NEGAUNEE- - - - - - - - - - - - - - - - - - - 6/7/24 - - - - - - - - - 5,736 Tons.

	Fe.	Phos	Sil.	Alu.	Mois.	Fe.Nat.
Mine	54.97	.083	9.24	4.25	15.47	-----
Hughes-Guentzler	54.85	---	----	----	15.80	46.18

PIONEER- - - - - - - - - - - - - - - - - - - 6/8/24- - - - - - - - - - - 8,993 Tons.

Mine	55.12	.086	9.67	4.23	15.80	-----
Crowell & Murray	55.20	---	----	----	14.73	47.07

PONTIAC- - - - - - - - - - - - - - - - - - - 6/13/24 - - - - - - - - - 10,896 Tons.

Mine	55.05	.084	9.64	4.16	15.43	-----
Cremer & Case	55.45	---	----	----	14.83	47.23

COLONEL- - - - - - - - - - - - - - - - - - - 6/13/24 - - - - - - - - - 5,683 Tons.

Mine	55.29	.077	9.84	4.26	15.25	-----
Hughes-Guentzler	55.80	---	----	----	15.62	47.08

PIONEER- - - - - - - - - - - - - - - - - - - 6/18/24 - - - - - - - - - 8,837 Tons.

Mine	55.00	.082	10.58	4.09	15.29	-----
Cremer & Case	55.35	---	-----	----	14.63	47.25

PETER WHITE- - - - - - - - - - - - - - - - - 6/19/24 - - - - - - - - - 8,748 Tons.

Mine	54.88	.084	10.58	4.16	15.53	-----
Oscar Textor	54.65	---	-----	----	14.74	46.59

CENTRAL WEST- - - - - - - - - - - - - - - - -6/21/24 - - - - - - - - - 4,661 Tons.

Mine	55.05	.086	10.95	3.91	15.11	-----
Crowell & Murray	54.50	---	-----	----	14.20	46.76

A.E.R.SCHNEIDER- - - - - - - - - - - - - - - 6/24/24 - - - - - - - - - 7,924 Tons.

Mine	54.36	.088	11.30	3.87	14.88	-----
Cremer & Case	54.80	---	-----	----	14.54	46.83

W. H. WOLF- - - - - - - - - - - - - - - - - -6/26/24- - - - - - - - - - 8,924 Tons.

Mine	54.51	.088	10.69	4.02	14.45	-----
Hughes-Guentzler	55.00	---	----	----	14.03	47.28

MICHIGAN- - - - - - - - - - - - - - - - - - -6/28/24 - - - - - - - - - 3,157 Tons.

Mine	54.74	.085	11.21	4.44	15.17	-----
Cremer & Case	54.50	---	-----	----	13.49	47.15

PETER WHITE- - - - - - - - - - - - - - - - -6/29/24- - - - - - - - - - 8,825 Tons.

Mine	54.45	.083	10.97	4.15	14.50	-----
Cremer & Case	54.75	---	-----	----	13.78	47.21

ISHPEMING- - - - - - - - - - - - - - - - - -7/1/24- - - - - - - - - - - 6,264 Tons.

Mine	53.59	.082	11.98	4.22	15.73	-----
Oscar Textor	54.30	---	-----	----	14.38	46.49

PIONEER- - - - - - - - - - - - - - - - - - -7/3/24- - - - - - - - - - - 8,879 Tons.

Mine	53.72	.080	12.02	3.96	15.47	-----
Crowell & Murray	53.50	---	-----	----	14.10	45.96

BOEING MINE.

MARQUETTE- - - - - - - - - - - - - - - - - - 7/3/24 - - - - - - - - - - - 6,872 Tons.

	Fe.	Phos	Sil.	Alu.	Mois.	Fe.Nat.
Mine	55.16	.079	11.46	4.03	14.47	-----
Hughes-Guentzler	55.05	---	-----	----	14.13	47.27

PONTIAC- - - - - - - - - - - - - - - - - - - 7/6/24 - - - - - - - - - - - 5,493 Tons.

Mine	54.53	.077	11.96	4.22	14.82	-----
Crowell & Murray	54.80	---	-----	----	14.31	46.96

PETER WHITE- - - - - - - - - - - - - - - - - 7/10/24 - - - - - - - - - - 8,765 Tons.

Mine	54.79	.080	10.94	4.70	13.98	-----
Oscar Textor	55.03	---	-----	----	13.07	47.84

ISHPEMING- - - - - - - - - - - - - - - - - - 7/12/24 - - - - - - - - - - 9,823 Tons.

Mine	54.97	.080	10.79	4.51	14.61	-----
Crowell & Murray	54.70	---	-----	----	14.70	46.66

PONTIAC- - - - - - - - - - - - - - - - - - - 7/14/24 - - - - - - - - - - 11,044 Tons.

Mine	53.99	.083	11.47	4.89	15.69	-----
Crowell & Murray	54.25	---	-----	----	14.50	46.38

PETER WHITE- - - - - - - - - - - - - - - - - 7/19/24 - - - - - - - - - - 8,812 Tons.

Mine	54.37	.083	10.73	5.77	15.42	-----
Hughes-Guentzler	55.55	---	-----	----	14.20	47.66

W. G. MATHER- - - - - - - - - - - - - - - - -7/21/24 - - - - - - - - - - 9,758 Tons.

Mine	54.88	.082	10.52	4.83	14.47	-----
Oscar Textor	54.95	---	-----	----	13.84	47.35

PONTIAC- - - - - - - - - - - - - - - - - - - 7/23/24- - - - - - - - - - 11,011 Tons.

Mine	53.92	.083	11.04	6.78	15.85	-----
Hughes-Guentzler	54.45	----	-----	----	15.37	46.08

PIONEER- - - - - - - - - - - - - - - - - - - 7/28/24 - - - - - - - - - - 9,016 Tons.

Mine	54.10	.081	10.76	6.80	15.21	-----
Cremer & Case	54.40	---	-----	----	14.34	46.60

PONTIAC- - - - - - - - - - - - - - - - - - - 8/1/24 - - - - - - - - - - 11,028 Tons.

Mine	54.90	.075	9.79	6.61	15.36	-----
Oscar Textor	54.75	---	----	----	14.40	46.87

W. H. WOLF- - - - - - - - - - - - - - - - - -8/-/24- - - - - - - - - - - 7,019 Tons.

Mine	53.97	.080	10.83	7.00	15.32	-----
Crowell & Murray	54.30	---	-----	----	14.41	46.47

GRAND ISLAND- - - - - - - - - - - - - - - -8/4/24- - - - - - - - - - - 8,217 Tons.

Mine	55.22	.071	9.35	7.09	15.10	-----
Cremer & Case	55.00	---	----	----	14.51	47.02

W. G. MATHER- - - - - - - - - - - - - - - - -8/6/24- - - - - - - - - - - 3,376 Tons.

Mine	55.30	.077	10.66	5.94	14.18	-----
Crowell & Murray	55.56	---	-----	----	13.74	47.93

BOEING MINE.

PIONEER- - - - - - - - - - - - - - - - - - - 8/9/24- - - - - - - - - - - - 9,005 Tons.

	Fe.	Phos	Sil.	Alu.	Mois.	Fe.Nat.
Mine	55.05	.072	9.77	7.15	14.90	-----
Oscar Textor	55.55	---	----	----	13.77	47.90

THOS. BRITT- - - - - - - - - - - - - - - - - 8/13/24- - - - - - - - - - - - 5,881 Tons.

Mine	55.25	.070	9.63	6.82	15.31	-----
Crowell & Murray	56.05	---	----	----	14.27	48.05

W. H. WOLF- - - - - - - - - - - - - - - - - -8/14/24- - - - - - - - - - - - 9,190 Tons.

Mine	55.26	.068	9.46	6.82	15.29	-----
Hughes-Guentzler	55.25	---	----	----	14.37	47.31

PONTIAC- - - - - - - - - - - - - - - - - - -8/20/24- - - - - - - - - - - - 11,071 Tons.

Mine	54.92	.073	9.79	7.07	15.01	-----
Cremer & Case	55.20	---	----	----	13.04	48.00

PIONEER- - - - - - - - - - - - - - - - - - -8/22/24- - - - - - - - - - - - 9,022 Tons.

Mine	55.43	.071	8.86	6.57	14.59	-----
Oscar Textor	55.25	---	----	----	13.21	47.95

GRAND ISLAND- - - - - - - - - - - - - - - - 8/27/24- - - - - - - - - - - - 8,310 Tons.

Mine	55.08	.076	9.52	6.08	14.52	-----
Cremer & Case	56.30	---	----	----	13.06	48.95

MARQUETTE- - - - - - - - - - - - - - - - - -8/30/24- - - - - - - - - - - - 6,956 Tons.

Mine	55.02	.074	9.69	6.39	13.62	-----
Cremer & Case	55.75	---	----	----	13.14	48.42

W. G. MATHER- - - - - - - - - - - - - - - - 9/2/24- - - - - - - - - - - - 4,329 Tons.

Mine	55.27	.077	9.68	5.98	13.05	-----
Cremer & Case	56.00	---	----	----	13.42	48.48

GRAND ISLAND- - - - - - - - - - - - - - - - 9/9/24- - - - - - - - - - - - 8,133 Tons.

Mine	55.75	.079	8.51	7.15	14.09	-----
Crowell & Murray	56.23	---	----	----	13.10	48.86

W. H. WOLF- - - - - - - - - - - - - - - - - 9/13/24 - - - - - - - - - - - 9,321 Tons.

Mine	55.98	.079	8.88	6.72	13.97	-----
Hughes-Guentzler	57.03	---	----	----	13.11	49.55

GRAND ISLAND- - - - - - - - - - - - - - - - 9/21/24 - - - - - - - - - - - 8,134 Tons.

Mine	56.01	.079	8.92	6.53	14.59	-----
Oscar Textor	56.45	---	----	----	12.55	49.37

MARQUETTE- - - - - - - - - - - - - - - - - -9/25/24- - - - - - - - - - - - 6,899 Tons.

