiling from underground and open pit operations. Underground work was conducted only during the last two months of the year.

The following table shows the tonnage and analysis of the product shipped and stocked during 1922:

	<u>Tons</u>	<u>Fe.</u>	<u>Phos.</u>	<u>Mn.</u>	<u>Sil.</u>	<u>Al.</u>	<u>Mois.</u>
Open Pit Shipments-----	224,133	56.57	.081	.60	9.57	4.17	14.48
Stockpile Shipments-----	23,934	58.39	.076	.98	7.42	3.17	13.68
" Lean Ore Shipments-----	2,407	52.64	.077	1.29	13.52	2.78	14.55
TOTAL AND AVERAGES-----	250,474	56.70	.080	.64	9.40	4.06	14.40
Underground Ore Stocked-----	8,754	57.41	.084	.91	9.10	3.35	---
Open Pit Lean Ore Stocked-----	33,417	50.84	.101	--	17.74	5.91	10.45
TOTAL AND AVERAGES-----	42,171	52.20	.097	--	15.94	5.38	---

The grade of ore shipped from stockpile was up to our guarantee, but the open pit product was lower. The conditions in the pit made it extremely difficult to maintain a uniform grade of ore during the past season. We feel that the situation in the pit will be somewhat more favorable next year and that our expectations as to analysis will be realized. In the case of the underground ore, we are able to take some of the cretaceous material to good advantage. While the dry analysis is at present running somewhat below expectations (58.46 iron), the moisture is somewhat lower than the average of the underground ore and the natural iron is up to our guarantee of 49.69%.

The anticipated tonnage and analysis of our open pit and underground ores for shipment during 1923 follow:

	<u>Tons</u>	<u>Fe.</u>	<u>Phos</u>	<u>Sil.</u>	<u>Mn.</u>	<u>Alum.</u>	<u>Fe.Nat.</u>
First Class Open Pit Ore----	280,000	58.12	.084	7.81	.85	2.27	49.40
Second " " " "-----	30,000	55.03	.053	13.50	.83	1.57	46.78
Sandy Lean " " " "-----	90,000	49.40	.119	19.14	.17	6.26	44.71
Underground Ore-----	100,000	58.46	.093	6.64	.90	--	49.69
TOTAL AND AVERAGES-----	500,000	56.43	.090	9.96	.64	--	48.46

We will be obliged to ship some cretaceous ore from the pit next season, or go to the expense of stockpiling it, and it will be economical to take approximately 30,000 tons of second class ore. We found this advisable in working up details for next year's operations. As a result, the analysis of our 1923 shipments is estimated somewhat lower than a year ago. We have been conservative in making this estimate and we feel that the grade of ore should be at least as good as represented and we are in hopes of improving it somewhat.

We should secure about 10,000 tons per month from the underground workings, when development work has been completed on the top sub and the entire force is engaged in slicing and caving operations. At the present time considerable extra work is required to prevent sand runs and in transferring ore at the west end of the 1380' sub-level. The average tram at the west end of the mine is quite long and mining conditions are not favorable for good tonnage or costs in the proximity of the shore line. The general mining situation will improve considerably as the west end of the 1380' sub is drawn back. The product and costs on the 1370' sub should be much better than on the 1380'.

Stripping operations have progressed to a point where we will be able to begin loading ore in the pit to good advantage upon the opening of navigation. Provided the boat and car situations are favorable, we should secure a satisfactory open pit tonnage from the start. The addition of 1,500 75-ton cars to the Great Northern equipment and the providing of a cut off track from the main line to Nashwauk should result in a decided improvement in the Great Northern service next season. While the cut off does not directly affect the Hibbing District, it will eliminate a good deal of congestion at Kelley Lake and secure much better despatch for the west end of the Range, thus benefitting all operations. The fact that the Great Northern No. 2 dock has been rebuilt and will be in service will also be an important factor in improved service.

BOEING MINE ORE ESTIMATE OF JANUARY 1ST. 1923

The estimates of ore in sight at the Boeing Mine on January 1st., 1922 and September 2nd, 1922, the tonnage mined during the year and the estimate of January 1st., 1923, are shown below. A deduction of 10% was made for rock for the entire deposit and an additional deduction of 10% for mining loss in the case of the underground ore. A factor of 14 cubic feet per ton was used in these estimates.

ESTIMATE OF JANUARY 1ST. 1922

<u>OPEN PIT MERCHANTABLE</u>	<u>OPEN PIT LEAN SANDY</u>	<u>MILLING</u>	<u>UNDERGROUND</u>	<u>TOTAL</u>
1,638,000	---	521,000	637,000	2,796,000

ESTIMATE OF SEPTEMBER 1ST. 1922

1,536,000	285,000	521,500	637,350	2,979,850
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MINED DURING 1922

197,990	59,560	---	8,754	266,304
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ESTIMATE OF JANUARY 1ST. 1923

1,338,000	225,500	521,500	628,500	2,713,500
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Our open pit operations during 1922 showed a layer of cretaceous or sandy ore over the deposit. The drilling of the Boeing Mine failed to show the existence of this cretaceous material. While we estimated 285,000 tons of cretaceous ore on September 2nd and this was an increase in the total ore, it was necessary to reduce the estimate of open pit merchantable ore by 102,000 tons. In some cases there was a concentration in the drill records, and the bottom several feet of the cretaceous deposit showed up as merchantable grade. This is not surprising when you consider the extremely fine character of this sandy ore. Extreme care would have to be used in settling the sludge and ordinary Mesaba practice would not be sufficient. The net increase in our open pit steam shovel ore was 183,000 tons.

We knew that there was an ore channel at the west end of the pit, but it proved to be much deeper than anticipated. The increase in the amount of

ore here was offset, however, by a fold in the taconite between the two ore channels. This taconite was found to extend higher than our sections showed and in consequence the tonnage of ore between the channels was reduced.

Further development work at the west end of the 1380' sub shows the shore line to be located somewhat farther west than anticipated a year ago. The tonnage involved in this extension, however, is small.

The following table shows the analysis of the ore estimated as in sight on January 1st., 1923:

	<u>Tons</u>	<u>Fe.</u>	<u>Phos</u>	<u>Sil.</u>	<u>Mn.</u>	<u>Al.</u>	<u>Fe.Nat.</u>
Open Pit Merchantable-----	1,338,000	57.19	.085	8.28	.98	-	48.61
Open Pit Sandy-----	225,500	49.40	.119	19.14	.17	6.26	44.71
Milling Ore-----	521,500	58.85	.080	7.12	1.24	--	50.02
Underground Ore-----	<u>628,500</u>	<u>58.46</u>	<u>.093</u>	<u>6.64</u>	<u>.90</u>	<u>--</u>	<u>49.69</u>
TOTAL AND AVERAGES-----	2,713,500	57.15	.089	8.58	.94	--	48.81

We feel that the ore in the Boeing Mine has now been pretty well outlined and we do not consider that further exploratory work will increase the tonnage as estimated. We are doing some test pitting in the open pit and this work will be continued as the clean-up work of the contractor progresses. The test pitting is for the purpose of determining the grade, rather than with the idea of developing any additional ore.

2,685,000

1,685,000

GENERAL SURFACE

Due to the fact that the mine was not in operation, only such surface work was undertaken as was necessary for general maintenance. The grass plats about the mine buildings were cut and some willow slips were set out as borders.

The mine premises were policed and special attention was given to the timber yards to prevent fires. Sparks from the contractor's equipment started several fires in the muskeg area surrounding the pit and we were apprehensive during the dry spell in the summer that a wind might spring up and endanger our timber yard.

The team of Boeing mules, which had been kept at the Hill-Trumbull Mine since the Boeing closed, were returned to the Boeing.

The Great Northern Railway Company graded the Boeing Mine shipping yards and laid two tracks. These yards are located to the east of the mine and adjoin the Susquehanna yards of the Great Northern. Four tracks are to be provided, the remaining two to be laid next spring. We were able to operate during 1922, as the Susquehanna yards were not being used by that company. Although the haul to the Susquehanna yards is slightly longer, we experienced no appreciable delays on this account. The Boeing Mine yards when completed will accommodate 200 cars.

One of our sub-station transformers was burned out on August 23rd and was replaced by a spare that we were carrying. The spare transformer burned out September 5th and we were obliged to borrow one from the Great Northern Power Company. As our load during the summer was rather light, we were operating on two transformers, instead of the regular battery of three, and apparently there was too much overload. We received two new General Electric transformers in September and since that time we have had three transformers in use at all times.

As it was necessary to abandon the old road leading around the north end of the Boeing pit, we were obliged to do some work on the old road connecting the mine with the Brooklyn location. This road passed just to the
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east of our present stocking ground and as we figured that it might be necessary to extend such ground to the eastward, we graded about 700' of new road, skirting such proposed stockpile extension. The teamster did practically all of this work during the latter part of the summer.

The heating system was gone over very carefully in September and all leaks were repaired. The fire arch under the boilers was rebuilt, as the State Inspector had condemned the old one. The air compressor was gone over very carefully and new valves installed where necessary.

Upon the resumption of underground mining activities in October, 17 bents of the ore trestle were raised. This trestle has a capacity of approximately 100,000 tons, which should be more than ample for our product until the opening of navigation. The trestle was carried further eastward than the grounds have been graded, so that we could dump any waste rock encountered and spread same as a floor for additional stocking space. We took down 13 bents of the old rock trestle, as this was of no further service and we did not wish to purchase any more material than was necessary for the new trestle. The Fee Owners objected to our dumping any more rock from this trestle, due to its proximity to the open pit and their fear that it would slide down with the stripping face and become mixed with the surface material.

We did the necessary repairing to the open pit guard fence and the sidewalk along the Brooklyn Road.

The accumulation of silt and debris was cleared from the surface drainage ditches to prevent any blockages that might form dams.

STOCKING

The old ore trestle was taken down during July, water supply pipes were laid and preparations made for loading out the pile. The Bucyrus steam shovel was transferred to the Boeing from the Meadow Mine and Locomotive No. 19 from the Hill-Trumbull. The Great Northern were unable to supply a locomotive, so arrangements were made to use one of our engines and they paid us rental for same on the standard basis.

The Great Northern Railway Company laid a switch from the shaft track and extended a line for stockpile loading.

Stockpile loading was started July 28th and completed August 16th. Operations were interrupted on account of car service to some extent, and progress was slow, as the interior and bottom of the pile contained considerable frost.

At the completion of stockpile loading, the locomotive was returned to the Hill-Trumbull Mine and the steam shovel was moved to the side of the stocking ground and laid up.

The following table shows the tonnage of ore in stock when loading began and the amount shipped, also the analysis in each case:

	<u>Tons</u>	<u>Fe.</u>	<u>Phos</u>	<u>Mn.</u>	<u>Sil.</u>	<u>Alum.</u>
Merch. Ore in Stock July 28, 1922----	21,927	58.91	.076	1.03	7.34	2.93
Lean " " " " 28, 1922----	7,551	52.76	.083	1.09	12.82	2.50
Merch. Ore Shipped in 1922-----	23,934	58.39	.076	.98	7.42	3.17
Lean " " " 1922-----	2,407	52.64	.077	1.29	13.52	2.78

We had intended to take more of the lean ore, but as we cleaned up the pile before pit shipments were started, we had to do all the grading of lean ore with stockpile material. The lean ore pile was at the west end of the stocking ground and we were only able to work in such a quantity in each cut as could be handled. We might have been able to mix in more of the lean ore if we had had two shovels. Pit shipments will be going forward during 1923 while we are loading out the stockpile and shipping from the shaft. We should be able to clean up all of this lean ore without any trouble during the coming year.

We realized an overrun of 2,007 tons on our merchantable stockpile. This was very gratifying, as the pile was put on filled ground and there was an appreciable settlement. We did not dig down for the ore that had settled below the floor of the stocking ground, figuring that it was better to make our cuts level and recover this material at the end of the mine's operations.

The analysis of the ore as loaded out checked very closely with that obtained in making the pile.

Prior to resuming underground activities in November, the new stocking trestle was raised, as explained under "General Surface". When the easterly extension of the stocking ground has been filled with rock and low grade ore and made suitable for ore dumping, the grounds will have a capacity of about one

year's underground output.

The following table shows the ore stocked during November and December of 1922, together with the analysis. The lean ore left in stock is also shown.

	<u>Tons.</u>	<u>Fe.</u>	<u>Phos</u>	<u>Mn.</u>	<u>Sil.</u>	<u>Alum.</u>
Merch. Ore in Stock Jan. 1st., 1923--	8,754	57.41	.084	.91	9.10	3.35
Lean " " " " 1st., 1923--	5,144	52.76	.082	1.09	12.82	2.50

While the iron in the ore stocked during November and December is somewhat below our expectations, we figure that the average moisture will be below 15% and that the iron natural will be up to our anticipated figure. We are taking a small amount of the cretaceous material in the vicinity of the Susquehanna line. This particular ore runs around 55% iron and the moisture is below 10%. There is no water seeping through this material and we are able to mine it economically, due to the fact that the height of our sets in this particular locality would be reduced to about 7' in case we were only mining up to the cretaceous ore.

An area was grubbed and graded for a lean ore stockpile to the south of the open pit during the summer. The Winston-Dear Company erected a 700' trestle leading off from their old coal dock and stocked 33,417 tons of cretaceous, or blue sandy ore, on this ground. This ore was all placed on Boeing Mine property and the Fee Owners were entirely satisfied with the arrangement. We agreed to ship, or pay royalty on this tonnage before the expiration of our lease.

The stocking ground that we prepared here will accommodate approximately 80,000 tons of this material. It may be necessary to place some further tonnage here, although we anticipate mixing it in with the merchantable grade as it is encountered in the pit in future. The 33,417 tons will be loaded out from time to time, as it can be mixed in to advantage.

UNDERGROUND OPERATIONS

We received word in October to resume underground operations and we started on the 19th to put the equipment in condition for service and to do the necessary cleaning underground.

While the mine was idle, the force at the property consisted of seven men, the superintendent, captain, three pumpmen, clerk and night watchman. The superintendent and clerk devoted a large part of their time in checking over the contractor's operations, so that in reality five men were engaged in Boeing Mine work proper.

Upon several occasions, we hired extra men to assist in cleaning the sump and main level ditches of material washed down with the water from the open pit. We did a very thorough cleaning job of the main level ditches and sump during July. In connection with this work a chute was constructed from the skip dump and the silty material was dumped back into the pit. We had no place to dump this material on surface without going to considerable expense and as the contractor had not cleaned the ore where we dumped the sand, this was the cheapest way to handle it. While the cleaning operations were going forward, all of the pit water was handled with our surface pumps.