Mine	56.98	.076	9.58	6.40	13.99	-----
Cremer & Case	56.80	---	----	----	13.41	49.18

W. H. WOLF- - - - - - - - - - - - - - - - - 9/27/24 - - - - - - - - - - - 9,212 Tons.

Mine	56.31	.080	9.13	6.88	14.10	-----
Crowell & Murray	57.12	---	----	----	12.80	49.81

BOEING MINE.

PENOBSCOT- - - - - - - - - - - - - - - -10/3/24- - - - - - - - - - - - 6,508 Tons.

	Fe.	Phos	Sil.	Alu.	Mois.	Fe.Nat.
Mine	56.65	.081	8.85	6.83	13.95	-----
Hughes-Guentzler	56.60	---	----	----	13.08	49.20

MUNISING- - - - - - - - - - - - - - - - -10/4/24- - - - - - - - - - -5,901 Tons.

Mine	56.47	.079	8.91	7.00	13.42	-----
Crowell & Murray	56.60	---	----	----	12.65	49.44

PIONEER- - - - - - - - - - - - - - - - -10/5/24- - - - - - - - - - - 2,454 Tons.

Mine	56.69	.080	8.95	7.39	13.72	-----
Crowell & Murray	56.85	---	----	----	12.55	49.71

PETER REISS- - - - - - - - - - - - - - -10/10/24- - - - - - - - - -4,347 Tons.

Mine	56.48	.079	8.55	7.20	13.12	-----
Oscar Textor	56.20	---	-----	----	12.65	49.09

WM. H. WOLF- - - - - - - - - - - - - - -10/12/24- - - - - - - - - 8,172 Tons.

Mine	56.00	.071	10.12	----	13.75	-----
Oscar Textor	55.70	----	-----	----	12.80	48.57

PENOBSCOT- - - - - - - - - - - - - - - -10/19/24- - - - - - - - - 6,515 Tons.

Mine	55.98	.076	9.69	----	13.81	-----
Hughes-Guentzler	56.47	---	----	----	12.39	49.47

W. E. FITZGERALD- - - - - - - - - - - - -10/20/24- - - - - - - - - 6,953 Tons.

Mine	56.66	.074	9.25	----	13.85	-----
Cremer & Case	56.65	----	----	----	12.53	49.53

WM. G. MATHER- - - - - - - - - - - - - - -10/24/24- - - - - - - - 2,532 Tons.

Mine	56.86	.075	8.57	6.77	13.62	-----
Crowell & Murray	56.95	---	----	----	13.15	49.46

GRAND ISLAND- - - - - - - - - - - - - - -10/24/24- - - - - - - - - 8,210 Tons.

Mine	56.31	.076	10.14	-----	14.19	-----
Crowell & Murray	56.90	---	-----	-----	12.86	49.58

ANGELINE- - - - - - - - - - - - - - - - -11/7/24- - - - - - - - - 6,558 Tons.

Mine	57.00	.079	8.50	6.45	12.87	-----
Oscar Textor	57.78	---	----	----	11.45	51.16

PIONEER- - - - - - - - - - - - - - - - - 11/10/24- - - - - - - - - 8,890 Tons.

Mine	56.75	.078	8.30	6.97	13.19	-----
Hughes-Guentzler	57.00	---	----	----	12.24	50.02

PENOBSCOT- - - - - - - - - - - - - - - -11/18/24- - - - - - - - - 6,197 Tons.

Mine	56.65	.076	7.34	7.34	12.73	-----
Cremer & Case	56.65	---	----	----	12.75	49.43

BOEING MINE.

PIONEER- - - - - - - - - - - - - - - - - 11/20/24 - - - - - - - - - - 8,396 Tons.

	Fe.	Phos	Sil.	Alu.	Mois.	Fe.Nat.
Mine----------	56.36	.077	8.44	7.12	12.64	-----
Crowell & Murray----------	56.10	---	----	----	12.67	48.99

Included in the above cargoes are 4,817 tons of Helmer ore.

Following are the cargoes of Upson Grade shipped during the 1924 season. These cargoes are made up of 36,157 tons of Boeing ore and 24,042 tons of Hill-Trumbull ore:

A. S. UPSON- - - - - - - - - - - - - - -5/11/24- - - - - - - - - - - - 6,336 Tons.

	Fe.	Phos	Sil.	Mois.	Fe.Nat.
Mine----------	56.53	.066	10.25	12.02	-----
Hughes-Guentzler----------	57.12	---	11.04	10.66	51.03

A. S. UPSON- - - - - - - - - - - - - - -6/7/24- - - - - - - - - - - - 6,241 Tons.

Mine----------	57.11	.077	8.53	12.38	-----
Oscar Textor----------	57.45	---	8.50	10.41	51.47

A. S. UPSON- - - - - - - - - - - - - - -6/17/24- - - - - - - - - - - - 6,233 Tons.

Mine----------	57.10	.077	8.24	12.32	-----
Crowell & Murray----------	56.90	---	8.89	11.32	50.46

A. S. UPSON- - - - - - - - - - - - - - -7/20/24- - - - - - - - - - - - 6,435 Tons.

Mine----------	56.82	.072	9.19	12.62	-----
Oscar Textor----------	58.00	---	----	7.99	53.37

A. S. UPSON- - - - - - - - - - - - - - - 8/10/24 - - - - - - - - - - - - 6,399 Tons.

Mine----------	57.46	.075	8.00	11.04	-----
Cremer & Case----------	57.60	---	7.69	8.81	52.53

A. S. UPSON- - - - - - - - - - - - - - - 8/31/24 - - - - - - - - - - - - 6,350 Tons.

Mine----------	56.80	.065	8.37	12.25	-----
Hughes-Guentzler----------	56.85	---	7.90	11.25	50.45

A. T. KINNEY- - - - - - - - - - - - - - 9/4/24 - - - - - - - - - - - - 9,484 Tons.

Mine----------	56.26	.071	9.15	10.71	-----
Crowell & Murray----------	55.85	---	7.86	11.19	49.60

A. S. UPSON- - - - - - - - - - - - - - - 9/21/24 - - - - - - - - - - - - 6,376 Tons.

Mine----------	57.68	.070	8.66	11.39	-----
Oscar Textor----------	57.00	---	7.90	9.64	51.51

A. S. UPSON- - - - - - - - - - - - - - - 10/2/24 - - - - - - - - - - - - 6,345 Tons.

Mine----------	58.13	.074	8.49	11.67	-----
Cremer & Case----------	57.65	---	8.17	9.07	52.42

BOEING MINE.

A comparison of the Mine and Lower Lake analysis on the cargoes of straight Boeing ore follows:

	Fe.	Phos	Sil.	Alu.	Mois.	Fe.Nat.
Mine Analysis----------	55.29	.079	9.96	5.46	14.54	47.25
Lower Lake Analysis----	55.56	---	----	----	13.88	47.85

A comparison of the Mine and Lower Lake analysis on the cargoes of Upson Grade follows:

	Fe.	Phos	Sil.	Alu.	Mois.	Fe.Nat.
Mine Analysis----------	57.06	.072	8.79	----	11.76	50.35
Lower Lake Analysis----	57.09	---	8.45	----	10.09	51.33

A composite analysis of the season's shipments follows:

Tons.	Fe.	Phos	Sil.	Mn.	Alumina	Lime	Mag.	Sulphur	Loss
505,348	55.24	.080	9.81	.81	5.47	.21	.16	.010	4.45

The tonnage and analysis of the ores entering into the Upson mixture is shown below:

	Tons	Fe.	Phos	Sil.	Mois.	Fe.Nat.
Boeing Ore----------	36,157	55.31	.078	9.60	14.29	47.40
Hill-Trumbull Ore-----	24,042	59.69	.064	7.57	7.95	54.94
TOTAL AND AVERAGES----	60,199	57.06	.072	8.79	11.76	50.35

BOEING MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1924.

GRADE	IRON	PHOS.	SILICA	MANG.	ALUM.	MOIST.
Boeing Merch.,	55.38	.080	9.82	.86	-	-
" Susquehanna,	57.02	.078	9.05	.95	-	-
" Lean,			(No Production)			

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR-1924.

GRADE	IRON	PHOS.	SILICA	MANG.	ALUM.	MOIST.	Lake Erie IRON	Lake Erie MOIST.
Boeing Merch.,	55.29	.079	10.00	.84	5.46	14.54	55.57	13.87
" Susquehanna,			(No Shipments)					
" Lean,			(No Shipments)					

ORE STATEMENT - DECEMBER 31ST, 1924.

	PIT BOEING MERCHANT. ORE	PIT BOEING LEAN ORE	SHAFT BOEING MERCHANT. ORE	SHAFT BOEING LEAN ORE	BOEING SUSQUE-HANNA ORE	TOTAL	TOTAL LAST YEAR
On Hand Jan. 1, 1924,	-	33,417	17,659	-	-	51,076	47,315
Output for Year,	333,531	-	178,021	-	9,415	520,967	503,888
Stockpile Overrun,	-	-	3,814	-	-	3,814	-
Total,	333,531	33,417	199,494	-	9,415	575,857	551,203
Shipments,	333,531	-	164,512	-	7,305	505,348	500,127
Balance on Hand,	-	33,417	34,982	-	2,110	70,509	51,076
Increase in Output,						20,893	
Increase in Ore on Hand,						19,433	

1924 -- 1-8 Hour Shift, Jan. 1st to Dec. 31st, 1924.

1923 -- 2-8 Hour Shifts, Jan. 1st to Apr. 15th, 1923.
1-8 Hour Shift, Apr. 15th to Dec. 31st, 1923.
Pit operations began June 2nd, and ceased Nov. 9th, 1923.

BOEING MINE

SHIPMENTS FOR YEAR-1924.