To safeguard our pumping, we felt that it was advisable to secure sufficient equipment to handle the water in the pit. The Boeing Mine rented, and later purchased, two centrifugal pumps, one from the Crosby Mine, capable of handling 1,000 gallons per minute against 125' head, and the other with a capacity of 700 gallons per minute, from the Lake Mine. The Crosby pump was installed in the pit and the Lake pump underground. The Winston-Dear Company had their electric pumps in the pit, which combined with the Crosby pump, were capable of taking care of the pit flow.

The underground rotary dump was thoroughly overhauled and a number of alterations were made. When the dump was put in service, we found that it was necessary to alter the trip mechanism and also to add some weight to one side in order to properly balance it. We did considerable work on the dump

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and experienced numerous delays before it worked in a satisfactory manner. The dump is now working smoothly, although we feel that it is of too light a construction for the weight of cars and loads handled.

The work of cleaning the main level started early in November and by the 15th we had reached a point where No. 7 crosscut could be started. This crosscut is to tap the ore in the deep channel at the extreme west end of the open pit. This will be a scrambling operation and the ore should be removed prior to the spring thaw. As soon as No. 7 crosscut had advanced sufficient to clear the switch, cleaning operations were resumed and contracts were added from time to time, as dumping raises were made available. By the end of November we had 15 contracts working double shift.

The entire 1370' sub and practically all of the 1380' sub-level was found to be in good condition and comparatively little preliminary work was necessary to resume operations in the several mining places. On the 1380' sub, it was necessary to clean sand and caved material from approximately 100' of drift to the east of No. 122 raise. This particular drift was very wet when we shut down underground operations in the spring of 1921 and the weight was sufficient to crush the timbers. The open pit has now drained this territory and the workings are practically dry.

"MAIN LEVEL"

Contract No. 2 cut out in the rock at a point midway between Nos. 124 and 125 raises and drove No. 7 crosscut to the south for 143'. The first 80' of this crosscut was driven on a 50' radius curve, 20' being in taconite and the balance in ore. The crosscut had 40' to go on January 1st. When this is accomplished, raises will be put up at frequent intervals and scrambling operations inaugurated at the edge of the pit.

We expect to mine approximately 4,000 tons of ore along the edge of the pit. When this ore is removed, a drift will be extended to the southwest from the crosscut and raises will be put up therefrom to draw off the underground ore between the open pit limits and No. 5 rock crosscut to the west.

"1380 FOOT SUB-LEVEL"

Contract No. 17 cleaned out the sand runs and caves to the east of No. 122 raise. This gang was obliged to forepole and retimber approximately 100' of drift before mining operations could be started. No. 17 is now engaged in slicing back from the Susquehanna boundary to the north of No. 120 raise, where they dump their product.

Contracts Nos. 7, 8, 10, 11, 12 and 14 have been employed in slicing and drawing back from the Susquehanna boundary. The gangs are dumping into Nos. 121, 122, 123, 124, 126 and 128 raises.

The ore mined by these contracts has been absolutely dry and the tonnage realized has been comparatively satisfactory. All of these gangs are working under the sand and while we have had no runs, it has been necessary to use extreme care in advancing the slices. We have taken from 2' to 4' of cretaceous material here, as this allowed us to use from 8' to 10' legs and we secured a larger tonnage than would have been the case if we had mined simply to the cretaceous material. The sandy ore in this locality runs about 55% iron and the moisture is under 10%. The Fee Owner's Agent made quite a point of our taking this ore, if it could be done safely. They were entirely reasonable and stated that if it added to our expense, or was dangerous, that they would not require us to mine it. They were willing to leave the question of safety to Captain Prudon.

Contract No. 3 extended the crosscut to the west of No. 138 raise for 37', where a face of solid taconite was encountered. The gang was then transferred to the north workings and spent the remainder of the year in slicing along the Susquehanna line and scrambling ore from the old Susquehanna workings. This gang transfers their ore to the 1370' sub, dumping to the main level through No. 130 raise.

Contract No. 16 has been engaged in slicing along the Susquehanna line and scrambling such Susquehanna ore as they could secure to advantage.

The Fee Interests wished us to take such ore as had been left by the Susquehanna people and Mr. Agnew of the Susquehanna Company gave his permission. Mr. Agnew is to write the Great Northern interests a letter, giving them

permission to take any ore on their land that we may desire during the course of our mining.

A horse of rock cut off the ore on the Susquehanna side and they did not realize that there was another body to the west. This particular ore is high grade and we will continue mining such of it as we can gain advantageously. We have told the Fee Owners that we would not mine any ore on the Susquehanna ground where it was not profitable to us.

Contracts Nos. 4, 5 and 9 have been employed in extending crosscuts west from Nos. 131, 135 and 136 raises. We are endeavoring to determine the westerly extension of the ore body and these crosscuts will be pushed ahead until taconite is encountered, or the thickness of the deposit has decreased to 5'.

On account of the fact that the rock rises quite abruptly, it has been necessary to put in wheelbarrow trams and provide chutes for dumping and loading into sub-level cars. In the case of Contracts Nos. 4 and 9, the wheelbarrow tram has now become excessively long, and the cost is very high. We had no idea that the ore extended so far, but now that we find it does, we will have to make arrangements to lay tracks on a workable grade and use sub-level cars.

The tonnage realized from the contracts operating at the west end of the mine has been very low and the cost exceedingly high. As soon as all the crosscuts have reached mining limits, the gangs will be brought back and slicing started at points where we consider it safe to cave without endangering the location houses. We have taken up the question of leaving some ore at the west end of this sub to protect our location, with Mr. Concklin of the Great Northern Company.

Contracts Nos. 1 and 15 have outlined the deposit at the southwest extremity of the sub and have started slicing operations along the shore line. Most of the work accomplished by these gangs has been in the nature of drifting and the tonnage secured has been comparatively low. Their work in the proximity of the shore line will not be conducive of very satisfactory results. As the

slices are drawn back, however, mining conditions will improve. The ground in the proximity of the shore line is very hard and there is considerable seepage from the back.

We will take no cretaceous material from any of the workings at the westerly or southerly parts of the 1380' sub.

Contract No. 13 extended a drift to the southeast from No. 139 raise workings to the southerly mining limits. There is about 9' of ore in No. 13's breast, but it would not be advisable to extend this drift any further. It will be cheaper to mine any ore to the south as tram to pit. No. 13 is now engaged in slicing back toward No. 139 raise.

OPEN PIT ORE OPERATIONS

Stripping operations had uncovered sufficient ore in the northwest corner of the pit by the forepart of August to allow the mining of approximately 250,000 tons of ore. Arrangements had been made with the Winston-Dear Company to load out our 1922 requirements with their Model "300" shovel.

In order to drain the west end of the open pit, a drift was extended to the pit from our 1370' sub to the south of 125 raise, and raises were put up from Nos. 1 and 3 crosscuts. These pit connections took care of the water to good advantage and the contractor was not delayed with water while taking the ore cuts.

The contractor started cleaning ore the first of June and much to our surprise, we found a seam of cretaceous material overlying the main deposit. This cretaceous ore was a lean sandy looking material, but sampling showed that it ran around 45% natural iron and the Fee Owners insisted that it should be mined and mixed with our merchantable grade. We put down a number of test pits, which showed that the cretaceous ore had an average thickness of 12'.

We made a sieve test on the cretaceous ore, which resulted as follows:

		$\frac{1}{2}$	Fe.	Sil.	
Held On	4	20.7	47.82	21.14	
" "	8	8.9	50.25	18.72	
" "	20	7.4	51.87	15.45	
" "	40	3.9	47.34	21.57	
" "	60	7.9	43.29	28.09	
" "	80	8.9	47.98	20.67	
" "	100	10.0	54.95	11.56	
Passed	100	<u>32.3</u>	<u>49.14</u>	<u>20.63</u>	
TOTAL SIEVES,		100.0	49.07	19.81	10.2 Mois.

We were able to mine and mix 26,143 tons of sandy ore in our shipments and stocked 33,417 tons. We have agreed with the Fee Interests to ship or pay royalty on the sandy ore stocked, before the termination of our lease.

The Model "300" shovel was engaged from August 1st. to the 19th in loading sandy ore into stripping cars. This delayed our ore operations by several weeks. The Model "300" shovel started digging down into the merchantable ore the latter part of August and it was not until the first week in September that we were down to a sufficient depth for a full cut. The first cut was pushed westward, the end of the pit being reached the last of September.

We found that the fold in the taconite decreased our mining depth between the ore channels and that the west channel was much deeper than we had anticipated. The result of this was that the progress with our shovel was slowed up to a considerable extent. We had to block up and move over the taconite and then sink in following the ore to the westward. We followed the west channel down as far as possible with the shovel and the balance of the ore will have to be scrapped from underground operations.

While the shovel was progressing westward, a number of test pits were put down to determine the character and grade of the ore in the bottom of the cut. This was done, as it was necessary to mine down to the rock in all instances along the north stripping face. No ore berm was provided here, as we wished to mine the maximum tonnage open pit and allow the stripping bank to sluff down into the pit. In moving back to the east, the "300" shovel took all of the ore down to the rock in this area.

During the latter part of the ore season the "300" shovel extended the cut onto the east, or deep ore channel. Of course, it is not necessary to follow the rock here, as there is a protecting berm of ore and no underground operations are in the proximity. Late in October, the "300" shovel started climbing out of the cut, so as to be on top of the ore when the season's requirements were obtained. Unfortunately the grade of ore ran off very decidedly when the shovel was digging out and the last few cargoes were considerably below the average for the season.

It is the intention to test pit the ore quite thoroughly before the opening of navigation in 1923, so that we can determine on the best program of mining, to insure economical operating results, as well as to maintain a uniform grade.

The following table shows the open pit ore shipments by months and the analysis:

	<u>Tons</u>	<u>Fe.</u>	<u>Phos</u>	<u>Sil.</u>	<u>Mn.</u>	<u>Al.</u>	<u>Moist.</u>
August-----	32,440	56.94	.078	8.88	.40	4.53	15.49
September-----	122,524	56.87	.083	9.49	.57	4.12	14.25
October-----	62,758	56.11	.078	9.83	.72	4.06	14.20
November-----	<u>6,411</u>	<u>54.00</u>	<u>.083</u>	<u>12.05</u>	<u>.77</u>	<u>4.52</u>	<u>16.55</u>
TOTAL & AVERAGES	224,133	56.57	.081	9.57	.60	4.17	14.48

When the 300 shovel was digging out, we encountered some very low grade material, running below 40% in iron. We considered this waste material and wanted to dump it with the stripping. The Fee Owners, however, asked us to keep this separate and consequently we took it to the dump ground and made a separate pile. The Arthur Iron Mining Company will deed a small tract of land to the Fee Owners and all of this very low grade material, which we consider waste, will be placed here and the Fee Owners will be satisfactorily protected.

No doubt some of this very low grade material was mixed in our shipments at the end of the season and explains the very low iron content in the last few thousand tons forwarded.

The Great Northern car service was better at the Boeing Mine than at some of the other properties, due to the fact that the Arthur Iron Mining Co. officials interceded in our behalf. There were frequent short delays, however. It was necessary for us to shut down our operations for practically one week, due to a congestion at the Great Northern docks on account of the tie up of our boats.

We have decided to handle the open pit ore ourselves in 1923. We have ordered a Model "300" Marion shovel, three 19 x 26 American locomotives, duplicating those at the Hill-Trumbull, and the necessary track and other material for the work. We are purchasing the twelve 12-yd. dump cars from the

Hill-Trumbull Mine to handle any surface clean-up or lean material in the pit.

We will use some of the Winston-Dear tracks as well as their coal dock and water tank, until the stripping contract is completed. We have already made arrangements with the contractor to purchase the water tank, pipe lines and certain of the track when they finish their work.

STRIPPING

The Winston-Dear Company started stripping operations for 1922 on March 27th. The Company had at least part of their equipment in continuous service until the job was closed down on December 20th. A total of 1,028,412 cubic yards were moved during 1922 at a cost of \$.452 per yard.

The following table shows the yardage handled each month, the monthly stripping bills and the cost per yard. The total yardage and average cost is also shown.

	WINSTON-DEAR		---COST PER YARD---	
	BILLS	CUBIC YARDS	FOR MONTH	FOR YEAR
Previous to Jan. 1st. 1922--	\$1,582,895.51	3,734,935	--	\$.424
January-----	4,984.52	0	--	.425
February-----	9,117.43	0	--	.427
March-----	28,784.05	15,120	\$1.904	.433
April-----	41,127.68	76,763	.536	.435
May-----	62,461.37	159,140	.392	.434
June-----	67,061.30	225,857	.297	.426
July-----	47,663.53	144,061	.331	.423
August-----	36,111.84	65,403	.552	.425
September-----	28,536.22	88,103	.323	.423
October-----	43,484.23	104,030	.417	.423
November-----	45,303.70	92,776	.488	.424
December-----	50,539.03	57,159	.884	.430
TOTAL FOR 1922-----	\$ 465,164.90	1,028,412	.452	---
TOTAL TO JAN. 1ST. 1923-----	\$2,048,060.41	4,763,347	-	.430

The Model "300" shovel and three of the locomotives were engaged in ore loading from the forepart of August until November 10th, so that the stripping handled during this period was considerably reduced. If the equipment had not been used on ore service last summer, the stripping job would have been practically completed this year.

Our engineers have made a careful estimate of the remaining yardage to be stripped. Due to the excessive sluffing from the muskeg area at the east end of the pit, our original estimate of 4,984,500 yards will be increased by better than 300,000 yards.

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The original stripping estimate was based on cross sections through the drill holes. These sections were spaced 300' apart and they failed to show all of the inequalities and the average depth of stripping. Our present working sections are taken 100' apart and the estimates are, therefore, much more accurate. There was some increase in yardage on account of the original sections not showing accurately the average conditions throughout the pit. At the present time all of the stripping is completed at the north side of the pit and the remaining material is relatively easy to estimate. We should have no further sluffing of the banks.

The flow of water in the pit increased somewhat during the spring breakup and our pumps were taxed to capacity during the months of March and April. The contractor had three electric centrifugal pumps operating in the pit during this period, one of 150 gallon capacity, a second of 300 and a third of 600. These pumps were placed in different parts of the pit and were operated whenever it was necessary to relieve our underground equipment.