GRADE	PIT	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Pit, Boeing Merchantable,	333,531	-	-	333,531	-
Pit, Boeing Lean,	-	-	-	-	-
Shaft, Boeing Merchantable,	-	106,061	58,451	164,512	494,770
Shaft, Boeing Lean,	-	-	-	-	5,357
Boeing Susquehanna,	-	1,250	6,055	7,305	-
Total,	333,531	107,311	64,506	505,348	500,127
Total Last Year,	363,225	87,074	49,828	500,127	
Increase,				5,221	

BOEING MINE

COMPARATIVE MINING COST FOR YEAR

	1924	1923	INCREASE	DECREASE
Open Pit Product	333,531	363,225		29,694
Shaft Product	191,250	140,663	50,587	
Total Product	524,781	503,888	20,893	
OPEN PIT COSTS				
Operating Accounts	.263	.189	.074	
General Accounts	.029	.024	.005	
Winter Expense	.062	.009	.053	
Stripping Amortization	1.150	1.142	.008	
Total Open Pit Costs	1.504	1.364		
SHAFT COSTS				
Underground Costs	1.334	1.613		.279
Surface Costs	.141	.209		.068
General Mine Accounts	.204	.195	.009	
Loading & Shipping	.033	.050		.017
Total Shaft Costs	1.712	2.067		
Depreciation	.400	.427		.027
Occupation Tax	.024	.053		.029
Taxes	.080	.083		.003
Central Office	.010	.010		
Uncompleted Construction	.050		.050	
Cost Adjustments	.003	.002	.001	
Misc.Debits & Credits	.009	.115		.006
Total Cost on Cars	2.116	2.250		.134
No.Days Operating - Pit	142	124		18
No.Shifts & Hours "	1-10	1-10		
Avg.Daily Product	2349	2929		580
No.Days Operating -Shaft	307	308		1
No.Shifts & Hours	1-8	2-8;108		
Avg.Daily Product	623	457	166	

BOEING MINE

TIMBER STATEMENT FOR YEAR ENDING DECEMBER 31,1924.

KIND	LINEAL FEET	AVG.PRICE PER FOOT	AMOUNT 1924	AMOUNT 1923
7" to 9" Timber	135,066	.1001	13520.10	15835.90
9" to 12" "	102,321	.1001	10244.00	7918.00
Total Timber 1924	237,387	.1001	23764.20	23753.90
Total " 1923	237,387	.10		23753.90
	LINEAL FEET	PER 100'		
6' Lagging	674,820	.686	4636.00	3544.50
Poles	239,690	1.25	2996.12	2470.43
Covering boards	265,926	1.494	3973.77	6105.28
Total 1924	1,180,436		11605.89	12120.21
Product (1)			187,436	140,450
Feet timber per ton of ore			1.266	1.691
" Lagging			3.600	3.651
" Boards			1.418	3.174
" Poles			1.278	1.122
" Lagging per foot of timber			2.842	2.159
Cost per ton for timber			.126	.169
" lagging			.024	.025
" poles			.015	.017
" boards			.021	.043
" " timber,lagging & poles			.176	.254
Equivalent of stull timber to bd.measure			366,288	366,603
Feet of bd.measure per ton of ore			1.954	2.61

(1) Includes overrun.

BOEING MINE

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE

KIND	QUANTITY	AVERAGE PRICE	AMOUNT 1924	AMOUNT 1923
40% Powder	64,287	12.875	8277.35	5056.07
Total Powder	64,287	12.875	8277.35	5056.07
Fuse	150,200	.68	1021.41	640.32
Caps	39,300	1.118	439.57	321.16
Total Fuse,Caps,Etc.			1450.98	961.48
Total All Explosives			9728.33	6017.55
Product			187,436	140,450
Pounds of powder per ton of ore			.342	.279
Cost per ton for powder			.044	.036
" " fuse,etc.			.007	..007
" " all explosives			.051	.043
Avg.price per pound for powder			.12875	.1288

ANALYSIS OF BOEING MINE COST SHEET FOR THE YEARS 1923 AND 1924

OPEN PIT

We mined 333,531 tons of ore from the open pit in 1924, as compared with 363,225 tons in 1923, a decrease of 29,694 tons.

The analysis of the 1923 and 1924 open pit cost sheets follows:

PIT OPERATING ACCOUNTS:	----1923---- COST PER TON	----1924---- COST PER TON
Drilling and Blasting----------	$ .000	$.026
Steam Shovels, Operating----------	.047	.048
" " Repairs & Maintenance----------	.005	.009
Locos. & Cars, Operating----------	.066	.072
" " Repairs & Maintenance----------	.002	.005
Track Expense----------	.029	.028
Pumping & Drainage----------	.016	.035
Water Supply----------	.003	.002
General Open Pit Expense----------	.018	.035
Open Pit Superintendence----------	.003	.003
TOTAL----------	$ .189	$.263
GENERAL ACCOUNTS:		
Engineering----------	.002	.003
Assaying----------	.010	.009
Personal Injury Expense----------	.001	.001
Mine Office----------	.006	.009
Special Expenses----------	.000	.001
District Office----------	.005	.006
TOTAL GENERAL ACCOUNTS-------	$ .024	$.029
Stripping----------	1.142	1.150
Winter Expense----------	.009	.062
COST OF PRODUCTION----------	$1.364	$1.504

It was not necessary to do any "DRILLING & BLASTING" during 1923, whereas we were obliged to shake the hard cretaceous capping at the east end of the pit, as well as do considerable block holing and reducing of chunks during 1924. The 1924 cost of $.026 per ton shows as an increase.

For "OPERATING STEAM SHOVELS" there was an increase of $.001 per ton in the 1924 costs, as compared with the previous year. This was due to a lower tonnage handled and the slowing down of operations on account of the hard cretaceous capping and extensive manoeuvring of the shovel at the east end of the pit.

BOEING MINE.

There was an increase of $.004 per ton in the item "STEAM SHOVEL REPAIRS AND MAINTENANCE". The 350-ton shovel was new for the 1923 operations, whereas during 1924 more replacements and repairs were necessary.

Under "OPERATING LOCOMOTIVES & CARS" there was a 1924 increase of $.006 per ton. The amount of ore loaded per operating day was less, due largely to the unfavorable mining conditions at the east end of the pit. It was necessary to do considerable switching at the east end of the pit and the hard capping of cretaceous material slowed up loading operations appreciably.

There was a 1924 increase of $.003 per ton covering "REPAIRS TO LOCOMOTIVES & CARS". The locomotives were new in 1923, whereas in 1924 there had been some wear and the overhauling charges were higher.

"TRACK EXPENSE" showed a decrease of $.001 per ton. This is due to the fact that our permanent approach tracks were all laid by the end of 1923, and with the exception of the extension of the track to the east end of the pit, the charges to this caption were largely made up of relining and shifting of tracks.

"PUMPING AND DRAINAGE" showed an increase of $.019 per ton. The amount of water handled at the property was about the same as for the previous year, but it was necessary to handle considerable water in front of the shovel at the east end of the pit and this added to the cost. In order to prevent the water at the east end of the pit from washing surface material onto the cleaned ore, box launders were constructed and drifts were driven into the stripping bank to tap the water back from the face. This work was quite costly and a force of men were employed off and on here for several months.

There was a decrease of $.001 per ton for the item "WATER SUPPLY", due to the fact that we did not take water for our 350-ton steam shovel from the Village supply during the entire season of 1924, whereas we did in 1923. We found that the Village water was hard on the steam shovel flues and for this reason we syphoned water from the Susquehanna drainage ditch.

The increase of $.017 for "GENERAL OPEN PIT EXPENSE" was the result of the rather extensive clean-up work undertaken at the east end of the pit. During 1924 a Thew shovel was rented and operated here for several months. The costs included the operation of the shovel, as well as the work in connection with the tracks to the stripping dump and the handling of the material from the pit to the dump.

"ENGINEERING" shows an increase of $.001 per ton for 1924, due to the necessary work in connection with the test pitting and churn drilling.

The decrease of $.001 per ton in 1924 for "ASSAYING" was due to the fact that we did quite extensive bank sampling in 1923.

The caption "MINE OFFICE" shows a 1924 increase of $.003 per ton. During 1923 a larger proportion of the mine office expense was charged to stripping, which explains the increase.

The 1924 increase of $.001 for "DISTRICT OFFICE" was the result of making a larger charge to ore operations in 1924, as the stripping had been practically completed.

"WINTER EXPENSE" shows a 1924 increase of $.053 per ton. Most of the open pit equipment was new in the spring of 1923 and the repair charges for that year were quite light.

UNDERGROUND

The underground production for 1924 amounted to 191,250 tons, as compared with 140,663 tons in 1923. The larger output in 1924 was partially responsible for reducing the cost per ton in most of the accounts.

The analysis of the 1923 and 1924 underground cost sheets follows:

UNDERGROUND COSTS:	----1923---- COST PER TON	----1924---- COST PER TON
Development in Rock	$ .000	$ .016
Development in Ore	.000	.089
Stoping	.813	.641
Timbering	.417	.309
Tramming	.115	.074
Pumping	.077	.053
Compressors & Air Pipes	.070	.056
Underground Superintendence	.049	.034
Cave-In	.004	.002
Compressors & Power Drills	.013	.013
Hand Tramming Equipment	.008	.007
Electric Tramming Equipment	.028	.022
Pumping Machinery	.019	.015
TOTAL UNDERGROUND COSTS	1.613	1.334
SURFACE COSTS:		
Hoisting	.034	.026
Stocking Ore	.054	.045
Dry House	.036	.022
General Surface Expense	.049	.019
MAINTENANCE ACCOUNTS:		
Hoisting Equipment	.012	.008
Shaft	.000	.001
Top Tram Equipment	.021	.012
Docks, Trestles and Pockets	.001	.001
Mine Buildings	.002	.007
TOTAL SURFACE COSTS	.209	.141

	----1923---- COST PER TON	----1924---- COST PER TON
Brought Forward----------	$1.822	$1.475
GENERAL MINE ACCOUNTS:		
Insurance----------	.003	.003
Engineering----------	.020	.014
Analysis----------	.010	.011
Personal Injury Expense----------	.019	.063
Safety Department Expense----------	.000	.000
Telephones and Safety Devices----------	.005	.006
Special Expenses----------	.004	.001
Mine Office----------	.040	.033
District Office----------	.094	.073
TOTAL GENERAL MINE ACCOUNTS----------	.195	.204
COST OF PRODUCTION----------	$2.017	$1.679

Considerable development work was undertaken in 1924 at the east end of the property, with the result that the item "DEVELOPMENT IN ROCK" showed an increase of $.016 and "DEVELOPMENT IN ORE" $.089 per ton. There were no charges to Development in Rock and Ore during 1923.

The caption "STOPING" was lower by $.172 per ton for 1924. This is explained by the improved mining conditions and the fact that a better class of miners were employed. The contract rate per car was reduced in 1924 and the tons per miner in ore was increased appreciably. During 1923 a considerable part of the underground operation was on the top sub and more or less difficulty was experienced in holding the back of soft cretaceous material. Most of the 1924 work was under a mat.

There was a 1924 decrease of $.108 per ton for "TIMBERING". The property had been closed down some time previous to 1923 operations and considerable repair work was necessary during the early part of that year. Further than this, the class of material used in 1924 was superior and most of the gangs were operating under a mat. More or less repair work was done to the main-level timbering each year, but the absorbing of these charges by the larger tonnage mined in 1924 shows a lower cost per ton.

The item "TRAMMING" was $.041 per ton lower for 1924 than for the previous year. During the larger part of 1923, we trammed and hoisted on two shifts, whereas in 1924, most of the tramming was done on day shift and but one locomotive was in service part time on night shift.

The reduction of $.024 per ton for "PUMPING" in 1924 is due to the larger ore output realized.

"COMPRESSOR & AIR PIPES" and "UNDERGROUND SUPERINTENDENCE" show a 1924 reduction of $.014 and $.015 per ton respectively. These decreased costs are also due to the larger tonnage mined in 1924.

The accounts "HAND TRAMMING EQUIPMENT", "ELECTRIC TRAMMING EQUIPMENT" and "PUMPING MACHINERY" all showed a reduction in the cost per ton for 1924. This is explained by the larger output realized.

The 1924 decrease of $.008 per ton for "HOISTING" was due to the larger tonnage handled per shift.

Under "STOCKING ORE" there was a 1924 decrease of $.009 per ton. This is explained partly by the increased product handled per shift and also to the improvement in our stocking arrangement.

The 1924 decrease of $.014 per ton for "DRY HOUSE" is explained by the lower price paid for coal and the larger tonnage realized.

The item "GENERAL SURFACE EXPENSE" was $.030 per ton lower in 1924. During 1923 two of the location houses had to be moved on account of caving ground. The charges to this caption in 1924 were nominal.

The maintenance accounts "HOISTING" and "TOP TRAM EQUIPMENT" were lower by $.004 and $.009 per ton respectively in 1924. This reduction was explained by the larger tonnage handled during 1924.

Under "MINE BUILDINGS" there was a 1924 increase of $.005 per ton, due to the kalsomining of the interior of the several mine buildings and the painting of the steel headframe. Charges to this item were very nominal in 1923.

The 1924 reduction of $.006 per ton for "ENGINEERING" is due to the larger output for that year.

Under "PERSONAL INJURY EXPENSE" there was a 1924 increase of $.044 per ton. There was one fatality in 1924 and several bad hernia cases, whereas the compensation paid at the Boeing Mine during 1923 was largely for minor injuries.

The captions "MINE OFFICE" and "DISTRICT OFFICE" showed 1924 reductions of $.007 and $.021 respectively. The increased production from underground operations explains these decreases.

BOEING MINE.

WADE AND HELMER MINES

ANNUAL REPORT FOR 1924

The Wade-Helmer Mines were idle until August 1st., except for a crew of from six to eight men employed retimbering the Wade Mine workings, when stockpile loading and open pit mining was started. The usual idle force of six men was employed regularly, consisting of the captain, clerk, three pumpmen and night watchman.

Sufficient Wade stockpile ore has now been shipped to permit the erection of a short trestle and the stockpiling of approximately 30,000 tons of underground ore. It would take at least four months to secure this tonnage from the time the mine was reopened. A thorough job of retimbering was done throughout the sub-level workings and the mine is in very good shape for resuming mining activities.

The following is the tonnage and analysis of shipments made from the Wade-Helmer Mines for the 1924 season:

	Tons	Fe.	Phos	Sil.	Mn.	Mois.
Wade Stockpile----------	11,678	57.56	.064	8.07	1.15	12.92
Helmer Stockpile----------	17,172	56.60	.065	10.19	1.31	13.07
Helmer Pit----------	21,469	56.72	.054	12.09	.76	15.72
TOTAL AND AVERAGES--------	50,319	56.87	.060	10.51	1.04	14.16

STOCKPILE LOADING

The tonnage and average analysis of the ore in stock at the Wade and Helmer Mines on January 1st., 1924, follows:

	Tons	Fe.	Phos	Sil.	Mn.	Mois.
Wade Ore in Stock 1/1/24--	41,892	57.22	.064	7.50	1.27	-----
Helmer Ore in " 1/1/24--	16,684	56.48	.066	10.03	1.33	-----
TOTAL AND AVERAGES--------	58,576	57.01	.065	8.22	1.29	-----

Orders were received late in July to ship the Helmer stockpile, 8,000 to 10,000 tons of Helmer pit ore, and the balance to make a total shipment of 40,400 tons, from the Wade stockpile.

We started organizing our crew for loading out the Helmer stockpile on August 1st. and shipping was begun on the 6th of the month. Except for five

days, when the crew was transferred to the Wade pile, loading of Helmer stockpile ore continued until the 6th of September, when the pile was cleaned up. Loading operations at the Helmer were very slow, especially toward the last, due to clean-up cuts and digging the ore along the north bank, which was covered with a heavy wash. The work of cleaning the sand from the ore was done with the shovel casting the sand behind and loading the ore as the shovel advanced. This job was accomplished with practically no loss of ore.

The following is the tonnage and analysis of the ore in stock August 1st., 1924, and shipments from stockpile:

	Tons	Fe.	Phos	Sil.	Mn.
Helmer Stockpile Shipments----------	17,172	56.60	.065	10.19	1.31
Helmer Ore in Stock Aug. 1, 1924----	16,684	56.48	.066	10.03	1.33
TOTAL OVERRUN----------	488				

The shovel crew and pitmen were transferred to the Wade stockpile August 11th and loaded there for five days during the month and again on October 28th, a total of six days for the season. This ore was used for sweetening.

Following is the tonnage and analysis of Wade ore in stock August 1st., 1924, shipments for the season and the balance in stock January 1st., 1925:

	Tons	Fe.	Phos	Sil.	Mn.
Wade Ore in Stock August 1st, 1924--	41,892	57.22	.064	7.50	1.27
Wade Stockpile Shipments for Season-	11,678	57.56	.064	8.07	1.15
Wade Ore in Stock January 1, 1925---	30,214	57.22	.064	7.50	1.27

WADE MINE ORE ESTIMATE OF JANUARY 1ST. 1925

No ore was mined from any of the Wade deposits during the past three years, nor was any exploratory work undertaken; the estimates, therefore, remaining the same as of January 1st., 1922. The ore estimates are based on a factor of 13 cubic feet per ton, with a 10% deduction to cover mining loss in the case of underground ore.

The tonnage and average grade of ore in the several Wade deposits on January 1st., 1925, follows:

	Tons.	Fe.	Phos	Mn.	Sil.	Mois.
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:

	Tons.	Fe.	Phos	Mn.	Sil.
Above Main Level------	1,179,000	57.85	.074	1.33	6.40
Below Main Level------	186,000	58.11	.073	.74	7.03

The total ore by forty acre tracts as of January 1st., 1925, is as follows:

	Tons.	
SE¼ of SW¼ of Section 12, 58-19-------	305,000	Non-Bessemer.
NE¼ of NW¼ of " 13, 58-19-------	1,305,000	" "
NE¼ of NW¼ of " 13, 58-19-------	80,000	Bessemer.
NW¼ of NW¼ of " 13, 58-19-------	1,365,000	Non-Bessemer.

Of the ore remaining in the Wade Mine, 561,000 tons will be mined by the open pit method, and 2,494,000 tons from underground operations.

HELMER MINE ORE ESTIMATE OF JANUARY 1ST. 1925

Following is an estimate of the ore in sight at the Helmer Mine on January 1st., 1925, the tonnage reported a year ago and the amount mined during 1924.

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

	Tons
Open Pit Ore in Sight January 1st., 1924	15,000
Scram Ore in Sight January 1st., 1924	26,000
Underground Ore in Sight January 1st., 1924	68,000
TOTAL ORE IN SIGHT JANUARY 1ST., 1924	109,000
Open Pit Ore Mined During 1924	15,980
Scram Ore Mined During 1924	5,489
Underground Ore Mined During 1924	-----
TOTAL ORE MINED DURING 1924	21,469
Open Pit Ore in Sight January 1st., 1925	------
Scram Ore in Sight January 1st., 1925	20,500
Underground Ore in Sight January 1st., 1925	68,000
TOTAL ORE IN SIGHT JANUARY 1ST., 1925	88,500

There has been no change in the estimated tonnage at the Helmer Mine as compared with the previous year, other than deducting the tonnage mined during 1924.

The average analysis of the ore in sight at the Helmer Mine on January 1st., 1925, is as follows:

Tons	Fe.	Phos	Mn.	Sil.	Mois.
88,500	56.00	.070	1.35	9.50	12.50

WADE AND HELMER MINES.

ESTIMATE OF PRODUCTION FOR 1925

The estimate of production at the Wade Mine for 1925 is based on the assumption that orders to resume underground operations are received January 15th and opening and repair work is started immediately thereafter. The period of production is considered from January 15th to November 15th:

	Tons	Fe.	Phos	Mn.	Sil.	Mois.
Wade Open Pit Ore-----	50,000	58.50	.060	.70	8.05	12.50
Wade Underground Ore--	98,000	56.77	.064	1.43	7.49	12.50
TOTAL AND AVERAGES----	148,000	57.35	.063	1.18	7.68	12.50

For each month that orders to open the Wade Mine are delayed, 12,000 tons should be deducted from the underground production. We figure that it would take us a couple of months to open the mine and get the crew organized before we secure our normal production of 12,000 tons per month. If the Wade Mine is to be reopened, it would be advisable to start early in the year, so that we would be able to secure a good class of men.