The normal flow of water is about 1100 gallons per minute, and with the exception of such times as a heavy rainfall, or during the spring thaws, our underground pumping equipment can handle it to advantage.

The contractor removed the 150 gallon pump from the pit during the spring. This was taken to the dump and supplied the water for muskeg washing operations. The 300 gallon pump was taken from the pit by the contractor and stored, but the 600 gallon pump is still in place in the pit and can be used whenever necessary.

We rented the 1,000 gallon centrifugal pump from the Crosby Mine during the summer. This was used at the west end of the pit in connection with our sinking cuts in ore. The pump also took care of the pit drainage while we were cleaning our sump and main level ditches of the accumulation of silt and sand. The Boeing Mine purchased this pump from the Crosby at the end of the year.

In order to drain the water from the west end of the pit to our underground workings, the Carlson Exploration Company drove two 4" casings to one of our underground main level crosscuts. These pipes have handled all
BOEING MINE.

the water encountered at this end of the pit to good advantage. They are located in a point of depression in the ore and the water from approximately two-thirds of the pit drains through them.

The Model "92" shovel started stripping March 27th and was engaged for three weeks in grading for pit tracks. During May and June this machine took several cuts the entire length of the pit in order to reduce the bank ahead of the Model "300" shovel. Our estimate showed that there was more stripping to be removed with the "300" shovel to uncover the season's ore requirements than this machine was capable of during the time allotted. The track situation was such that the Model "92" shovel could not be operated to any extent during June. The machine was operated continuously from the first of July until late in the fall. This shovel's operations were confined to cutting down for our permanent approach and benching down the bank from the approach into the pit proper.

The Model "300" shovel, which had been cut down to the ore in December, 1921, was buried to the deck with silt and sand that had washed down the bank during the spring breakup. The water conditions were so bad that it was impossible to start digging with this machine until early in May. We had planned to clean the top of the ore along the entire length of the north cut, but the ground was so wet and the slides of muskeg so frequent that practically no progress was made and we were obliged to bring the shovel up to a higher elevation.

The Model "300" shovel did not strike the ore until it was about opposite the shaft on the 15th of June. During the balance of the year this machine operated on top of the ore.

The stripping cut reached the west end of the pit early in July and the machine was then turned around for a second cut. This cut was completed by the end of July. These two cuts on ore uncovered all the tonnage necessary for our open pit requirements for 1922. The Model "300" machine started on ore operations August 1st.

As the "300" shovel could not clean the wet sliding material at the east end of their cut, the contractor brought over a Marion drag line from the
BOEING MINE.

Scranton job. This machine cleaned down to the ore along the east end of the cut, and dug drainage ditches for the handling of pit waters to the stand pipes. The drag line was only operated when one of the other shovels was idle, the crews being transferred back and forth. While ore loading was in progress, the night crew operated the drag line. While this machine has not handled any considerable yardage, it would have been exceptionally difficult to have dug the wet material with any other equipment. The drag line has now completed work in the pit and will be taken out in the spring.

The Model "300" shovel completed ore loading November 10th and was put back on stripping. A cut was taken along the south side of the ore excavation. The machine reached the west end of the pit early in December and was turned around and started back with the third cleaning cut when operations were suspended.

There was considerable water flowing in from the stripping bank and operations with the "300" machine were slowed down considerably as a result thereof. During the unusually cold weather in December, it was difficult to handle the wet material in the dump cars. Although the cars were washed with a salt brine frequently, the dirt would freeze to the bottoms.

The Winston-Dear Company will repair the equipment for next year's operations and will resume stripping as early in the spring as weather conditions permit.

The double track to the dump has required practically no repairs during the past year. These two lines were put in good shape in 1921. A guantlet system of tracks was installed across the bridges and this did away with four switches. No delays or accidents resulted.

The dump grounds have been in very good condition the past year. The wash dump at the northeast corner of the property was used all summer and the contractor was able to line out the tracks without any slides occurring.

During April and May a 20' trestle was extended 200' across the top of the dump in the vicinity of the sewer ditch. This fill will make the third lift of the dump and should have sufficient capacity to accommodate the

BOEING MINE.

yardage remaining in the pit.

The washing of the muskeg to the northwest of the dump caused the muskeg to heave some distance to the eastward and it was found necessary to change a section of our drainage ditch. A new ditch was dug to divert the surface water around the area affected. We obtained permission from the Rogers-Brown Iron Company to make this change. The ditch is now in solid ground and any further movement of the muskeg will not affect it.

An area on top of the dump near the highway bridge has been set aside for the dumping of taconite and very lean ore, which we consider waste. The Fee Owners will not let us dump this material so as to mix it with stripping. The Arthur Iron Mining Company are to deed this piece of land to the Fee Owners, so their rights to the material dumped will be protected.

SHIPMENTS

Following are the cargoes of Boeing ore shipped during the past season and the analysis of same as obtained at the mine and by the Lower Lake

Chemists:

<u>WM. G. MATHER</u>	- 8/4/22 -						6,697 Tons.
	<u>Fe.</u>	<u>Phos</u>	<u>Sil.</u>	<u>Alum.</u>	<u>Mois.</u>	<u>Fe.Nat.</u>	
Mine-----	58.71	.077	7.03	3.07	13.58	-----	
Cremer & Case-----	58.80	---	---	---	13.45	50.89	
<u>PONTIAC</u>	- 8/7/22 -						3,702 Tons.
Mine-----	57.85	.074	7.76	3.26	13.53	-----	
Cremer & Case-----	58.10	---	---	---	13.39	50.32	
<u>J. H. SHEADLE</u>	- 8/9/22 -						3,755 Tons.
Mine-----	57.54	.077	8.15	3.04	14.14	-----	
Oscar Textor-----	57.88	---	---	---	13.46	50.09	
<u>GRAND ISLAND</u>	- 8/14/22 -						7,127 Tons.
Mine-----	57.40	.074	8.43	3.15	14.25	-----	
Crowell & Murray-----	57.85	---	---	---	12.92	50.38	
<u>J. H. SHEADLE</u>	- 8/20/22 -						4,892 Tons.
Mine-----	57.55	.077	8.84	3.16	13.07	-----	
Oscar Textor-----	57.87	---	---	---	13.35	50.14	
<u>PIONEER</u>	- 8/22/22 -						1,363 Tons.
Mine-----	58.11	.079	7.84	4.41	13.60	-----	
Crowell & Murray-----	57.78	---	---	---	13.93	49.73	
<u>MICHIGAN</u>	- 8/25/22 -						3,836 Tons.
Mine-----	56.73	.076	9.34	5.37	15.20	-----	
Cremer & Case-----	56.20	---	---	---	16.13	47.14	
<u>PONTIAC</u>	- 8/27/22 -						752 Tons.
Mine-----	57.41	.077	7.26	4.94	16.30	-----	
Oscar Textor-----	58.25	---	---	---	11.98	51.27	
<u>ISHPEMING</u>	- 8/28/22 -						10,463 Tons.
Mine-----	55.49	.085	10.31	4.85	15.24	-----	
Hughes-Guentzler-----	55.80	---	---	---	15.17	47.34	
<u>J. S. DUNHAM</u>	- 8/29/22 -						2,678 Tons.
Mine-----	54.90	.087	11.25	4.85	15.17	-----	
Crowell & Murray-----	55.70	---	---	---	14.26	47.76	

BOEING MINE.

MARQUETTE - - - - - 8/31/22- - - - - 2,380 Tons.

	Fe.	Phos	Sil.	Alum.	Mois.	Fe. Nat.
Mine-----	58.33	.076	8.43	4.24	15.92	-----
Cremer & Case-----	58.60	---	---	---	16.06	49.19

CHRISTOPHER - - - - - 8/31/22- - - - - 1,814 Tons.

Mine-----	57.36	.076	8.17	4.34	16.83	-----
Hughes-Guentzler-----	56.10	---	---	---	14.62	47.90

GRAND ISLAND - - - - - 9/4/22- - - - - 8,747 Tons.

Mine-----	58.29	.072	7.46	3.86	15.40	-----
Oscar Textor-----	59.00	---	---	---	14.09	50.69

MICHIGAN - - - - - 9/4/22- - - - - 3,423 Tons.

Mine-----	59.01	.074	7.66	3.38	15.40	-----
Cremer & Case-----	59.50	---	---	---	14.82	50.68

PENOBSCOT - - - - - 9/6/22- - - - - 1,339 Tons.

Mine-----	59.18	.072	7.94	3.32	15.35	-----
Crowell & Murray-----	59.90	---	---	---	---	50.48

WM. G. MATHER - - - - - 9/9/22- - - - - 10,608 Tons.

Mine-----	59.41	.067	7.96	3.38	15.80	-----
Crowell & Murray-----	60.25	---	---	---	15.12	51.14

W. H. WOLF - - - - - 9/13/22- - - - - 9,657 Tons.

Mine-----	58.92	.070	8.59	3.30	16.00	-----
Hughes-Guentzler-----	58.75	---	---	---	14.53	50.21

SHAUGHNESSY - - - - - 9/15/22- - - - - 8,662 Tons.

Mine-----	57.86	.077	9.11	3.33	14.55	-----
Crowell & Murray-----	57.25	---	---	---	13.25	49.66

NEGAUNEE - - - - - 9/16/22- - - - - 6,373 Tons.

Mine-----	57.60	.077	9.26	3.29	14.07	-----
Hughes-Guentzler-----	57.33	---	---	---	12.60	50.11

MICHIGAN - - - - - 9/16/22- - - - - 10,507 Tons.

Mine-----	57.74	.078	8.60	3.58	13.73	-----
Oscar Textor-----	56.35	---	---	---	12.47	49.32

A.E.R. SCHNEIDER - - - - - 9/20/22- - - - - 8,658 Tons.

Mine-----	57.25	.085	8.63	3.94	14.28	-----
Cremer & Case-----	56.70	---	---	---	13.04	49.31

PIONEER - - - - - 9/21/22- - - - - 9,673 Tons.

Mine-----	57.12	.086	8.81	3.97	14.13	-----
Crowell & Murray-----	57.15	---	---	---	13.27	49.56

J.H. SHREADLE - - - - - 9/22/22- - - - - 10,422 Tons.

Mine-----	56.56	.090	9.36	4.22	14.27	-----
Hughes-Guentzler-----	57.55	---	---	---	13.49	49.79

BOELING MINE.

<u>W. H. WOLF</u>		-9/25/22-					9,602 Tons.
	Fe.	Phos	Sil.	Alum.	Mois.	Fe.Nat.	
Mine-----	56.33	.089	10.06	4.59	14.13	-----	
Oscar Textor-----	57.55	---	---	---	13.35	49.87	
<u>MICHIGAN</u>		-9/27/22-					-10,334 Tons.
Mine-----	55.05	.095	11.17	5.24	13.43	-----	
Oscar Textor-----	55.90	---	---	---	13.79	48.19	
<u>PONTIAC</u>		-10/6/22-					12,155 Tons.
Mine-----	56.95	.074	9.35	4.17	13.85	-----	
Crowell & Murray-----	57.95	---	---	---	13.92	49.88	
<u>MICHIGAN</u>		-10/9/22-					-10,488 Tons.
Mine-----	56.32	.076	9.13	4.00	13.86	-----	
Oscar Textor-----	57.43	---	---	---	14.00	49.39	
<u>PETER WHITE</u>		-10/15/22-					9,103 Tons.
Mine-----	56.52	.081	9.33	4.24	13.96	-----	
Crowell & Murray-----	56.85	---	---	---	13.65	49.09	
<u>PONTIAC</u>		-10/18/22-					-11,558 Tons.
Mine-----	56.39	.082	9.19	4.03	14.02	-----	
Cremer & Case-----	56.70	---	---	---	13.24	49.19	
<u>A.E.R. SCHNEIDER</u>		-10/23/22-					8,265 Tons.
Mine-----	56.37	.081	9.20	4.12	13.94	-----	
Crowell & Murray-----	56.45	---	---	---	14.43	48.30	
<u>PONTIAC</u>		-10/27/22-					-11,447 Tons.
Mine-----	55.91	.084	9.89	4.28	14.23	-----	
Hughes-Guentzler-----	56.45	---	---	---	13.97	48.56	
<u>CROFT</u>		-10/29/22-					9,478 Tons.
Mine-----	54.44	.088	11.69	4.99	13.78	-----	
Oscar Textor-----	54.70	---	---	---	13.54	47.29	
<u>SHEADLE</u>		-11/3/22-					4,984 Tons.
Mine-----	55.30	.084	10.53	4.02	13.77	-----	
Cremer & Case-----	56.10	---	---	---	13.72	48.40	
<u>NEGAUNEE</u>		-11/3/22-					3,190 Tons.
Mine-----	54.44	.087	11.56	4.00	13.94	-----	
Oscar Textor-----	55.85	---	---	---	13.60	48.25	
<u>MARQUETTE</u>		-11/6/22-					-7,199 Tons.
Mine-----	54.02	.084	12.31	4.59	15.29	-----	
Hughes-Guentzler-----	54.55	---	---	---	14.51	46.64	
<u>PONTIAC</u>		-11/8/22-					-5,143 Tons.
Mine-----	54.17	.083	12.26	4.50	15.50	-----	
Crowell & Murray-----	53.70	---	---	---	16.30	44.95	

BOEING MINE.

The Boeing ore was shipped in thirty-six cargoes, which averaged as follows:

	<u>Tons</u>	<u>Fe.</u>	<u>Phos</u>	<u>Sil.</u>	<u>Alum.</u>	<u>Mois.</u>	<u>Fe.Nat.</u>
Mine Analysis-----	250,474	56.79	.079	9.36	4.03	14.39	-----
Lower Lake Analysis---	250,474	57.03	---	----	----	13.78	49.17

The composite sample of the season's shipments shows the following complete analysis:

	<u>Tons</u>	<u>Fe.</u>	<u>Phos</u>	<u>Sil.</u>	<u>Mn.</u>	<u>Alum.</u>	<u>Lime</u>	<u>Mag</u>	<u>Sul.</u>	<u>Loss</u>
Lerch Brothers-----	250,474	56.52	.082	9.59	.61	4.24	.12	.10	.012	4.37

BOEING MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1922.

GRADE	IRON	PHOS.	SILICA	MANG.	ALUM.
Boeing,	56.62	.081	9.55	.61	4.12
Boeing Lean Ore,	50.96	.099	17.46	-	5.70

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1922.

GRADE	IRON	Mine	SILICA	Lake Erie	
		PHOS.		IRON	MOIST.
Boeing,	56.77	.078	9.36	57.11	13.87
Boeing Lean Ore,	(All Mixed)				

ORE STATEMENT - DECEMBER 31ST, 1922.