Our open pit production of 50,000 tons is based on mining only the tonnage available without additional stripping, except for some hand handling of surface material washed onto the cleaned area. Before any open pit ore can be mined a new incline tramway will have to be constructed on Wade land and the shaft house and hoisting equipment moved onto the Wade property.

WADE AND HELMER MINES.

GENERAL SURFACE

The Wade and Helmer premises have been patrolled by day and night watchmen during the past year. The Captain has acted in the capacity of day watchman. No irregularities have been reported.

Upon completion of open pit operations, the crew was employed for four days cleaning the drainage ditch and repairing the dyke around the north side of the Helmer pit. Two men were engaged during the last two weeks of November, cleaning the mine water drainage ditch of an accumulation of sand and debris and boarding up broken windows throughout the location.

By the end of November the crew was reduced to a total of six men, our regular idle time force.

ACCIDENTS

There were no accidents at the Wade-Helmer Mines during the past year.

UNDERGROUND OPERATIONS

Monthly inspections were made of the underground workings of the Wade Mine throughout the year. The main level opening into the Helmer pit is blocked with ice every winter and the extreme cold weather during January was of longer duration than usual and ice formed a greater distance into the drainage drift. This cut off the circulation of air through the Wade workings to such an extent that the fungus growth and dry rot made considerable progress. The main level timber under a number of raises, raise cribbing and ladders and sollars gave way, due to dry rot during February and March. Several sand runs occurred on the sub-levels during this time.

As there was no immediate prospect of starting the Wade Mine, it was decided to begin repair work. On April 8th a crew of six men was hired and the balance of the month was spent cleaning the tramway of sand and silt accumulated behind the protective dam since the mine was closed in May, 1921. It is necessary to provide a dam so that the pit water may be controlled at times of heavy rains and when the current goes off. Upon completion of the clean-up work the sides of the drift were lagged from the shaft to No. 9 cross-cut.

During May the force was increased to eight men. The drift sets under raises Nos. 600, 700, 701, 702, 703, 800, 801, 900, 901, 902 and 9, and several sets either side of the raises, were renewed. Under raises where the sets had not broken down, the old timber was unsafe for handling dirt through the chutes. No hoisting of ore was done at the time repairs were made in the sub-levels in 1922 and all the dirt compartments were filled. When drawing off the material from several of the raises the rotted cribbing dropped away. It was necessary to recribb raises Nos. 600, 700, 701 and 802 from the main level to the 1390' sub-level and Nos. 902 and 903 to the 1400' sub-level. The man way between the 1400' and 1420' sub-levels was also recribbed. When building new slides at the bottom of these raises, they were constructed with the idea of installing half moon stoppers when operations are resumed.

Repair work was started by part of the timber gang on the 1390' sub-level May 26th. The compressor was started up at this time in order to furnish fresh air and create a circulation throughout the sub workings. The timbering on this sub-level was in very poor condition, except in the vicinity of the Oliver boundary, where the workings are quite damp and the air is better. A thorough job of retimbering was done throughout the 1390', 1400' and 1420' sub-levels. The drift on the 1390' sub between Nos. 600 and 700 raises showed considerable weight and it was necessary to forepole in repairing the greater part of the distance. A pillar of rock on the sub above evidently has broken away and is responsible for this condition. Very little weight was evidenced in other portions of the sub-levels, the repair work being done by taking out the old timber and putting in new.

The only work done along the main tramway was the placing of props under the long caps at the switches. All repairs were completed on October 24th.

Before letting the crew go, the storage sump was cleaned. It was the first time since its construction in 1919. During the past summer, we had unusually heavy rains, which carried a quantity of sand and silt into the sump. This job was completed on November 15th and the crew discharged.

Three pumpmen have been employed on 8-hour shifts during the past year. With the exception of some flood water during the heavy rains of July, pumping conditions were normal throughout the year. The snow and ice in the pit melted very gradually and there was no perceptible increase in the volume of water pumped. During the heavy rains of July and October, it was necessary to operate the centrifugal pump for a few hours at a stretch upon several occasions. Except for replacing several bearings on the intermediate shaft on the pole pump, only minor repairs were made during the year.

Two men were employed the last two weeks of August cleaning the wash from the Helmer underground portal. This work was very slow, due to a number of very heavy rains, which washed the material back almost as fast as it could be dug away. The Model "36" shovel, which was used in loading out the stockpile, was employed for a day on this work. The portal was opened and an inspection

was made of the Helmer workings on August 29th. The inspection was made to determine the length of time and the cost to put the mine in shape for operation.

The main drift from the pit in, was found in very good shape, there being only 8 or 10 sets of timber to be replaced. The raises and sub-levels were in rather bad condition, but as the workings were not extensive, we estimated that it would take five weeks to put them in shape for mining with six gangs.

On account of the length of time and expense of opening the Helmer underground and the fact that it could only be operated for a limited time, it was decided not to attempt any underground work, but mine all available open pit ore and reassign the lease.

Several underground cars, part of the rail and pipe were removed from the Helmer workings. It was impossible to remove all the equipment, on account of the condition of the raises and sub-level drifts. The expense necessary to make the repairs was not warranted, as the equipment had little salvage value.

Mr. W. H. Crago, Mining Engineer, made an inspection of the Helmer underground workings and open pit on October 28th. His inspection was in connection with a report to be made for the Guardian and Trust Company of Cleveland.

OPEN PIT OPERATIONS

Upon the completion of loading out the Helmer stockpile on Sept. 6th, open pit mining was started. The Model "36" Marion shovel was cut in just east of the incline pocket along the south bank and mined to the Wade-Helmer line. The ore secured in this first cut was of a very satisfactory grade, both as to iron and silica content. The ore in the next cut to the south was badly mixed with heavy seams of taconite and it was necessary to cast the rocky material behind the shovel. Such a large quantity of rock developed in the cut that work along this bank had to be abandoned and the shovel moved along the Wade-Helmer line, taking a cut to the north. The ore in this territory only averaged between 5' and 8' in depth, the bottom rock being very irregular. The shovel was then moved east of the incline along the Oliver line, where approximately 4,000 tons of ore averaging better than 57% iron and about 9% silica were secured.

Helmer pit loading was continued to October 24th, at which time we had mined all of the open pit ore of satisfactory grade, or that which could be mined except at an excessive cost.

The following is the tonnage and analysis of Helmer pit shipments for the season of 1924:

	Tons	Fe.	Phos	Sil.	Mn.	Mois.
Helmer Pit Ore----------	21,469	56.72	.054	12.09	.76	15.72

Our original estimate of open pit ore available was from 8,000 to 10,000 tons, which was to be shipped with the Helmer stockpile and a portion of the Wade pile to make a total of 40,400 tons. During the course of open pit mining we developed an additional tonnage in the bottom between the incline pocket and Wade line. It was decided to mine and ship all Helmer ore of a satisfactory grade, in order to catch up with our back minimums and be in shape to reassign the Helmer lease January 1st., 1925.

Upon the completion of ore loading in the Helmer pit on October 23rd., work was started to move all the equipment onto the Wade side of the pit, in

anticipation of surrendering the lease. The shovels, locomotive, cars, rails, ties, pipe and all material of value, were removed from the Helmer pit by November 5th and the pit left in condition for throwing up the lease.

SHIPMENTS

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

	Fe.	Phos	Sil.	Mois.	Fe.Nat.
CENTRAL WEST - 8/13/24 - 2,918 Tons.					
Mine	57.17	.063	8.91	12.31	-----
Crowell & Murray	56.70	---	8.12	12.15	49.81
JOHN ANDERSON - 8/17/24 - 5,100 Tons.					
Mine	57.02	.065	9.00	12.56	-----
Cremer & Case	56.30	---	8.34	12.83	49.08
W. G. MATHER - 8/25/24 - 4,263 Tons.					
Mine	57.10	.068	9.19	12.94	-----
Hughes-Guentzler	56.40	---	8.71	12.54	49.33
NEGAUNEE - 8/30/24 - 3,103 Tons.					
Mine	57.37	.066	9.00	13.42	-----
Oscar Textor	56.28	---	8.07	13.23	48.83
J. A. CAMPBELL - 9/5/24 - 3,044 Tons.					
Mine	56.97	.065	9.64	12.31	-----
Crowell & Murray	56.80	---	8.73	10.92	50.60
ISHPEMING - 9/12/24 - 3,031 Tons.					
Mine	56.46	.068	9.73	13.35	-----
Cremer & Case	56.40	---	8.54	12.36	49.43
PETER WHITE - 9/19/24 - 3,125 Tons.					
Mine	56.80	.062	9.44	13.72	-----
Hughes-Guentzler	55.95	---	9.76	12.64	48.88
W. E. FITZGERALD - 9/25/24 - 3,157 Tons.					
Mine	57.20	.054	10.29	13.25	-----
Crowell & Murray	57.55	---	9.32	13.28	49.91
PETER REISS - 10/10/24 - 4,432 Tons.					
Mine	57.34	.052	10.62	15.00	-----
Oscar Textor	55.90	---	11.65	12.94	48.67
R. J. PAISLEY - 10/17/24 - 2,922 Tons.					
Mine	56.67	.051	10.40	15.10	-----
Cremer & Case	55.65	---	10.74	12.21	48.85
PRESQUE ISLE - 10/24/24 - 3,021 Tons.					
Mine	56.94	.052	10.27	16.90	-----
Oscar Textor	55.05	---	12.48	13.34	47.71

W. H. WOLF- - - - - - - - - - - - - - - - -10/31/24- - - - - - - - - - - 5,296 Tons.

	Fe.	Phos	Sil.	Mois.	Fe.Nat.
Mine	57.03	.060	12.18	15.84	-----
Crowell & Murray	55.95	---	14.54	13.19	48.57

PIONEER- - - - - - - - - - - - - - - - -11/1/24- - - - - - - - - - - 2,090 Tons.

Mine	56.92	.062	10.07	13.91	-----
Crowell & Murray	56.75	---	8.75	13.65	49.00

In addition to the above there were 4,817 tons of Helmer ore mixed and shipped with the Boeing Grade.

Following is a division of the tonnage and analysis of the ore shipped from the Wade-Helmer Mine during the 1924 season:

	Tons	Fe.	Phos	Sil.	Mn.	Mois.
Wade Stockpile	11,678	57.56	.064	8.07	1.15	12.92
Helmer "	17,172	56.60	.065	10.19	1.31	13.07
Helmer Pit	21,469	56.72	.054	12.09	.76	15.72
TOTAL & AVERAGES	50,319	56.87	.060	10.51	1.04	14.16

A composite analysis of the season's shipments follows:

	Fe.	Phos	Sil.	Mn.	Alu.	Lime	Mag.	Sulphur	Loss By Ignition.
Wade Mine---	57.34	.066	7.97	1.10	2.14	.85	.26	.013	5.10
Helmer Mine-	56.47	.062	11.12	1.00	1.81	.67	.24	.015	4.22

A comparison of the Mine and Lower Lake analysis on the cargoes of straight Wade-Helmer ore follows:

	Fe.	Phos	Sil.	Moist.	Fe.Nat.
Mine Analysis--------	57.02	.061	9.97	13.93	-----
Lower Lake Analysis--	56.25	---	10.04	12.73	49.09

HELMER-WADE MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1924.

GRADE	IRON	PHOS.	SILICA	MANG.	MOIST.
Helmer,	56.72	.053	12.09	.76	15.72
Wade,		(No Production)			

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1924.

			Mine			Lake Erie	
GRADE	IRON	PHOS.	SILICA	MANG.	MOIST.	IRON	MOIST.
Helmer,			(All Mixed)				
Wade,			(All Mixed)				

ORE STATEMENT - DECEMBER 31ST, 1924.

	HELMER	WADE	TOTAL	TOTAL LAST YEAR
On hand January 1, 1924,	16,684	41,892	58,576	97,625
Output for Year,	21,469	-	21,469	-
Stockpile Overrun,	488	-	488	-
Total,	38,641	41,892	80,533	97,625
Shipments,	38,641	11,678	50,319	39,049
Balance on Hand,	-	30,214	30,214	58,576
Increase in Output,			21,957	
Decrease in Ore on Hand,			28,362	

1924 -- Mine Idle Jan. 1st to Sept. 8th, 1924.
1-10 Hr. Shift, Sept. 8th to Oct. 23rd, 1924.
Mine Idle Oct. 24th to Dec. 31st, 1924.

1923 -- Mine Idle during Year.

HELMER-WADE MINE

SHIPMENTS FOR YEAR-1924.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Helmer,	21,469	17,172	38,641	3,670
Wade,	-	11,678	11,678	35,379
Total,	21,469	28,850	50,319	39,049
Total Last Year,			39,049	
Increase,			11,270	

WADE-HELMER MINE

COMPARATIVE WAGES AND PRODUCT

	1 9 2 4	1 9 2 3	INCREASE	DECREASE
PRODUCT No.Hours & Shifts	21,957	-		
AVG.NO.MEN WORKING				
Surface	9	4	5	
Underground	8	4	4	
Total	17	8	9	
AVG.WAGES PER DAY				
Surface	4.94	5.30		.36-6.77%
Underground	5.21	4.84	.37-7.64%	
Total	5.07	5.08		.01-.19%
WAGES PER MO.OF 25 DAYS				
Surface	123.50	132.50		9.00
Underground	130.25	121.00	9.25	
Total	126.75	127.00		.25
PRODUCT PER MAN PER DAY				
Surface	7.59			
Underground	7.77			
Total	3.84			
LABOR COST PER TON				
Surface	.650			
Underground	.671			
Total	1.321			
AVG.PRODUCT BRK'G & TRM'G				
" WAGES CONTRACT MINERS				
" " " TRAMMERS				
TOTAL NO.OF DAYS				
Surface	2891	1564	1327	
Underground	2824	1400	1424	
Total	5715	2964	2751	
AMOUNT FOR LABOR				
Surface	14282.76	8285.97	5996.79	
Underground	14723.52	6780.51	7943.01	
Total	29006.28	15066.48	13939.80	

Proportion of Surface to Underground Men:

1924- 1 to .88
1923 - 1to 1
1922- 1 to 2.50
1921- 1 to 3.92
1920- 1to 2.84
1919- 1 to 3.14

1924 -Pit operations during months of Sept. and October.

ANNUAL REPORT FOR THE YEAR ENDING DECEMBER 31, 1924.

Ishpeming, Michigan,

January 15, 1925.

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 1924.

Cleveland-Cliffs Iron Company,
Ishpeming, Republic & Iron River Districts.

Cleveland-Cliffs Iron Company,
North Lake District.

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

Cleveland-Cliffs Iron Company,
Gwinn District.

Cleveland-Cliffs Iron Company,
Mesabi 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 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.

NUMBER.	MINE OR DISTRICT.	FOR WHOM.
1	Negaunee Mine,	Bethlehem Iron & Steel Corporation.
1	Athens Mine,	Pickands, Mather & Company.
1	Boeing Mine,	Col. J. B. Cavanaugh.
1	Helmer Mine,	Struthers Furnace Company.
1	Mesabi District,	M. H. Barber.
5	Boeing & Hill Trumbull Mines,	Directors, Mesaba-Cliffs Iron Mining Co.
2	Boeing & Hill Trumbull Mines,	Arthur Iron Mining Company.
1	Negaunee & Cascade Districts,	G. R. Jackson.
1	Gwinn District,	W. W. Graff.
1	North Lake District,	J. M. Bush.
1	Republic & Iron River Districts,	C. J. Stakel.

LOOSE LEAVES.

Cliffs Shaft and Holmes,	Lucien Eaton.
Hydro Electric System,	O. D. McClure.
Boeing Mine,	Carl Brewer.
Hill Trumbull,	H. C. Bolthouse.

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. No mining operations were conducted during the year 1924 upon the portion known as the Corbit lease. On the Mitchell lease, mining operations have been conducted. Maps for the fee owners have been supplied upon demand.

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

No maps of the Barnes-Hecker or Moore and Chase properties have been requested during 1924. Mr. P. P. Chase has made several visits to this office and has been informed as to the progress of mining operations.

For the fee owners of the Negaunee Mine, 14 sets of maps have been prepared and sent to the Cleveland office.

Maps of the Roman Catholic Cemetery property at Negaunee have been sent each month to Mr. R. S. Archibald, the engineer in charge.

For the Stephenson Mine fee owners, maps have been furnished to their engineer from the Gwinn office.

The Lessors of the Virgil Mine have been furnished with maps in accordance with the terms of the lease.

Blue prints of the Helmer Mine workings have been furnished to Mr. M. H. Barber, who is to send them to the fee owners through the Cleveland office.

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

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

Yours truly,

J. E. Jopling.

Chief Engineer.

JEJ:LTD.

REPORT OF THE ENGINEERING FORCE EMPLOYED DURING THE YEAR 1924,

AND A BRIEF OUTLINE OF THEIR WORK,

BY REGINALD J. CHENNEOUR, ASSISTANT CHIEF ENGINEER.

THE FORCE.

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

NAME.	POSITION.	ENTERED.
R.J.Chenneour	Asst.Chief Engineer	Entire year.
H. O. Moulton	Engineer	" "
J. E. Hayden	"	Left in May.
A. Rock	Helper	Entire year.
J. Trosvig	Engineer	" "
T. A. Miller	"	" "
S. Malmgren	Helper	" "
C.W.Nicolson	Engineer	" "
K. C. Pellow	"	" "
A. Minnear	Helper	" "
F. A. Olson	Engineer and Helper	March 1, 1924.

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 constitutes a working day. There was no work Saturday afternoons during the 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	273	1½		274½	99.4
H. O. Moulton	267½	7		274½	97.4
J. E. Hayden	94	10		104	90.4
C.W.Nicolson	257	17½		274½	93.6
T. A. Miller	267	7½		274½	97.3
K. C. Pellow	261½	3½	9½	274½	95.3
J. Trosvig	261	8	5½	274½	95.1
A. Rock	257½	10½	6½	274½	93.8
A. Minnear	270	4	½	274½	98.4
S. Malmgren	280½	~~2½~~	3½	274½	102.2
F. A. Olson	219½	9		228½	96.1

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:

	1920.		1921.		1922.		1923.		1924.	
	VACATION.	SICK.	VACATION.	SICK.	VACATION.	SICK.	VACATION.	SICK.	VACATION.	SICK.
R.J.Chenneour	25	10	17	3	11	0	6	0	1½	0
H. O. Moulton	2½	0	4½	0	23	2	9½	1	7	0
J. E. Hayden	23	4½	19	0	12	4	52½	0	10	0
C.W.Nicolson	0	1	24	0	10½	0	1	0	17½	0
T. A. Miller	16½	0	3½	0	23	0	7½	0	7½	0
K. C. Pellow	22½	1½	13½	49½	11	7½	9½	7	3½	9½
J. Trosvig	26½	1	11½	8	10	5	0	0	8	5½
A. Rock	14½	0	4½	0	6½	4	½	6½	10½	6½
A. Minnear	18	1	0	0	0	0	4	2	4	½
S. Malmgren	8	1½	0	0	0	0	0	0	0	3½
F. A. Olson									9	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 year:

	1920.	1921.	1922.	1923.	1924.
R.J.Chenneour	12	12	12	12	12
H. O. Moulton	12	12	12	12	12
A. Rock	12	12	12	12	12
J. Trosvig	12	12	12	12	12
J. E. Hayden	12	12	12	12	4½
T. A. Miller	12	12	12	12	12
S.Malmgren	12	6	0	12	12
C.W.Nicolson	11	12	12	12	12
A. Minnear	12	6	3½	12	12
K. C. Pellow	12	12	12	12	12
P. Denn	9	5	0	0	0
F. A. Olson	12	6	0	0	10
C. C. Taylor	12	6	0	0	0
A. E. Carlson	12	6	0	0	0
J.D.McCarthey	6	6	0	0	0
Average number of men	14 1/3	11 5/12	8¼	10	10 2/12

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

REGINALD J. CHENNEOUR, as Assistant Chief Engineer, has had charge of the office during the year, supervising the office work, field and underground surveys. He had charge of the construction of roads which were built and repaired to cross the West end of the Storage Basin. A wooden bridge was built at one point across the Dead River. This was necessary because the old roads had been flooded.