	PIT		UNDERGR'D		TOTAL LAST YEAR
	BOEING LEAN ORE	BOEING	BOEING LEAN ORE	TOTAL	
On hand January 1, 1922,	-	21,927	7,551	29,478	8,883
Output for Year,	33,417	234,894	-	268,311	20,595
Total,	33,417	256,821	7,551	297,789	29,478
Shipments,	-	248,067	2,407	250,474	-
Balance on Hand,	33,417	8,754	5,144	47,315	29,478
Increase in Output,				247,716	
Increase in Ore on Hand,				17,837	

1922 -- Mine Idle Jan. 1st to Aug. 10th, 1922.
Pit operations began Aug. 11th, and ceased Nov. 4th, 1922.
2-8 Hour Shifts Underground, 6 days per week, Nov. 16th to Dec. 31, 1922.

1921 -- 3-8 Hour Shifts, Jan. 1st to July 1st, 1921.
2-8 Hour Shifts, July 1st to Dec. 31st, 1921.

BOEING MINE.

TIMBER STATEMENT FOR THE YEAR ENDING DECEMBER 31, 1922.

KIND	LINEAL FEET	AVG. PRICE PER FOOT	AMOUNT	
			1 9 2 2	1 9 2 1
6" to 8" Timber	9,390	.10	939.00	-
8" to 10 "	4,024	.10	402.40	-
Total - 1922	13,414	.10	1,341.40	-
Total - 1921	-	-	-	-
	LINEAL FEET	PER 100'		
6' Lagging	81,795	.691	565.25	-
Poles	9,677	1.500	145.16	-
Covering Boards 5/8"	50,000	1.6635	831.75	-
No.4 Boards	4,000	3.75	150.00	-
Total - 1922	145,472	1.163	1,692.16	-
Product			8,754	-
Feet of timber per ton of ore			1.532	
" lagging " "			9.343	
" boards " "			6.171	
" poles " "			1.105	
" lagging per foot of timber			6.097	
Cost per ton for timber			.153	
" lagging			.065	
" poles			.017	
" boards			.112	
" timber, lagging, poles & boards			.347	
Equivalent of stull timber to bd.measure			17,438	
Ft.Bd.measure per ton of ore			1.992	

MADE IN U.S.A.

BOEING MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY	AVERAGE PRICE	AMOUNT 1922	AMOUNT 1921
40% Powder	2,650	14.15	375.13	-
Total Powder	2,650	14.15	375.13	-
Fuse	9,500	.702	66.73	-
Caps	3,800	1.162	44.19	-
Total Fuse, Etc.			110.92	-
Total All Explosives			486.05	-
Product			8,754	-
Cost per ton for Powder			.302	-
" " Fuse, Etc.			.013	-
" " All Explosives			.055	-
Avg. price per Lb. for Powder			.1415	-

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WADE AND HELMER MINES

ANNUAL REPORT FOR 1922.

The Wade-Helmer Mines were idle during the entire year. The properties were closed May 28th, 1921, and no further mining activities have been undertaken since that time.

The average analysis and ore in stockpile as of January 1st., 1923, is the same as reported January 1st., 1922, and is as follows:

	<u>Tons</u>	<u>Fe.</u>	<u>Phos</u>	<u>Mn.</u>	<u>Sil.</u>
Wade Ore in Stock Jan. 1st. 1923---	77,271	57.22	.064	1.27	7.50
Helmer Ore in Stock Jan.1st.1923---	<u>20,354</u>	<u>56.48</u>	<u>.066</u>	<u>1.35</u>	<u>10.03</u>
TOTAL AND AVERAGES- - - - -	97,625	57.07	.064	1.29	8.03

Wade-Helmer Mines
Bond
MADE IN U.S.A.

WADE MINE ORE ESTIMATE OF JANUARY 1ST. 1923

As no ore was mined from any of the Wade deposits during the year, the estimates remain the same as on January 1st., 1922. These figures are based on a factor of 13 cubic feet per ton and a 10% deduction is made to cover mining loss in the case of the underground ores.

The tonnage and average grade of ore in the several deposits as of January 1st. 1923, follows:

	<u>Tons</u>	<u>Fe.</u>	<u>Phos</u>	<u>Mn.</u>	<u>Sil.</u>	<u>Mois.</u>
West Deposit-----	1,365,000	57.90	.074	1.05	6.79	13.25
East Deposit-----	1,515,000	56.91	.075	1.83	7.44	13.50
Deacon Deposit---	80,000	56.65	.045	1.16	8.04	12.50
" " ---	95,000	55.77	.053	.42	8.43	12.50

Following are the tonnages and grades of ore in the West Deposit above and below the main haulageway:

	<u>Tons</u>	<u>Fe.</u>	<u>Phos</u>	<u>Mn.</u>	<u>Sil.</u>
Above Main Level---	1,179,000	57.85	.074	1.33	6.40
Below Main Level---	186,000	56.11	.073	.74	7.03

The total ore by forty acre tracts as of January 1st., 1923, is as follows:

	<u>Tons</u>	
SE $\frac{1}{4}$ of SW $\frac{1}{4}$ of Section 12, 58-19-----	305,000	Non-Bessemer
NE $\frac{1}{4}$ of NW $\frac{1}{4}$ of " 13, 58-19-----	1,305,000	" "
NE $\frac{1}{4}$ of NW $\frac{1}{4}$ of " 13, 58-19-----	80,000	Bessemer.
NW $\frac{1}{4}$ of NW $\frac{1}{4}$ of " 13, 58-19-----	1,365,000	Non-Bessemer.

HELMER MINE ORE ESTIMATE OF JANUARY 1ST. 1923

As no ore was mined from the Helmer deposit during the year, the estimates remain the same as on January 1st., 1922. These figures are based on a factor of 13 cubic feet per ton and a 10% deduction is made for mining loss in the case of underground ore, 20% for rock in the open pit and 25% for rock in the scam ore.

The Helmer tonnage in sight January 1st., 1923, follows:

	<u>Tons</u>
Open Pit-----	15,000
Scram Ore-----	26,000
Underground Ore----	<u>68,000</u>
 TOTAL- - - - -	 109,000

There is no indication that any additional ore will be developed in the Helmer, in fact, due to the low grade and restricted mining conditions underground, we are apprehensive that this total tonnage cannot be mined at a profit.

The average analysis of the ore in sight January 1st., 1923, follows:

<u>Tons.</u>	<u>Fe.</u>	<u>Phos</u>	<u>Mn.</u>	<u>Sil.</u>	<u>Mois.</u>
109,000	56.00	.070	1.35	9.50	12.50

Of the ore remaining in the Wade-Helmer Mines, 576,000 tons will be mined by the open pit method, 26,000 tons by scam to pit and 2,562,000 tons from underground operations.

ESTIMATE OF PRODUCTION FOR 1923

Our estimate of production for 1923, provided operations are resumed May 1st., and continued to November 15th, is as follows:

	<u>Tons</u>	<u>Fe.</u>	<u>Phos</u>	<u>Mn.</u>	<u>Sil.</u>	<u>Mois.</u>
Wade Open Pit Ore-----	100,000	58.50	.060	.75	7.00	12.50
Wade Underground Ore--	61,000	57.50	.061	.95	8.13	12.50
Helmer Ore-----	<u>10,000</u>	<u>56.00</u>	<u>.070</u>	<u>1.30</u>	<u>10.25</u>	<u>12.50</u>
 TOTAL AND AVERAGES----	 171,000	 58.00	 .061	 .85	 7.59	 12.50

While our estimated production shows an average of 58% iron, both our Wade and Helmer stockpiles are under grade, and the season's shipments, provided all the stockpiles and our estimated production were forwarded, would be approximately a half point below the average.

GENERAL SURFACE

A day and night watchman have been employed at the Wade-Helmer Mines throughout the year. No irregularities were reported.

During February a contract was let for the cleaning of all the out-houses in the location. This work was completed in March, at a cost of \$205.00. Some repair work was also done from time to time during the year on the cess-pools and sewers. This work, however, was not extensive.

The mine and location premises were cleaned of an accumulation of rubbish several times during the summer months and maintained in a neat condition. The roofing on four of the old houses moved to the Wade location from the Helmer Mine, was renewed during the month of October.

All the mines in the Kinney District have been either closed entirely or operating only on a small scale. As a result, most of our old men have drifted away. There are only eight families now living in the location. The labor conditions in the Kinney District have never been favorable and should we resume operations this summer, we anticipate that some difficulty will be experienced in building up an efficient organization.

The hoist, compressor, gasoline locomotives and miscellaneous supplies moved from the Meadow Mine, were unloaded and stored near the Wade shaft during December. The Meadow warehouse was torn down and shipped to the Wade and will be used as a housing to store the machinery and supplies transferred from that property.

UNDERGROUND OPERATIONS

Three pumpmen were employed on eight hour shifts. Except during the spring break-up and the rainy period of April and May, pumping conditions at the Wade-Helmer properties were normal. At no time, however, was our pumping capacity taxed to the limit. The normal amount of water pumped is approximately 600 gallons per minute.

The motor on the centrifugal pump has failed three times during the past several months. The trouble is due to an accumulation of moisture and coils burning out. Although the motor has been housed in and is run each day with the idea of keeping it dry, a third coil burned out about the middle of November. Temporary repairs were made and the pump is in service. We intend to make such repairs to this pump as will correct this trouble.

Inspections of the underground workings had to be discontinued in February on account of poor air in the sub-level workings.

The bulk of the water draining from the open pit into the Wade Mine, seeps through the ore and enters the drift some distance back from the pit portal. There is some seepage, however, in the vicinity of the open pit and a solid block of ice formed, shutting off all ventilation. The result was that the air was very poor in the mine and it was impossible to make inspections of the workings until June. It would be quite expensive to keep this drift free of ice and so no attempt was made to chop it out until April, when it started to melt. Even after the drift was open it was sometime before the air had cleared sufficiently to permit an inspection of the workings.

The June inspection found the main tramways and working places in much better condition than we had anticipated. Although the lagging had broken down in several places, there was no evidence of weight. No material change was noticed until an inspection early in September. At this time the main tramways were found in very good condition, but a great change had taken place in the sub-level drifts. The timbering and lagging had become covered with a heavy fungus growth and had broken down in a number of places, due to a dry rot.

A crew of six miners was sent from the Crosby Mine, as it was impossible to secure men in the Kinney District for this short job. These six men were employed during the entire month of October and up to November 25th, when the repair work on the 1390, 1400 and 1420 Foot Sub-Levels was completed.

On the 1390' Sub-Level, lining sets and new lagging were placed in all the main cross-cuts and the tops of the raises repaired where necessary. On the 1400' and 1420' Sub-Levels the repairs were less extensive, as the timber here did not show any considerable deterioration. This no doubt is due to the better circulation of air through the upper sub-levels, where there evidently are openings to the surface caves. All the working places should remain in good condition for the next five or six months. Should mining be resumed at the Wade Mine within this time, it will be possible to start producing ore from twelve places after a few days preliminary work.

The Helmer portal has been blocked by the wash from the open pit banks. Before resuming underground work here, it will be necessary to do quite a little cleaning with the Model "36" steam shovel in the open pit, as well as remove such sand and clay as has washed into the main drift.

We had several very heavy rains during May and the wash from the sides of the pit was quite considerable along the north and west sides of the Helmer stockpile.

It looked for a time as though we would make some shipments from the Wade and Helmer stockpiles during the later part of the summer. When the steam shovel crew completed stockpile loading at the Boeing in August, they were sent to the Wade Mine to get the pit equipment (the "36" Marion and Lima Locomotive) in shape and start clean-up work along the sides of the Helmer stockpile. This work had only been in progress four days when word was received that no shipments were to be made during 1922. All repair and clean-up work was discontinued and the shovel crew sent to the Hill-Trumbull Mine. There is no use to do any further clean-up work in the Wade-Helmer pit until we are ready to move the pile, as the surface material would again wash down.

HELMER-WADE MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1922.

GRADE	IRON	PHOS.	SILICA	MANG.
Helmer,				(No Production)
Wade,				(No Production)

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1922.

GRADE	IRON	PHOS.	SILICA	MANG.
Helmer,				(No Shipments)
Wade,				(No Shipments)

ORE STATEMENT - DECEMBER 31ST, 1922.

	HELMER	WADE	TOTAL	TOTAL LAST YEAR
On hand January 1, 1922,	20,354	77,271	97,625	28,103
Output for Year,	-	-	-	69,522
Total, Shipments,	20,354	77,271	97,625	97,625
Balance on Hand,	20,354	77,271	97,625	97,625
Decrease in Output,			69,522	

1922 -- Mine Idle during Year.

1921 -- 2-8 Hour Shifts, Jan. 1st to May 28th, 1921.
Mine closed May 27th, 1921.

WADE-HELMER MINE

COMPARATIVE MINING COST FOR YEAR

	1 9 2 2	1 9 2 1	INCREASE	DECREASE
PRODUCT	0	69,522		
Underground Costs		1.908		
Surface Costs		.191		
General Mine Accounts		.182		
Total		2.281		
Plant Account		.120		
Equipment		.003		
Taxes		.216		
Central Office		.068		
Contingent Expense		.008		
Idle Expense		.779		
Cost Adjustment		.211		
Cost on Stockpile		3.686		
Loading, & Shipping				
Misc. Debits & Credits		.038		
Total Cost on Cars		3.724		
No. Days Operating		125		
No. Shifts & Hours		2-8hr		
Avg. Daily Product		556		
<u>COST OF PRODUCTION</u>				
Labor		1.492		
Supplies		.789		
Total		2.281		

Mine closed May 28, 1921.
Not operated in 1922.