He made the surveys at the Holmes Mine during the months of January, February and March.

In May, he went to the Algoma Steel plant at Sault Ste. Marie, Ontario, and together with the Steel Company engineers estimated the C.C.I.Company's ore in stock.

At various times he assisted the engineers with their underground and surface surveys.

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

HENRY O. MOULTON, Engineer, has been in charge of the engineering work at the Negaunee and South Jackson Mines the entire year and the Maas Mine after May 15th.

At the Negaunee Mine, he made the regular surveys and noted and posted all geology. He also gave lines for sinking No.3 shaft.

On the surface he had charge of construction of foundations and housing for a ventilating fan which will be installed at the collar of No.2 shaft. He also estimated the coal in stock.

At the South Jackson Mine, he made the necessary surveys.

At the Maas Mine after May 15th, he made the monthly surveys and noted and posted geology.

He made surveys to outline the grounds at the President's Cottage and in the office wrote a description to cover the same.

ENGINEERING DEPARTMENT.

In the office, in addition to his regular work, he prepared the annual report maps, made the Tax Commission estimate and prepared maps of the same for the above mines.

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

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Negaunee Mine,	13%	9%	27%	49%
Maas Mine,	5	5	11	21
Miscellaneous,	1	10	19	30
Total,	19%	24%	57%	100%

J. ELLZEY HAYDEN, Engineer, did the engineering work at the Maas Mine until May 15th when he left the employ of the Company to engage in the manufacture of roofing rock, pebble-dash, etc.

At the Maas Mine, he made the regular monthly surveys and noted and posted all geology.

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

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Maas Mine,	24%	5%	40%	69%
Miscellaneous,	2	2	27	31
Total,	26%	7%	67%	100%

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

On surface he made estimates of ore in stock. In the office he prepared the annual report maps and made the Tax Commission estimate and maps.

At the Gwinn Mine, he made air tests and instructed the men as to how to gunite the shaft at this mine. He also made air tests at the Negaunee and Maas Mines and assisted Mr. Moulton in making computations to determine the size fan necessary to install at the Negaunee Mine to furnish sufficient air for the Maas and Negaunee Mines.

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

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Athens Mine,	15%	12%	39%	66%
Miscellaneous,	4	9	21	34
Total,	19%	21%	60%	100%

TOM A. MILLER, Engineer, did the engineering work at the Cliffs Shaft Mine.

At this mine, he made monthly surveys and located all diamond drill holes. He also ran a number of check surveys to check old work.

On surface he gave lines for additional stocking trestle and estimated the ore in stock.

In the office he prepared the annual report maps, made the Tax Commission estimate and maps of the same.

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

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Cliffs Shaft Mine,	21%	5%	62%	88%
Miscellaneous,	1	8	3	12
Total,	22%	13%	65%	100%

KENNETH C. PELLOW, Engineer, did the engineering work at the Republic, Barnes-Hecker and Spies-Virgil Mines.

At the Republic Mine, he made monthly surveys and located all diamond drill holes. He also ran check surveys for lines on the 2670' level where a drift is being driven to a point under No.9 shaft. The shaft will be raised from this point.

He also gave lines for sinking Pascoe Shaft from the 2670' to the 2770' level.

In the office he prepared the annual report and Tax Commission maps in addition to the regular work.

At the Barnes-Hecker Mine, he made the regular surveys and plumbed from the 2nd to the 3rd level to check the old 3rd level surveys.

On the surface he gave lines for additional stocking trestle.

In the office, in addition to the regular mine work, he made the Tax Commission estimate, made maps of the same and prepared the annual report maps.

At the Spies-Virgil Mine, he made the regular surveys and plumbed from the 3rd to the 4th and 5th levels to establish the surveys. Drifting on the 4th and 5th levels and the pump house lay-out took a lot of survey work.

On the surface he ran surveys and contoured an area on which it is proposed to build a number of dwellings.

In the office he prepared the annual report and Tax Commission maps.

For the Cascade Explorations he spent some time in the field locating drill holes and surveying for contours.

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

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Republic Mine,	12%	2%	27%	41%
Barnes-Hecker Mine,	7	1	20	28
Spies-Virgil Mine,	7	3	18	28
Miscellaneous,	0	2	1	3
Total,	26%	8%	66%	100%

JOHN TROSVIG, Engineer, did the engineering work at the Morris-Lloyd Mines for the entire year.

At this mine he made the regular surveys, located diamond drill holes and assisted the geologists with their surveys.

On the surface he made an estimate of the siliceous ore in stock, laid out and gave lines for stocking trestle and made a survey for the proposed permanent steel trestle.

In the office he prepared the annual report maps, made the Tax Commission estimate and did considerable work on the maps of the proposed steel trestle lay-out.

He also ran surveys and gave lines for the Barnes-Hecker drainage ditch.

Below is a table showing the percentage of his time spent on Morris-Lloyd Mines and other miscellaneous work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Morris Mine,	18%	4%	47%	69%
Lloyd Mine,	6	1	15	22
Miscellaneous,	3	4	2	9
Total,	27%	9%	64%	100%

FREDERICK A. OLSON, Engineer and Helper, entered this office on march 1st, having been employed before this time continuously at the Dead River Storage Dam. After April 1st, he made the surveys at the Holmes Mine and at other mines helped the engineers with their surface and underground surveys and office work.

At the Holmes Mine, he made the regular surveys. In the office, in addition to regular mine work, he prepared the annual report and Tax Commission maps.

Over one half of his time was taken up with work other than at the Holmes Mine. He assisted with the Cascade Exploration surveys.

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

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Holmes Mine,	16%	3%	30%	49%
Miscellaneous,	6	23	22	51
Total,	22%	26%	52%	100%

ALBERT ROCK, Helper, assisted the engineers with their surface and underground surveys and drove the Dodge truck. For about two months of the year, his entire time was taken up with printing the annual report maps.

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

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
8%	60%	32%	100%

ARCHIBALD MINNEAR, Draftsman and Helper, made the surveys for the Salisbury Mine until June 30th when this mine was closed.

At the Salisbury Mine, he made the regular surveys and in the office made the annual report maps.

When not employed with Salisbury work, he assisted the engineers with their surface and underground surveys and office work.

He did most of the office work in connection with the Cascade Exploration maps.

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

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Salisbury Mine,	7%	2%	18%	27%
Miscellaneous,	26	20	27	73
Total,	33%	22%	45%	100%

SEXTUS MALMGREN, Helper, assisted the engineers with their underground and surface surveys, cleaned tapes, made blue prints and assisted in making the annual report prints.

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

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
41%	20%	39%	100%

CHOPPERS.

It was necessary to employ two choppers for two weeks to chop lines for the Cascade Exploration surveys.

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,	20%	22%	58%	100%
Barnes-Hecker Mine,	28	18	54	100
Cliffs Shaft Mine,	35	8	57	100
Holmes Mine,	36	12	52	100
Lloyd Mine,	30	14	56	100
Maas Mine,	23	24	53	100
Morris Mine,	30	14	56	100
Negaunee Mine,	22	25	53	100
Republic Mine,	37	4	59	100
Salisbury Mine,	30	14	56	100
Spies Mine,	33	15	52	100
Average,	30%	15%	55%	100%

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

ENGINEERING DEPARTMENT.

DISTRIBUTION OF ENGINEERING LABOR FOR YEARS 1922, 1923 AND 1924.