WADE-HELMER MINE

COMPARATIVE WAGES AND PRODUCT

	1 9 2 2	1 9 2 1	INCREASE	DECREASE
PRODUCT	-	69,522		69,522
No. Hours & Shifts		2-8hr		
AVG. NO. MEN WORKING				
Surface	2	13		11
Underground	5	51		46
Total	7	64		57
AVG. WAGES PER DAY				
Surface	5.15	5.62		.47-9%
Underground	4.19	5.43		1.24-22%
Total	4.50	5.47		.97-17%
WAGES PER MO. OF 25 DAYS				
Surface	128.75	140.50		11.75
Underground	104.75	135.75		31.00
Total	112.50	136.75		24.25
PRODUCT PER MAN PER DAY				
Surface		17.88		
Underground		4.48		
Total		3.58		
LABOR COST PER TON				
Surface		.314		
Underground		1.212		
Total		1.526		
AVG. PRODUCT ERK'G & TRM'G		6.25		
" WAGES CONTRACT MINERS		5.67		
" " " TRAMMERS		5.67		
TOTAL NO. OF DAYS				
Surface	762 $\frac{1}{4}$	3889		3126- $\frac{3}{4}$
Underground	1622 $\frac{1}{2}$	15506		13883- $\frac{1}{2}$
Total	2384- $\frac{3}{4}$	19395		17010- $\frac{1}{4}$
AMOUNT FOR LABOR				
Surface	3927.90	21837.15		17909.25
Underground	6796.32	84239.98		77443.66
Total	10724.22	106077.13		95352.91

Proportion of Surface to Underground Men:

1922 - 1 to 2.50
 1921 - 1 to 3.92
 1920 - 1 to 2.84
 1919 - 1 to 3.14
 1918 - 1 to 3.59

Mine closed May 28, 1921.

ANNUAL REPORT FOR THE YEAR ENDING DECEMBER 31, 1922.

Ishpeming, Michigan,

January 16, 1923.

ENGINEERING DEPARTMENT.

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

Building.

Dear Sir:-

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

LIST OF ANNUAL REPORT MAP BOOKS FOR 1922.

Cleveland-Cliffs Iron Company,
Ishpeming and North Lake Districts.

Cleveland-Cliffs Iron Company,
Negaunee, Iron River & Republic Districts,
& Hydro Electric System.

Cleveland-Cliffs Iron Company,
Mesabi District.

Cleveland-Cliffs Iron Company,
Gwinn District.

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

Special books have been prepared for the other companies which are interested in the Cleveland-Cliffs Iron Company's mines and also books and loose prints have been given to the superintendents of the various districts as follows:

BOOKS - OR LOOSE LEAVES.	DISTRICT.	FOR WHOM.
Loose leaves	Ishpeming	L. Eaton
Book	North Lake	J. M. Bush
"	Negaunee	G. R. Jackson
"	Iron River & Republic	C. J. Stakel
Loose leaves	Hydr-Electric System	O. D. McClure
Book	Mesabi	M. H. Barber
Loose leaves	Boeing	C. Brewer
" "	Hill-Trumbull	H.C.Bolthouse
Book	Gwinn	W. W. Graff
"	Negaunee	Lackawanna Steel Co.
2 Books	Wade,Boeing,Hill-Trumbull	Arthur Iron Mining Co.
5 "	Boeing and Hill-Trumbull	Mesaba-Cliffs Iron Mining Co.
Book	Athens Mine	Pickands, Mather & Co.
"	Boeing Mine	Col. J. B. Cavanaugh

The address of Colonel J. B. Cavanaugh is Royal Mineral Association,
Hibbing, Minnesota.

Maps of the Athens Mine have been sent monthly to the Cleveland office
for Pickands, Mather & Company. Upon request maps showing portions of the
Athens Mine have been furnished for the Mitchell and Corbit fee interests.

For the Oliver Iron Mining Company's Adams strip lying between the
Maas and Negaunee Mines, maps have been prepared as usual.

Maps of the Barnes-Hecker and Moore & Chase properties have been fur-
nished upon request.

Fourteen sets of maps have been prepared for the Negaunee Mine fee
owners.

Monthly maps have been sent out to the engineer in charge of the
Roman Catholic Cemetery property at Negaunee.

Stephenson Mine maps have been furnished to that company's resident
engineer.

Exploration maps of the Virgil have been sent out in accordance with
the lease.

Mr. R. J. Chenneour, Assistant Engineer, has written the following
pages covering the report of work done by the force employed in the engineer-
ing office.

Following the above, I have added a few remarks on the Abstract Depart-
ment and on various subjects.

Yours truly,

J. E. Jopling
Chief Engineer.

JEJLTD.

REPORT OF THE ENGINEERING FORCE EMPLOYED DURING THE YEAR 1922,
AND A BRIEF OUTLINE OF THEIR WORK,

BY REGINALD J. CHENNEOUR, ASSISTANT ENGINEER.

THE FORCE.

The following additional men were employed during the year: Archibald Minnear, as engineer's helper and draftsman, entered the employ October 13th; Sextus Malmgren, as engineer's helper, entered the employ December 22nd.

The following table shows the personnel of the Department during the year, arranged in order of entrance:

NAME.	POSITION.	ENTERED.
R.J.Chenneour	Asst. Eng.	Entire year.
H. O. Moulton	Engineer	" "
J. E. Hayden	"	" "
A. Rock	Helper	" "
J. Trosvig	Engineer	" "
T. A. Miller	"	" "
C.W.Nicolson	"	" "
K. C. Pellow	"	" "
A. Minnear	Helper	3 $\frac{1}{2}$ months.
S. Malmgren	"	$\frac{1}{2}$ month.

The following table shows the days worked, days sickness, percentage of days worked, etc, for all men in the Department. The vacation column shows time granted for regular vacations. Eight hours constitute a working day. There was no work Saturday afternoons during the year. When the vacation column shows over fifteen days, it usually is due to the fact that there was little or no vacation taken during the previous year. The total days as shown in the table are actual working days:

NAME.	DAYS WORKED.	DAYS VACATION.	DAYS SICK.	TOTAL DAYS.	PERCENTAGE DAYS WORKED.
R.J.Chenneour	264	11	0	275	96.5%
H.O.Moulton	250	23	2	275	91.4
J. E. Hayden	259	12	4	275	94.5
C.W.Nicolson	264 $\frac{1}{2}$	10 $\frac{1}{2}$	0	275	96.5
T. A. Miller	252	23	0	275	92.1
K. C. Pellow	256 $\frac{1}{2}$	11	7 $\frac{1}{2}$	275	93.7
J. Trosvig	260	10	5	275	95.0
A. Rock	264 $\frac{1}{2}$	6 $\frac{1}{2}$	4	275	94.5
A. Minnear	58	0	0	58	100.0

The following table shows the number of working days lost because of sickness and vacation by men in the Department for the last five years:

	1918.		1919.		1920.		1921.		1922.	
	VACATION.	SICK.	VACATION.	SICK.	VACATION.	SICK.	VACATION.	SICK.	VACATION.	SICK.
R.J.Chemeour	12	0	2 $\frac{1}{2}$	0	25	10	17	3	11	0
H.O.Moulton	1	1	27	5	21 $\frac{1}{2}$	0	4 $\frac{1}{2}$	0	23	2
J. E. Hayden	0	0	0	0	23	4 $\frac{1}{2}$	19	0	12	4
C.W.Nicolson	0	0	0	0	0	1	24	0	10 $\frac{1}{2}$	0
T. A. Miller	0	0	18 $\frac{1}{2}$	1 $\frac{1}{2}$	16 $\frac{1}{2}$	0	3 $\frac{1}{2}$	0	23	0
K. C. Pellow	6	4	13	15 $\frac{1}{2}$	22 $\frac{1}{2}$	1 $\frac{1}{2}$	13 $\frac{1}{2}$	49 $\frac{1}{2}$	11	7 $\frac{1}{2}$
J. Trosvig	11	10	6 $\frac{1}{2}$	1 $\frac{1}{2}$	26 $\frac{1}{2}$	1	11 $\frac{1}{2}$	8	10	5
A. Rock	14	0	4 $\frac{1}{2}$	2 $\frac{1}{2}$	14 $\frac{1}{2}$	0	4 $\frac{1}{2}$	0	6 $\frac{1}{2}$	4
A. Minnear	0	4	9	8 $\frac{1}{2}$	18	1	0	0	0	0

The following table gives the names of the men employed in the Department during the last five years, arranged in order of entrance, showing the months worked and the average number of men per month:

	1918.	1919.	1920.	1921.	1922.
C. Brewer	12	3	0	0	0
R.J.Chemeour	12	12	12	12	12
H. O. Moulton	12	12	12	12	12
J. K. Osborne	12	12	1	0	0
A. Rock	12	12	12	12	12
J. Trosvig	12	12	12	12	12
J. E. Hayden	0	0	12	12	12
T. A. Miller	2 $\frac{1}{2}$	11	12	12	12
J. J. Heilala	12	10	0	0	0
S.Malmgren	12	12	12	6	
C.W.Nicolson	0	0	11	12	12
W.F.H.Janzen	12	12	1	0	0
C. Nicholls	4	3 $\frac{1}{2}$	0	0	0
A. Alanen	12	8 $\frac{1}{2}$	0	0	0
A. Minnear	12	12	12	6	3 $\frac{1}{2}$
M.C.Connolly	3 $\frac{1}{2}$	0	0	0	0
K. C. Pellow	12	12	12	12	12
P. Denn	9	8	9	5	0
F. Christian	3	0	0	0	0
Shu Choe	3 $\frac{1}{2}$	0	0	0	0
A. Ham	0	8	1	0	0
F. A. Olson	0	2	12	6	0
C. C. Taylor	0	0	11	6	0
A. E. Carlson	0	0	11 $\frac{1}{2}$	6	0
J.D.McCarthy	0	0	6	6	0
Average number of men	14 $\frac{1}{8}$	13 $\frac{1}{2}$	14 $\frac{1}{3}$	11 $\frac{5}{12}$	8 $\frac{1}{4}$

The work performed by each man in the Department is described briefly as follows:

REGINALD J. CHENNEOUR, as Assistant Engineer, has had charge of the office during the year, supervising the office work, field and underground surveys.

He developed a scheme to determine the number of cubic feet per ton of ore in place. Briefly, it consists of securing representative chunks of ore and then immersing in melted parafine, after which it is submerged in water and the amount of water displaced measured. Correction in water displacement is made for the parafine coating. At the Hoist dam he made the necessary surveys to start construction work. This consisted of surveys for spur railway track, buildings and spillway section of the dam. He secured data from the superintendents which was used to answer a questionnaire sent out by the American Institute of Mining & Metallurgical Engineers, supervised the making of sketches to accompany the same and assisted Mr. Jopling in answering it.

In the office, in addition to the regular routine work, he assembled the annual report and Tax Commission maps of all mines, had them photographed and printed and finally bound in books.

HENRY O. MOULTON has been in charge of the engineering work at the Negaunee and South Jackson Mines for the entire year.

At the Negaunee Mine he made weekly and monthly surveys, noting and posting geology. The incline slicing system, which is being tried at this mine, required a large part of his time. He gauged the skip and cage runners of the above mine to determine the clearance.

At the South Jackson Mine he made the necessary surveys.

In the office, in addition to the regular work, he prepared the annual report and Tax Commission estimate for the above mines. In connection with the Dead River Water Power lands he did considerable work in the field and office, preparatory to the purchase of the Ollila and Wiippola lands.

He assisted in completing the maps of Sections 10, 11 and 12, 47-27.

At various times he helped the other engineers with their mine and surface surveys.

Below is a table showing the percentage of his time spent at the Negaunee Mine and other miscellaneous work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Negaunee Mine,	21%	7%	35%	63%
Miscellaneous,	5	13	19	37
Total,	26%	20%	54%	100%

J. ELLZEY HAYDEN did the engineering work at the Maas Mine for the entire year. At this mine he made weekly and monthly surveys, noting and posting geology, gave lines to start incline mining system, laid out additional stocking trestle, designed and laid out a sewer to dispose of waste from dry and engine house. He did some work in connection with the enlarging and lining of the Maas shaft with concrete, using steel sets.

In the office, besides the regular work for the mine, he prepared the annual report and Tax Commission estimate.

He made a new estimate of ore in the Race Track tract to the West of the Maas Mine.

At the Algoma Steel Company's plant at Sault Ste. Marie, Ontario, he made a joint estimate with their engineer of the Negaunee and Stephenson ore in stock on July 5th.

At the Maas, Negaunee and Athens Mines he made tests to determine the cubic feet per ton of ore in place and plotted curves showing the results obtained.

He assisted in plotting maps of Sections 11 and 12, 47-27.

He worked on the abstracts of the water power lands.

At various times he helped other engineers with their underground and surface surveys.

Below is a table showing the percentage of his time spent at the Maas Mine and other miscellaneous work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Maas Mine	24%	6%	46%	76%
Miscellaneous	4	6	14	24
Total	28%	12%	60%	100%

CLYDE W. NICOLSON had charge of the engineering work at the Athens Mine for the entire year. At this mine he made the surveys, noted and posted geology.

He prepared the plans and specifications for the steel stocking trestles and laid out the concrete footings to support the same. From the time the steel work was delivered he was at the mine constantly supervising the erection and the concrete work in connection with the same. The mine surveys and office work during this period he kept up after regular working hours.

He also designed and supervised the installation of a small timber preservative plant for this mine.

He prepared a report on drainage problems of the Stephenson Mine.

At various times he assisted the other engineers with their work.

In the office he prepared the annual report and Tax Commission estimate for the Athens Mine and worked on miscellaneous abstracts.

Below is a table showing the percentage of his time spent on Athens Mine and other work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Athens Mine	7%	45%	34%	86%
Miscellaneous	2	2	10	14
Total	9%	47%	44%	100%

TOM A. MILLER did the engineering work at the Holmes and Cliffs Shaft Mines.

At the Holmes Mine he made the monthly surveys and sampled the ore areas on the 3rd and 4th levels. Working places along the Lake Superior Iron Company's boundaries were surveyed frequently to avoid trespassing.

At the Cliffs Shaft Mine he made regular monthly surveys. On surface he staked out two trestles for lump ore and did the necessary survey work in connection with the construction of the new recrushing plant.

He also measured all the Company houses in the Ishpeming District and prepared a statement showing the yardage in each to be painted.

In the office, in addition to the regular work, he prepared the annual report and Tax Commission maps for the above mines. He did some work on

miscellaneous abstract maps, etc.

He helped the other engineers with their surface surveys and office computations.

Below is a table showing the percentage of his time spent at the Holmes and Cliffs Shaft Mines and other work.

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Holmes Mine	19½	3%	46%	68%
Cliffs Shaft Mine	6	3	14	23
Miscellaneous	1	3	5	9
Total	26%	9%	65%	100%

KENNETH C. FELLOW did the engineering work for the Republic Mine, Virgil Exploration and for the latter part of the year the Barnes-Hecker Mine.

At the Republic Mine he made monthly surveys, located all diamond drill holes and ran special surveys to continue sinking in the Pascoe Shaft.

In the field he measured all the houses and sheds at Republic which were to be painted and made a tabulated list to show the yardage in each.

At the Barnes-Hecker Mine he made the surveys and gave lines for all development work. This mine requires frequent surveying because of the importance of watching the changes in the structure of the ground.

In the office, in addition to the regular work, he prepared the annual report and Tax Commission maps for the above mines, posted the analyses on the Barnes-Hecker maps and prepared a map showing leases and numbers of each in the Republic District.

For the Virgil Exploration he surveyed and mapped all diamond drill hole locations.

Below is a table showing the percentage of his time spent on the Republic, Barnes-Hecker and Virgil and miscellaneous work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Republic Mine	8%	3%	39%	50%
Barnes-Hecker Mine	7	0	17	24
Virgil Exploration	0	2	8	10
Miscellaneous	4	4	8	16
Total	19%	9%	72%	100%

JOHN TROSVIG did the engineering work at the Morris-Lloyd Mine and the Barnes-Hecker Mine until September.

At the Morris-Lloyd Mine he made monthly surveys, laid out drifts and raises for a sub-level stope and gave lines to start the incline mining system. He also accompanied the geologists underground, noting geological features. He ran check surveys on the 6th level. On surface he made surveys and an estimate of yardage to be removed to secure larger stocking room. He also gave lines and elevations for additional stocking trestle.

At the Barnes-Hecker Mine he gave lines for new development and ran check surveys on all levels. He secured notes and data to prepare a report on the drainage problem for this mine and the Morris-Lloyd. He accompanied the geologist underground, noting geological features.

He also located and gave lines and elevations for a small ditch to carry the spring flood water to the West into the creek in which the mine water discharges.

In addition to the regular mine work, he made an estimate of the houses, sheds and fences to be painted at the Barnes-Hecker and Morris-Lloyd locations and prepared a tabulated list of the same.

In the office, besides the regular work, he prepared annual report and Tax Commission estimate for the Morris-Lloyd Mine.

Below is a table showing the percentage of his time spent on Morris-Lloyd and Barnes-Hecker Mines:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Morris Mine	22%	4%	38%	64%
Lloyd Mine	5	2	16	23
Barnes-Hecker Mine	6	3	4	13
Total	33%	9%	58%	100%

ALBERT ROCK, helper, assisted the engineers with their underground and surface surveys and drove the Dodge truck. After December 15th his entire time was spent printing the annual report maps.

Below is a table showing the percentage of his time spent underground, in the field and office:

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
9%	62%	29%	100%

ARCHIBALD MINNEAR, draftsman and helper, was employed in October and has assisted the engineers with their office, underground and surface work.

Below is a table showing the percentage of his time spent underground, in the field and office:

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
31%	13%	56%	100%

The following table shows the percentage of time spent underground, in the field and in the office for engineering work for mines in this district:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Athens Mine	10%	54%	36%	100%
Barnes-Hecker Mine	33	18	49	100
Cliffs Shaft Mine	26	17	57	100
Holmes Mine	27	12	61	100
Lloyd Mine	21	15	64	100
Maas Mine	28	18	54	100
Morris Mine	31	15	54	100
Negaunee Mine	30	21	49	100
Republic Mine	17	10	73	100
Spies Mine	0	20	80	100
Average	23%	20%	57%	100%

The next table shows the distribution of time and cost for the various mines and other work for the last three years:

OFFICE EXPENSE.

Below is a comparative table of office expense for three years:

	1920.	1921.	1922.
Traveling expense and livery,	\$ 558.82	\$ 252.88	\$ 266.86
Supplies (See below), - -	2604.75	2910.19	1503.47
Operating automobiles, - - -	2009.39	1877.24	990.27
Office expense, - - - -	230.91	107.93	38.21
Insurance, - - - -	221.25	221.25	231.26
Taxes, - - - -	45.06	43.63	41.68
Total,	\$5670.18	\$5413.12	\$3071.75
Total salaries general office Engineers # - -	30750.75	22078.12	18204.89
Total charges to Eng. Dept.	\$36420.93	\$27491.24	\$21276.64

Does not include salary of Chief Engineer and Stenographer.

The following table shows extraordinary charges for supplies in the above for the year 1922:

American Blue Print Paper Company, - - -	\$ 73.85
Childs Art Gallery, - - - -	80.50
Papers and periodicals, - - - -	24.00
Stenglein Bindery, - - - -	64.00
George A. Newett, - - - -	36.83
United States Blue Print Paper Company, - -	152.93
Hoover Steel Ball Company, - - - -	32.00
American Blue Print Paper Company, - - -	17.73
Monroe Calculating Machine Company, - - -	200.00
C. A. Gustafson, - - - -	33.33
C. L. Berger & Sons, - - - -	63.20
Keuffel & Esser, - - - -	170.88
American Blue Print Paper Company, - - -	21.73
E. L. Derby, Jr., Agent, - - - -	62.00
Eugene Dietzgen Company, - - - -	48.95
Auto for Engineering Department (Depreciation)	180.83
Auto Truck Eng. and Geol. Depts. "	249.38

AUTOMOBILES.

The Dodge truck and touring car were purchased new on March 15, 1922, and were run continuously until December 15th when they were put up for the balance of the year.

Below is a comparative statement of auto and livery expense for three years. NOTE: Years 1920 and 1921, using Ford truck and touring car; Dodges in 1922:

	1920.	1921.	1922.
Company houses, -	\$426.49	\$251.18	\$255.84
Company automobiles:			
Salaries,	780.23	601.31	0
Expense,	1229.16	1275.93	990.27
Livery hire, -	3.33	0	0
Traveling expense,	0	1.70	11.02
Total	\$2439.21	\$2130.12	\$1257.13
<u>COST OF OPERATING AUTOMOBILES.</u>			
	1920.	1921.	1922.
Chauffeur's salary,	\$ 780.23	\$ 601.31	\$ 0
Gasoline, oil, etc,	280.50	246.39	208.34
Tires and tools,	255.92	207.84	70.35
Repairs,	181.69	292.75	70.90
Miscellaneous,	49.40	77.58	87.21
Insurance,	123.36	113.08	123.36
Depreciation,	338.29	338.29	430.11
Total,	\$2009.39	\$1877.24	\$ 990.27

M I N E S.

ATHENS MINE.

Weekly surveys were made and all geology posted.

A steel trestle was designed and ordered and at the present time is nearly completed.

A small preservative plant was designed and erected to treat main level timbers.

BARNES-HECKER MINE.

Surveys were made for this mine which consisted of main and sub-level development. Check surveys were run on all levels. The geology was noted and mapped. On surface lines and grades were given for a small ditch to carry the spring flood water to the West into the small creek into which the mine water is discharged.

CLIFFS SHAFT MINE.

The monthly surveys were made and a number of check surveys run. On surface surveys were made for additional lump ore stocking trestle and for the construction work in connection with recrushing plant which is now being built.

HOLMES MINE.

The regular monthly surveys were made. All workings along Section 16

Mine boundaries were surveyed frequently for possible trespasses. Ore areas on the 3rd and 4th levels were sampled and the results mapped. On surface additional stocking trestle was laid out.

MAAS MINE.

Weekly surveys were made and geology noted and mapped. A new scheme for enlarging the shaft, lining same and an estimate of its cost was prepared.

The incline system of mining was started.

On surface a sewer was laid out to carry waste from the dry and engine house into the city sewer system. This sewer is being built now.

MORRIS-LLOYD MINE.

Monthly surveys were made and geology noted. Check surveys were run on the 6th and 7th levels. A sub-level stoping method of mining was laid out in the Morris Mine and is now in operation.

A drift is being run to start the incline system of mining in the Section 6 ore body.

On surface additional stocking trestle was laid out and an estimate of yardage that would have to be removed made to secure greater ore stocking capacity.

NEGAUNEE MINE.

Weekly surveys were made and geology noted and mapped. The skip and cage runners were gauged. The incline system of mining, which is being used at this mine, required a large part of the engineer's time.

REPUBLIC MINE.

Monthly surveys were made and all diamond drill holes located.

Check surveys were run to continue sinking in the Pascoe Shaft.

On surface a new drill sharpening shop was staked out. Heights and lines were given for additional stocking trestle.

SOUTH JACKSON MINE.

The outline of the pit was surveyed after a small tonnage had been removed by the steel shovel.

SPIES MINE.

Sinking was started in the present shaft. This has required but little engineering work.

VIRGIL EXPLORATION.

Surface diamond drill holes were located and mapped.

MISCELLANEOUS.

RACE COURSE AT NEGAUNEE.

A new estimate was prepared showing the probable ore in this parcel.

CU. FT. OF ORE PER TON IN PLACE.

Tests were made at the Athens, Maas and Negaunee Mines and curves plotted to show the comparative results.

TRANSMISSION LINE.

A change in ^{the} transmission line at the old Dexter Mine was surveyed and the old maps corrected.

REPAIRS TO RENTED HOUSES.

Estimates were prepared of the yardage in houses and sheds to be painted in the Ishpeming District, North Lake and Barnes-Hecker locations and tabulations prepared.

STEPHENSON MINE DRAINAGE.

A report was made showing the probable drainage problem in the vicinity of the Stephenson Mine.

NORTH LAKE DRAINAGE.

A report was partially completed on the drainage ~~at~~ in the North Lake District from the Barnes-Hecker Mine East to the Morris-Lloyd Mine. This will be completed during the year 1923.

ESTIMATE OF ORE IN STOCK AT ALGOMA STEEL PLANT, SAULT STE. MARIE, ONT.

A joint estimate of the Negaunee and Stephenson ores in stock on July 5th was made with the Algoma engineers.

ABSTRACTS.

Abstract maps were prepared of the Dead River Storage Dam lands and other miscellaneous abstract work.

CONTOUR MAPS.

SECTION 10, 47-27 CONTOURS.

Survey notes on this section were all plotted and the maps completed.

SECTION 11, 47-27 CONTOURS.

A 200' to the inch map was posted to include the last surveys.

SECTION 12, 47-27 CONTOURS.

The small amount of work done in this section was plotted.

DEAD RIVER STORAGE DAM E & A 414.

Surveys were made to start construction work, which consisted mainly of the location of railway spur, buildings, spillway section of the dam, etc.

REPORT ON THE ABSTRACT DEPARTMENT FOR THE YEAR 1922.

Documents received have been recorded and copies made when necessary. The abstract of the Minnesota mines and the water power lands are still incomplete.

OPTIONS FOR MINING LEASES.

No options for mining leases have been acquired during the year.

MINING LEASES.

The mining lease under which this Company has operated the Crosby Mine has been surrendered as of December 31, 1922. The Crosby Washing Plant lease has been retained. The Plant has been sub-let to M. A. Hanna & Company.

No new mining leases were taken out during the year.

DOCUMENTS RECORDED.

The following is a list of documents placed in the files during the year 1922:

	<u>NO. RECEIVED.</u>	<u>LAST FILE NO.</u>
Land offers, - - -	53	1354
Authorizations, - -	1	117
Deeds and Miscellaneous,	64	777
Easements, - - - -	9	145
Rights of Way, - - -	6	188
Water rights, - - -	13	30
Surface leases, - -	70	2007
Applications for Sale, -	12	68
Sales, - - - - -	38	330
Tax Histories, - - -	11	517
Legal Opinions, - - -	32	170

LAND OFFERS.

Among the land offers was a list of lands owned by the State of Minnesota, the descriptions of which were shown upon a special map and a report on same received from the Hibbing office. A number of these offers covered property on the Minnesota ranges, among which might be mentioned the Arko Mine on the Cuyuna Range, offered by Mr. Robert M. Adams. This property was examined by Messrs. Barber, Derby and myself. In November, Mr. Adams offered a large number of holdings on the Mesabi Range, some of which covered wash ore properties at the Western end of the Range and others consisted of a tract of land at the extreme East end.

Other offers consisted of property in various states; also in Canada and South America. There were a number of offers in Negaunee from parties desirous of selling their houses and lots.

AUTHORIZATION.

On February 7th, Authorization No. 117 was issued for further explorations on the Virgil Mine property.

DEEDS AND MISCELLANEOUS DOCUMENTS.

This record includes the register of deeds to this Company and also a number of documents principally covering Minnesota property and conveying various rights for which no other place has been provided.

EASEMENTS.

Those for 1922 are mostly Minnesota documents.

RIGHTS OF WAY.

These are also mostly for Minnesota. Two are for highways in Marquette County.

WATER RIGHTS.

Besides the Minnesota documents, there are a number of permits issued to the City of Negaunee for storm sewers across mining property. A permit was granted by Marquette County for the construction of a dam across Dead River at the Hoist.

APPLICATIONS FOR SALE.

These applications are the ones which were received from the Land Department.

SALES.

The sales of Company land which have been entered in this register are those which were sent from the Land Department.

LEGAL OPINIONS.

Most of the legal opinions relate to the title of lands in the Dead River Storage Basin.

LAND OFFER PLAT BOOK.

The information contained in the land offer plat book has been posted.

OUTSIDE EXPLORATIONS.

The register of outside explorations has been posted, using all the

information we could find in the office.

ABSTRACTS.

Additional abstracts have been secured, most of them covering lands in the Dead River Storage Basin. For the Minnesota abstracts, Mr. Carl Brewer is still at work preparing a book similar to those on the Company's mineral rights and water power in this district.

PYRITES.

No offers of pyrites were received during the year. The Company's inquiries regarding pyrites have ceased.

MICHIGAN STATE TAX COMMISSION.

Mr. L. P. Barrett, Appraiser of Mines for the Michigan State Tax Commission, visited this office and the Company's mines during the first week in March. According to his request, the maps for the year 1921 were furnished to him on the end of January so that he might examine them before his visit. He was asked whether the information consisting of maps and tabulations was satisfactory. He replied that it was and further stated that in this matter the Cleveland-Cliffs Iron Company was in a class by itself.

FORCE OF ENGINEERS.

Of the men who were laid off in June 1921, Mr. Archibald Minnear resumed his position as engineer's helper on September 12th.

MOORE & CHASE AND BARNES-HECKER LEASES.

During August, Messrs. G. W. Moore and P. P. Chase came to the office to investigate the maps of these properties. Mr. Chase went underground with me at the Barnes-Hecker Mine. Upon request, maps of all their properties were furnished.

MINING METHODS.

For the American Institute of Mining & Metallurgical Engineers a questionnaire on mining methods was prepared in this office according to suggestions made by superintendents and engineers and it was completed June 26th. An outline for a history of mining methods on the Marquette Range was completed August 22nd.

OLD RECORDS.

Among the old records obtained from the Hard Ore office last year was the correspondence of the Cleveland Iron Mining Company's agents prior to 1883. This correspondence was rearranged and placed in the lower vault of the Engineering Building. A report on the same is dated June 29, 1922.

DEAD RIVER WATER POWER.

Additional lands were secured covering property in the Dead River Storage Basin. The construction of the Hoist dam was begun.

BLUE MINE.

The diversion ditch at the Blue Mine was completed through which the waters of Partridge Brook now flow in the same channel from which they were diverged ~~for~~ ^{after} the Oliver Iron Mining Company's agreement had been made.

IRON ORE INDICATIONS.

Mr. R. A. Brotherton, of the Land Department, called the attention of this Department to indications for iron ore which he had noted while engaged on surveys about twenty years ago. The territory in which these indications are to be found is in the South part of Tilden Township and about ten miles South of Ishpeming. On October 5th, an excursion was made with Mr. Brotherton but further search was deferred until next spring.

DEPLETION.

From December 7th to 11th I was at the Company's office in Cleveland to answer questions on the subject of depletion.

THE CLEVELAND-CLIFFS IRON COMPANY.

REPORT OF THE GEOLOGIST FOR THE YEAR ENDING DECEMBER 31, 1922.

STAFF.

The staff of the Geological Department in 1922 is given in Table I below.

There were no changes in the personnel during the year:

TABLE I.

<u>NAME.</u>	<u>OCCUPATION.</u>	<u>DURATION OF EM- PLOYMENT IN 1922.</u>	<u>DAYS LOST. SICKNESS.</u>	<u>VACATION.</u>	<u>% OF WORKING DAYS WORKED.</u>
E.L.Derby, Jr.	Geologist in charge of Department.	Entire year	0	24 $\frac{1}{4}$	93.4
E. A. Allen	Assisting Geologist, testing diamond drill holes, collecting & labeling samples, etc.	Entire year	14	12 $\frac{1}{2}$	92.8
Gustav Afuhs	Draftsman	Entire year	$\frac{1}{2}$	7	98.0

The year was divided into the factors shown in Table II below:

TABLE II.

Total days of eight hours worked, - -	274 $\frac{1}{2}$ days.
Sundays, - - - - -	53 "
Days resulting from Saturday afternoons,	26 "
Holidays, - - - - -	11 $\frac{1}{2}$ "
Total	365 days.

Table III, below, shows the average number of men regularly employed on the staff of the Geological Department during the last five years:

TABLE III.

<u>YEAR.</u>	<u>AVERAGE NUMBER OF MEN.</u>
1918	4.85
1919	5.44
1920	4.06
1921	3.56
1922	3.00

DIVISION OF WORK AMONG THE MEMBERS OF THE DEPARTMENT.

H. L. Smyth. The work of the Geological Department continued under the direction of Mr. H. L. Smyth as Consulting Geologist, with the exception of the months of June, July, August and September when a leave of absence was occasioned by illness.

E. L. Derby, Jr. The larger part of my time the past year, as in former years, was taken up with the general oversight and supervision of the work of the Department. This has included, besides the usual routine office work, surface drilling explorations in the Iron River District; underground drilling in the Francis, Republic and Stephenson Mines; and the underground geological surveys in the Athens, Barnes-Hecker, Cliffs Shaft, Francis, Holmes, Maas, Morris-Lloyd, Negaunee, Republic and Stephenson Mines. I, personally, made the underground geological surveys of all new development work in these mines.

My time, not taken up with these duties, was spent chiefly as follows:

In February, I made an examination of the mine workings, maps and surface plant of the Delta Mine at Iron River in company with Mr. Stakel. This was covered by a special joint report in connection with an offer of this property to the Company.

In March, I reviewed the Tax Commission estimates with Mr. Barrett, State Appraiser of Mines.

In July, I spent two days in the Duluth office of the Oliver Iron Mining Company analyzing the figures it submitted to the Government in determining the rate of depletion of its $3/4$ interest in the Lake Superior Iron Company. This work was in connection with the claim we later filed with the Government covering the value and depletion of our $1/4$ interest in this property.

In August, I continued the work of depletion of our interest in the Lake Superior Iron Company and also made a valuation estimate of the Jackson property for depletion purposes. I also made an examination of the Arko property on the Cuyuna Range jointly with Mr. Jopling in response to an

offer of this property to the Company. A special joint report covers our findings.

In October, I spent ten days at our Cleveland office and three days in Washington on mineral valuations for depletion of our 1/4 interest in the Lake Superior Iron Company, the Regent Iron Company, the Jackson and Empire properties.

In December, I made a joint estimate of the ore in the Race Course at Negaunee and in the American Mining Company strip under the old D. S. S. & A. Railway right of way, or so-called Adams Mine, with Messrs. Cronk, Anderson and Hulst, engineers for the Oliver Iron Mining Company.

E. A. Allen. Mr. Allen continued as an assistant in the Department throughout the year. He also spent a small part of his time assisting in the Engineering Department in the capacity of truck driver and in underground surveying. The major part of his time in the Geological Department was applied to collecting, sampling and filing drill samples from the current explorations and in making Maas Compass surveys of the several holes. He ran tests on the drill water from several of the holes drilled on the Virgil property to determine the possible soluble sulphur content of this ore. He occasionally assisted me in underground geological surveys. He spent considerable time assisting Mr. Hayden, of the Engineering Department, in making a large number of tests to determine the cubic feet per ton factor of ore in place in the Maas, Negaunee and Athens Mines. He also made the regular monthly carbon report and the annual inventory of diamond drill equipment and did some map work in the office.

Gustav Afuhs. Mr. Afuhs continued as draftsman throughout the year. His work, as in years past, has consisted chiefly in preparing cross-sections of drilling and in posting the current extensions on the underground geological maps and cross-sections of all the operating mines on the Michigan Ranges. He spent considerable time the past year, however, making a new set of geological cross-sections of the Athens, Morris-Lloyd and Negaunee Mines to be used exclusively for Tax Commission estimates of these properties. He colored all the annual report sheets of the ~~Athens~~ Company's

drilling for the year and made copies of drill results for our outside exploration files of all important land offers that were received. The rest of his time was occupied with the routine work of the office.

SURFACE GEOLOGICAL SURVEYS.

Practically no surface geological work was done during the past year. This was due principally to the reduced staff not having time to devote to this branch of the work. Since June 1921, when the depression in the iron business necessitated the reduction of the staff to a minimum, we have gotten along without an assistant geologist by confining our attention only to the more pressing duties of the Department.

UNDERGROUND GEOLOGICAL SURVEYS.

Without an assistant geologist, it has been necessary to depend on several of the engineers for current underground geological data in our operating mines, more particularly in the areas previously developed. I have personally made geological surveys of all new development work in all the mines except the Cliffs Shaft and Republic. In this way we have kept the geological maps and cross-sections of all the mines with the exception of the latter two up to date.

ATHENS MINE.

The Athens Mine continued to be a steady producer. Work in the property was practically confined to mining, the development work having been completed for the present. The geological maps and cross-sections were posted regularly from information furnished us by Mr. Nicolson, Engineer at the property.

AUSTIN MINE.

The Austin Mine was opened again on June 5th and mining continued for the remainder of the year. The work was confined mainly to scrambling on the various levels in the area having a triangular cross-section made by the footwall and the boundary of the Stephenson Mine. A small amount of ore, however, was removed from the shaft pillars, which, during the re-

mainder of the life of the mine, will produce the bulk of the tonnage. No geological data was necessary for the maps of these properties and no geological surveys were made.

BARNES-HECKER MINE.

Work at this property was resumed on June 5th at the time the operating mines were placed on a full time basis. Dams which had been constructed on each of the three levels to control the flow of water to the pumps while the mine was closed and the North Lake area on surface being drained were blasted out and development work resumed. The 1st and 2nd levels were driven ahead, raises put up from all the levels and a number of sub-levels opened up to determine the limits of the ore. This work continued throughout the remainder of the year and geological surveys were made regularly and the maps and cross-sections kept posted up to date. On September 28th, a rough estimate was made of the ore as indicated by the work to date with a result of 882,000 tons. At the end of the year another estimate was made for the Tax Commission which shows a total of 402,100 tons. The latter is very conservative.

CLIFFS SHAFT MINE.

The Cliffs Shaft Mine, which was closed May 31, 1921, was again opened on June 26, 1922. On account of the reduced size of our staff, no geological surveying was attempted in this property on account of the openings remaining accessible for a relatively long period. We anticipate, however, that this work will be caught up some time during the present year.

FRANCIS MINE.

This property produced continuously throughout the year. Geological surveys were made regularly and the geological maps and cross-sections posted. Considerable development work was done during the year and was confined to the extension of the 6th level and the opening up of the ore on the South limb of the syncline above the 5th level. Sub-levels were opened in the upward extension of this ore all the way to the elevation of the 3rd level. We have proved that the formation folds over to the South but as yet the development work has not progressed far enough to determine

whether ore in merchantable quantities exists on the South side of this fold.

HOLMES MINE.

The Holmes Mine was a continuous producer throughout the year. There was a small amount of development work on the 3rd level and several new sub-levels were opened between the 2nd and 3rd levels. Regular geological surveys were made and the geological maps and cross-sections posted.

MAAS MINE.

The Maas Mine produced continuously throughout the year. The geological maps and cross-sections were posted regularly from data furnished us by Mr. Hayden, engineer at the property. The work consisted almost entirely of mining, the only development work being the driving of a timber haulage level half way between the 3rd and 4th main levels.

MORRIS-LLOYD MINE.

Mining was continuous at this property throughout the year. Development work was pushed on the 7th level of the Morris Mine and several small ore bodies encountered which presumably connect with the 6th level. Several sub-levels also were developed between the 6th and 7th levels and the Spies system of mining introduced in one of the larger ore bodies above the 6th level. We have made regular geological surveys of all new development work and have used data furnished us by Mr. Trosvig, Engineer at the property, for posting the geological maps and cross-sections of the areas of the property where only mining is being conducted.

NEGAUNEE MINE.

The Negaunee Mine continued to be one of the largest producers on the Range, the work, however, being confined almost entirely to mining. A new so-called incline slice system of mining is being introduced in one portion of the mine. The geological maps and cross-sections have been posted regularly from data supplied to us by Mr. Moulton, engineer at the property.

REPUBLIC MINE.

The Republic Mine also produced continuously throughout the year. All the ore mined has come from the Pascoe Shaft workings and most of it from

the 2470' and 2570' levels. The latter level is a new one opened up during 1922 and has developed an ore area in the lens extending down from the 2470' level that is even larger than that encountered on the latter level, which is very encouraging. No regular geological surveys were made but all extensions have been posted on the geological maps and enough information obtained to make the regular Tax Commission estimates.

SPIES MINE.

No mining was done at this property during the year but work was started during the summer to sink the shaft an additional 800', from which drifts will be driven to the Virgil property, adjoining the Spies on the West, and through which the ore on the former will be mined.

STEPHENSON MINE.

This property produced continuously throughout the year. The development work consisted of extending the crosscuts on the 6th level and opening up several new sub-levels between the 5th and 6th levels. The greater part of the ore mined during the year has come from just above and just below the 5th level. Regular geological surveys were made and the geological maps and cross-sections posted to date.

EXPLORATIONS.

Drilling explorations were carried on during 1922 in the following districts and mines:

<u>FROM SURFACE.</u>	<u>DISTRICT.</u>	<u>RANGE.</u>
	Iron River	Menominee
<u>FROM UNDERGROUND.</u>		
	<u>MINES.</u>	<u>DISTRICT.</u>
	Francis	Gwinn
	Republic	Republic
	Stephenson	Gwinn

No options for exploring and no mining leases were acquired during the year.

Mining lease No.16 covering the Crosby Mine was surrendered December 31, 1922.

Table IV, which follows, gives the footage drilled, the ore encountered and the cost per foot of drilling for both surface and underground explorations. It will be noted that the average cost of surface drilling was \$3.49 per foot, excluding certain items which are not actually drilling expenses but which are charged to the explorations. By including these items, the average cost was \$3.93 per foot. The average cost of underground drilling in the same way was \$3.37 per foot and \$3.57 per foot respectively. The average cost of all drilling was \$3.44 per foot and \$3.79 per foot respectively. These costs are less than those of last year by 21.3% and 26.3% respectively, in spite of the fact that there was only 7634' of drilling in 1922 against 16011' in 1921, or less than one half, resulting in a corresponding increase in the overhead expense for 1922. The wage scale averaged very nearly the ~~same~~ same in both years.

Table V, which also follows below, gives a comparative cost per foot of total drilling for the last five years:

TABLE IV.
SUMMARY OF DRILLING FOR 1922.

EXPLORATION.	DESCRIPTION. SEC. T. R.	STAND- PIPING FT.	CHURN DRILLING FT.	DIAMOND DRILLING FT.	TOTAL FT.	FIRST CLASS ORE FT.	SECOND CLASS ORE FT.	LEAN ORE FT.	TOTAL COST "A".	COST PER FT. "A".	TOTAL COST "B".	COST PER FT. "B".
<u>SURFACE DRILLING.</u>												
Virgil	24 43 35	380		4268	4648	593	302	188	\$18,251.12	\$3.93	\$16,216.09	\$3.49
Total Surface Drilling		380		4268	4648	593	302	188	\$18,251.12	\$3.93	\$16,216.09	\$3.49
<u>UNDERGROUND DRILLING.</u>												
Francis Mine	27 45 25			156	156	5	0	10	500.36	3.21	456.44	2.93
Republic Mine	7 46 29			2403'6"	2403'6"	261	151	138	9,139.79	3.80	8,661.69	3.60
Stephenson Mine	204 20 & 29 45 25			426'4"	426'4"	137	0	5	1,011.83	2.37	933.69	2.19
Total Underground Drilling				2985'10"	2985'10"	403	151	153	\$10,651.98	\$3.57	\$10,051.82	\$3.37
Grand Total Drilling		380		7253'10"	7633'10"	996	453	341	\$28,903.10	\$3.79	\$26,267.91	\$3.44

NOTE: Cost "A" includes taxes, office expense, engineering, analysis, legal and personal injury.

Cost "B" excludes " " " " " " " " " " (to compare with contract price).

There was no contract drilling done during 1922.

TABLE V.
SUMMARY OF FOOTAGE DRILLED AND COST PER FOOT OF DRILLING FOR LAST FIVE YEARS.

YEAR.	TOTAL FEET DRILLED.	COST PER FOOT "A".	COST PER FOOT "B".
1918	44,138	\$3.65	\$3.49
1919	42,844	4.49	4.31
1920	26,638	5.41	4.81
1921	16,011	5.14	4.37
1922	7,634	3.79	3.44

SURFACE EXPLORATIONS.

MENOMINEE RANGE.

IRON RIVER DISTRICT.

SECTION 24, 43-35.

The only exploration from surface conducted during the year was the drilling done on the Virgil Mine property. This work commenced early in March. The reason for this drilling was to verify the results of the holes drilled several years ago by the Wickwire Mining Company, who formerly leased the property, and also to prove up enough tonnage if possible to warrant sinking the Spies shaft and drifting to the site.

The first hole, No.50, was located about midway between and 100' East of the points where ore was encountered in Wickwire holes Nos.8 and 10. The result of this hole very strikingly confirmed the old drilling, both as to footage and grade of ore.

A series of three holes, Nos.51, 52 and 53, were then drilled on a North-South line 150' East of No.50 to cross-section the ore horizon and explore for its Easterly extension. Good ore in merchantable quantity was encountered in each hole. From this drilling and the results of the old Wickwire holes, we estimated approximately one and a half million tons of developed ore in consequence of which the Spies shaft is now being sunk and drifts planned to reach and mine it.

This drilling by no means limits the tonnage of prospective ore on the property. At the end of the year, an additional hole, No.54, was located and started 100' North and 150' East of No.52 to further aid in laying out the development levels. It was standpiping at a depth of 10' on the last of the year.

UNDERGROUND EXPLORATIONS.

FRANCIS MINE.

One hole, No.19, was drilled in the Francis Mine during the year. It was drilled horizontally and due South from the 126' sub-level on the South limb of the deposit to demonstrate if possible a continuation of ore on the South side of a turnover in the formation in this vicinity. The results proved unsatisfactory as the formation was found to be relatively flat for quite a distance, thus preventing a flat hole from crosscutting the formation sufficiently to thoroughly explore it. The work was discontinued for the present because there was no good location available from which to drill across objective ground.

REPUBLIC MINE.

Drilling in the Republic Mine was continuous throughout the year. During that time twenty one holes, Nos.489 to 509, inclusive, were completed and hole No.510 drilled to a depth of 379'. The total footage drilled during the year was 2403.5'.

All but two of these holes were drilled horizontally and all of them from current working levels, or levels immediately adjacent to them, according to a plan of systematic exploration that has been followed for several years. This resolves itself into three main divisions. In the first place, an attempt is made on all new levels to locate the downward extension of known ore lenses immediately above where they are not found by drifting along the quartzite hanging contact but presumably have dropped back into jasper footwall. Secondly, the hanging contact zone is explored for new ore bodies by drilling in cases where rock drifting is unwarranted until a discovery of ore is made. Lastly, a systematic exploration of the jasper formation is made back to a horizon 100' to 200' from the hanging contact, it being the experience in this mine that all ore bodies of any consequence occur within this zone.

Two holes, Nos.498 and 499, were drilled with dips of -27° and -19° , respectively, in order to reach their objective points from the available

set-ups.

In addition to carrying out this program, several of the holes were drilled through the ore bodies, starting in ore, to determine their thicknesses for the purpose of planning and laying out pillars for their support, as distinct from purely exploring.

All holes were drilled from Pascoe Shaft levels. Nos. 489 to 493, inclusive, were drilled from the 2370' level. A small amount of ore was encountered in No. 489 but so far additional drilling hasn't proved it to be of merchantable extent.

Holes Nos. 494, 495 and 496 were drilled from the 1710' level. Holes Nos. 494 and 496 encountered, in a merchantable quantity, a continuation of ore being mined from below but which in the back of the stope had narrowed to an unmerchantable width.

Hole No. 497, drilled on the 2070' level, was unsuccessful in finding ore.

Holes Nos. 498 and 499 were drilled from the floor of a stope on the 1850' level to determine the dip and trend of the ore in its downward extension as drilling on the level below had failed to locate it.

Holes Nos. 500 and 510 were drilled from the 2470' level into the foot-wall jasper but failed to discover new ore.

Holes Nos. 501, 502 and 507 were drilled from the 1950' level but also encountered no ore.

Holes Nos. 503 to 506, inclusive, were drilled from the 2570' level. The first three holes were located to determine the thickness of ore in the main stope in order to facilitate the plan^{ning} of supporting pillars and No. 506 was drilled to locate the hanging wall contact.

Holes Nos. 508 and 509 were drilled from the 1570' level and encountered small amounts of merchantable ore.

STEPHENSON MINE.

Six holes were drilled in the Stephenson Mine during the year.

Holes Nos.1, 2 and 6 were drilled from the 6th level. No.1 was drilled vertically and No.2 with a dip of -45° S. $63^{\circ}22'$ W. from the Northeast end of the level to get an idea of the downward extent and trend of the ore at this point. No.6 was drilled with a dip of -60° due South from the South end of the level to determine the trend of the main Stephenson ore body below the level. All these holes were successful in encountering appreciable footages of ore and fulfilled their objectives.

Holes Nos.3, 4 and 5 were drilled as uppers, the first two at $+90^{\circ}$ and the last at $+75^{\circ}$, all from the 840' sub-level. These holes were located for the purpose of tapping and draining the ledge basin over the main ore body for which churn drill hole No.66 was sunk from surface to the 6th level in 1920 but without success in draining the basin. So far these three holes have failed to aid materially in this problem but it is hoped that a solution will be found during the present year.

EXPLORATIONS BY OTHER COMPANIES.

Mr. Ernest Allen, who some years ago made periodical visits to the explorations of other companies on Michigan and Wisconsin iron ranges, did not continue to do so in 1922. The reason for this is partly due to the business depression and resulting curtailment of activities and partly to the fact that very little exploring was done during the year by other companies.

EXAMINATIONS OF MINERAL LAND OFFERS.

Two mineral land offers were examined during the year as follows:

Delta Mine property, No.1306.

Arko Mine property, No.1320.

The Delta Mine is located within the city limits of Iron River and close to the center of the town. Mr. Stakel and I both examined the underground workings, surface plant and maps and embodied the results in a

special joint report. The offer was turned down.

The Arko Mine is a manganiferous property on the Cuyuna Range near Iron-ton, Minnesota. Mr. Jopling accompanied me on this examination and the results are compiled in a special joint report in which Mr. Barber joined us. The property has possibilities as a manganiferous ore producer and we recommended that an exploring option be taken. The offer has since been declined, however, without any further action being taken.

EXPENSE STATEMENT.

Tables VI and VII, which follow, show a detailed statement of charges to Geological expense for the year and a comparative statement of these charges for the last three years. They are self-explanatory:

TABLE VI.

DETAILED STATEMENT OF CHARGES TO GEOLOGICAL EXPENSE FOR YEAR 1922.

GEOLOGICAL DEPARTMENT.

<u>Salaries.</u>	<u>Travel.</u>	<u>Operating Autos.</u>	<u>Supplies.</u>	<u>Office Expense.</u>	<u>Total.</u>
\$12,279.80	\$312.64	\$860.72	\$881.01	\$19.52	\$14,353.69

EXPENSES OF H.L. SMYTH.

<u>Travel.</u>	<u>Supplies.</u>	<u>Misc.</u>	<u>Total.</u>
\$74.88	\$2.00	\$120.00	\$196.88

SUMMARY.

Expenses of Geological Department,	-	\$14,353.69
" " H. L. Smyth,	-	196.88
Total		\$14,550.57

The more important items grouped above as travel, operating autos and supplies are as follows:

Travel.

Rail travel,	-	\$256.87
Horse maintenance,	-	130.65

Operating Autos.

Depreciation on Buick,	-	\$47.50
" " truck for Eng. & Geol. Depts.	-	83.12 (Geol.prop.)

Supplies.

Rental of Maas Compasses, -	\$100.00
Maas Compass supplies, - -	43.00
Blue print paper, etc, - -	72.25
Annual report, - - - -	166.46
Steel balls for testing ore factors, - - - -	26.00
Monroe Calculating Machine, -	100.00
Tracing cloth, - - - -	85.44

TABLE VII.

COMPARATIVE STATEMENT OF CHARGES TO THE GEOLOGICAL DEPARTMENT FOR LAST THREE YEARS.

	<u>1922.</u>	<u>1921.</u>	<u>1920.</u>
Salaries, - - - - -	\$12,279.80	\$16,643.16	\$18,846.76
Travel, - - - - -	312.64	552.25	412.74
Operating autos, - - - -	860.72	1,075.18	1,189.45
Supplies, - - - - -	881.01	1,190.29	1,365.96
Visiting Outside Explorations,	0	0	197.66
Miscellaneous, - - - - -	19.52	45.91	199.30
Total,	\$14,353.69	\$19,506.79	\$22,211.87
Expenses of H. L. Smyth, i.e., travel, supplies and miscellaneous,	196.88,	773.56	686.19
Grand total,	\$14,550.57	\$20,280.35	\$22,898.06

ANGELINE MINE

On February 16th the underground pumping equipment was removed from the mine and the Oliver Iron Mining Company started to handle the water with their own pumps. The Cameron centrifugal pump and motor was shipped to the Dead River Storage Dam. The hoist, underground haulage set and accessories are still in the engine house. The hoist is not in very good condition and would not be suitable for use at any other mine. However, the hoist motor is in good condition and is available for service at any time that it might be needed at some other mine.

CLIFFS SHAFT MINE

This mine was idle until June 26th with the exception of the underground pumps, which have been operating continuously and have not given us any trouble.

The installation of a Re-crushing Plant has been started at this mine. This will consist of a 48" Symons disc crusher, two belt conveyors and a magnetic separator, with the necessary motors for their operation. As all the equipment for this plant has not been received, it is impossible to say just when it will be ready to operate.

All the mechanical equipment operated in a satisfactory manner and there were no delays of importance.

HARD ORE SHOPS

There were no additions or changes made in the Shops. All equipment operated in a satisfactory manner.

HOLMES MINE

The motor driving the large crusher at this mine burned out on December 23rd. This did not cause much delay as it was replaced by a motor taken from the South Jackson Crushing Plant.

There were no additions or changes made to the mechanical equipment. Operation was very satisfactory.

LAKE MINE

The work of removing the underground pumping equipment was started on February 16th and was finished on the 24th. All the pumping equipment was stored in the blacksmith shop at the mine with the exception of the plunger pump motor, which was taken to the General Storehouse, and the centrifugal pump and motor, which was shipped to the Boeing Mine.

The water from this mine is taken care of by the pumping plant maintained at the Angeline Mine by the Oliver Iron Mining Company.

SALISBURY MINE

This mine has been idle the entire year.

The only mechanical equipment in operation was the underground pumps, which operated in a satisfactory manner and caused no trouble of any kind. Some repairs to the centrifugal pump motors are necessary and parts have been ordered for the same.

ATHENS MINE

An Ingersoll-Rand "PRE-2" air compressor, capacity 2275 cu. ft. per minute, driven by a General Electric 450 H.P. motor, was purchased from the United States Shipping Board, Hog Island, Pa. It has been installed in the engine room and is operating very nicely. It was started up on November 24th.

ATHENS MINE (Cont'd)

The skip and cage hoists have both been equipped with "Lilly" hoist controls of the same type as those in use at the Maas Mine. The operation of these safety devices is as perfect as it is possible to get them. We do not think we will have any more overwinds on any hoist that it equipped with this type of control.

The new steel stocking trestle is about completed.

There has been no trouble of any kind with the mechanical equipment.

MAAS MINE

The Aldrich plunger pump formerly in service on the second level was moved down to the third level. This is a much better arrangement as all of the main pumps are now in the same pump station and one operator can take care of them.

The steam turbine was operated from August 26th to September 6th, from September 19th to October 7th, from October 12th to October 24th, from October 30th to November 8th and from December 7th to December 22nd. This was necessary on account of the low water in the rivers.

On December 29th, at about 10:00 P.M., fire started from some unknown cause in the carpenter shop. The roof was entirely burned off the carpenter shop, a part of the roof on the blacksmith shop and most of the belting in the machine shop was destroyed.

There were no other changes or additions and all mechanical equipment operated in a satisfactory manner.

MAAS CRUSHING PLANT

This plant was in operation from May 15th to November 15th. Operation was very satisfactory.

It will be necessary to replace the conveyor belt as the old one is completely worn out; also the screen above the crusher. Both the belt and screen are on the ground and will be installed before spring.

NEGAUNEE MINE

We have had considerable trouble with hot bearings on the flywheel set at this mine. We now think we have this taken care of as we have installed a rotary oil pump with a cooling tank, which will supply the bearings with considerable more oil under pressure.

The underground centrifugal pump motor burned out and was repaired. This did not affect mine operations.

All other mechanical equipment operated satisfactorily.

SOUTH JACKSON CRUSHING PLANT

Not in operation.

SOUTH JACKSON MINE

Operations in the Pit were conducted from May 19th to June 17th and from September 13th to September 27th. The mechanical equipment operated in a satisfactory manner.

BARNES-HECKER MINE

On January 9th the 2,000 G.P.M. pump at North Lake sank to the bottom of the lake. The pump was recovered and the motor taken to the Hard Ore Shops and dried out and put in service again on January 24th. On February 7th a bad mud slide occurred and we came near losing the 4,000 G.P.M. pump. It was necessary to discontinue the use of this pump, leaving us with only the 2,000 G.P.M. pump in operation. The water at this time was down about 17 ft. From this time on we had considerable trouble on account of the spring water, and as we were able to lower the water only about 3" per day it was a pretty slow job. At present we are doing the pumping on two 8 hr. shifts and holding the water near the bottom.

The water conditions at the mine are a good deal better. One pump

BARNES-HECKER MINE (Cont'd)

is now able to take care of the water, while formerly it took three pumps.

We have had considerable trouble with the belt driving the Aldrich pump on the third level. We have ordered herringbone gears to replace this belt drive.

All other mechanical equipment operated in a satisfactory manner.

LLOYD MINE

We have installed "Lilly" hoist controls on the skip and cage hoists at this mine. These are operating very nicely.

There were no other changes or additions to the mechanical equipment. Operation was very satisfactory.

MORRIS MINE

A "Lilly" hoist control has been installed on the cage hoist, and it is operating satisfactorily. The control for the skip hoist is on the ground and will be installed as soon as possible.

There were no other additions or changes to the mechanical equipment and operation of same was very satisfactory.

Generator on underground haulage set burned out again and was replaced by a reserve set.

SECTION 6 SHAFT

There were no changes or additions to the mechanical equipment at this mine. All equipment operated in a satisfactory manner.