	1922.			1923.			1924.			PERCENT INCREASE.	PERCENT DECREASE.
	LABOR.	TIME IN DAYS.	PER CENT.	LABOR.	TIME IN DAYS.	PER CENT.	LABOR.	TIME IN DAYS.	PER CENT.		
Angeline,	$3.26	½	0	0			0				
Athens,	$3064.80	365½	16.31	$3712.44	377	15.42	$2671.59	236¼	8.40		7.02
Barnes-Hecker,	1146.28	167	7.46	1557.24	195½	6.47	1378.65	167	5.93		.54
Cliffs Shaft,	797.99	105	4.69	2601.51	338½	10.81	3250.38	406	14.43	3.62	
Holmes,	1762.03	245¾	10.99	1483.78	185½	6.17	1549.96	214	7.60	.43	
Lloyd,	850.18	112½	5.03	1306.27	169	5.43	930.78	110	3.91		.52
Maas,	2809.29	292	13.06	2660.75	274¼	11.06	2305.75	210	7.47		3.59
Morris,	1958.76	275¾	12.33	2556.13	342½	10.62	2344.46	281½	10.01		.61
Negaunee,	2488.71	264	11.80	2944.76	280½	12.24	2308.79	222	7.89		4.35
Ogden,	0			0			80.64	7	.25	.25	
Republic,	1410.13	179¼	8.03	1534.23	178	6.38	1456.49	172	6.11		.27
Salisbury,	43.28	6	.27	23.79	3½	.10	718.67	107	3.80	3.70	
South Jackson,	24.97	2¾	.12	24.01	2½	.10	84.46	8	.28	.18	
Spies,	179.30	25	1.11	415.92	44½	1.73	277.63	32½	1.15		.58
Virgil,	28.99	4½	.20	602.53	78	2.51	1059.59	119½	4.25	1.74	
Total Ishpeming, Negaunee, Republic and Iron River,	$16567.87	2046	91.40	$21423.36	2469¼	89.04	$20417.84	2292¾	81.48		7.56
GWINN DISTRICT MINES.											
Austin,	$9.69	1	.04	$60.12	9	.24	$39.47	5	.18		.06
Francis,	37.03	5	.22	85.70	12	.35	80.13	9½	.34		.01
Gwinn,	23.92	3 3/8	.15	0			240.85	19	.67	.67	
Mackinaw-Gardner,	2.50	3/8	.02	0			0				
Princeton,	28.30	3¾	.17	0			0				
Stephenson,	83.08	10½	.47	73.45	10½	.30	173.32	25½	.91	.61	
Total Gwinn District,	$184.52	24	1.07	$219.27	31½	.89	$533.77	59	2.10	1.21	
MESABI DISTRICT MINES.											
Boeing,	$33.32	5	.23	$77.02	11½	.32	$81.45	10½	.37	.05	
Crosby,	23.46	3¼	.15	0			0				
Hill-Trumbull,	33.35	5	.22	78.84	11½	.33	81.45	10½	.38	.05	
Meadow-Flower,	16.30	2½	.11	0			0				
Wade-Helmer,	21.09	2¾	.12	0			9.84	1½	.05	.05	
Total Mesabi District,	$127.52	18½	.83	$155.86	23	.65	$172.74	22½	.80	.15	
WATER POWER.											
Dead River Stor.Dam E & A 414	621.33	65½	2.93	$1049.97	99	4.36	$922.86	87	3.09		1.27
Operating Elec.Power Plants	158.17	18	.80	650.23	72½	2.70	650.80	63	2.24		.46
Escanaba River Water Power	0			0			194.64	15	.53	.53	
Total,	$779.50	83½	3.73	$1700.20	171½	7.06	$1768.30	165	5.86		1.20
SURVEYS AND CONTOURS.											
Section 10, 47-27,	$92.46	14½	.65	0			0				
" 11, "	124.82	12½	.56	0			0				
" 12, "	21.83	2½	.11	0			0				
" 14, "	62.70	6½	.29	0			0				
" 22, "	0			$18.62	3½	.08	0				.08
" 24, "	0			5.56	1	.02	0				.02
" 27, "	0			10.64	2	.05					.05
Cascade Exploration,	0			0			$1581.01	222	7.89	7.89	
Total,	$301.81	35	1.61	$34.82	6½	.15	$1581.01	222	7.89	7.74	
MISCELLANEOUS.											
Abstracts,	$145.02	17	.76	$177.00	15	.73	$216.39	18½	.66		.07
Oper.Hydro Elec.Plants Carp Basin No.2,	0			$118.09	11½	.49					.49
Miscellaneous,	98.65	13½	.60	236.45	22½	.99	318.17	34	1.21	.22	
Total,	$243.67	30½	1.36	$531.54	49	2.21	$534.56	52½	1.87	.34	
Grand total,	$18204.89	2238½	100.00	$24065.05	2750¾	100.00	$25008.22	2813¼	100.00		

OFFICE EXPENSE.

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

	1922.	1923.	1924.
Traveling expense and livery,	$ 266.86	$ 295.27	$ 80.75
Supplies (see below), - -	1503.47	2453.41	1967.72
Operating automobiles, - -	990.27	1261.85	1242.80
Office expense, - - -	38.21	306.18	556.63
Insurance, - - - -	231.26	231.25	231.25
Taxes, - - - - -	41.68	42.78	43.96
Total,	$3071.75	$4590.74	$4123.11
Total salaries general office, Engineers,# - - - -	18204.89	24065.05	25008.22
Total charges to Eng. Dept.	$21276.64	$28655.79	$29131.33
# Does not include salary of Chief Engineer and Stenographer.			

The following table shows the extraordinary charges in the above for the year 1924:

The W. Bingham Company, - -	$ 23.00
The Lufkin Rule Company, - -	29.99
C. L. Berger & Sons (Transit),-	324.87
Stenglein Bindery, - - -	70.27
George A. Newett, - - -	48.50
Stenglein Bindery, - - -	36.53
American Blue Print Paper Company,	19.86
Keuffel & Esser Company, - -	11.84
Stenglein Bindery, - - -	28.20
Childs Art Gallery, - - -	76.40
Frederick Post Company, - -	136.39
Stenglein Bindery, - - -	24.00
E. J. Longyear Mfg. Company, -	43.33
Keuffel & Esser, - - -	12.17
Munising Foundry, - - -	10.00
Childs Art Gallery, - - -	368.87

AUTOMOBILES.

The Dodge truck and touring car were operated the entire year. Below is a comparative statement of auto and livery expense for three years:

	1922.	1923.	1924.
Company horses, - - -	$ 255.84	$ 289.14	$ 80.55
Company automobiles:			
Expense, - - - -	990.27	1261.85	1242.80
Traveling expense, - -	11.02	6.13	.20
Total,	$1257.13	$1557.12	$1323.55
COST OF OPERATING AUTOMOBILES.			
Gasoline, oil, etc, - -	$208.34	$169.97	$212.00
Tires and tools, - - -	70.35	206.41	99.11
Repairs, - - - - -	70.90	116.35	239.12
Miscellaneous, - - -	87.21	77.18	29.40
Insurance, - - - -	123.36	104.81	104.76
Depreciation, - - -	430.11	587.13	558.41
Total,	$990.27	$1261.85	$1242.80

M I N E S.

ATHENS MINE.

Regular surveys were made and all geology posted. Tests were made on all ventilating fans. An estimate of ore and coal in stock was also made.

BARNES-HECKER MINE.

Regular surveys were made and geology noted and posted. Additional stocking trestle was laid out.

The 6th level drift from the Morris Mine was holed by a raise from the 6th level to the 3rd level Barnes-Hecker. The surveys check very closely.

CLIFFS SHAFT MINE.

Regular monthly surveys were made and all diamond drill holes located. Check surveys were run on a number of levels. Additional stocking trestle was laid out and an estimate of the ore in stock made.

HOLMES MINE.

Regular monthly surveys were made. All working places along the Section 16 Mine boundary were surveyed frequently. On surface the outline of the caving ground was surveyed.

MAAS MINE.

Regular surveys were made and geology noted and posted. Onsurface additional stocking trestle was laid out.

MORRIS-LLOYD MINES.

Underground surveys were made and all geology noted and posted. Diamond drill holex locations were surveyed. A special survey and maps were made for the proposed permanent steel trestle.

OGDEN MINE.

An estimate was made of ore available at this mine.

NEGAUNEE MINE.

Surveys were made and geology noted and posted. No.3 shaft was sunk to the 13th level and the pentice removed. The plat is now being cut on the 13th level.

Air tests and computations were made to determine the size ven-

tilating fan that would be necessary to ventilate the Maas and Negaunee Mines. Foundations and part of the housing for a 1000 cu. ft. fan were built. This work will be completed next year.

REPUBLIC MINE.

Monthly surveys were made and all diamond drill holes located. Special surveys were run to start drifting on the 2670' level. This level will be connected with No.9 shaft. When a point directly under No.9 shaft is reached, it will be raised to hole into the bottom of the present shaft. Lines were given to sink the Pascoe Shaft from the 2670' to the 2770' level.

SOUTH JACKSON MINE.

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

SALISBURY MINE.

Regular surveys were made at this mine until June 30th, when it was closed down.

SPIES-VIRGIL MINE.

Surveys were made and lines given on new levels and for the new pump station. The shaft was plumbed and surveys transferred to the 4th and 5th levels.

MISCELLANEOUS.

BARNES-HECKER DIVERSION DITCH.

Surveys were run and lines and grades given for digging this ditch.

REPAIRS TO RENTED HOUSES.

Houses in the Negaunee District were measured for painting.

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

A joint estimate of the C.C.I.Company's ores in stock at this plant was made by their and our engineers. The results of the estimate checked very closely.

DEAD RIVER STORAGE DAM E & A 414.

The necessary surveys in connection with new construction were made. Photographs were taken monthly to show progress of construction. The building and repairs to roads and the construction of a new wooden bridge were supervised from this office. These roads are to take the place of those which have been flooded by the Storage Basin.

CASCADE EXPLORATION.

Surveys were run to locate diamond drill holes and for contouring. All land corners in existence on this exploration were located. In the office new maps were made.

REMARKS ON THE ABSTRACT DEPARTMENT AND VARIOUS SUBJECTS FOR THE YEAR 1924.

Documents received have been recorded and copies made where necessary.

MINING OPTIONS AND LEASES.

No options nor mining leases were taken out in 1924. The lease of the Francis Mine at Gwinn was surrendered as of May 1, 1924.

MISCELLANEOUS DOCUMENTS RECORDED.

The following is a list of documents recorded during the year:

	NO. RECEIVED.	LAST FILE NO.
Land offers, - -	92	1514
Authorizations, -	0	117
Deeds and Miscellaneous,	38	857
Easements, - -	1	146
Rights of Way, - -	7	201
Water rights, - -	0	32
Surface leases, -	343	2440
Applications for Sale,	0	77
Sales, - - -	21	399
Tax Histories, - -	29	553
Legal Opinions, -	5	183

LAND OFFERS.

The greater part of these offers were of houses and lots in Negaunee, a number of which were accepted. A few mining properties on different ranges were offered to this Company but none of them were accepted; besides these, the offers consisted, as in other years, of explorations or unexplored lands, mostly in Michigan, Minnesota and Wisconsin, together with a few from other states and also from Canada.

DEEDS AND MISCELLANEOUS DOCUMENTS.

These were mostly deeds of lots in the City of Negaunee which the Company purchased. Two of these documents related to Minnesota lands and one was the purchase of water power lands in Marquette County.

RIGHTS OF WAY.

Most of these documents cover the rights of way of the L. S. & I. Railway Company in Marquette and Alger Counties.

ENGINEERING DEPARTMENT.

SURFACE LEASES.

The greater part of these consist of leases upon the lots in the Hard Ore and Barnum Additions, the plats of which were recorded in 1924, and also lots of house property and gardens in the Gwinn District.

SALES.

These were sales of lands in the vicinity of the mineral properties.

TAX HISTORIES.

The tax histories recorded are those of the hydro-electric lands.

LEGAL OPINIONS.

These also related to hydro-electric lands.

LAND OFFER PLAT BOOK.

This book has been posted to show the position of land offers and explorations upon the different ranges.

ABSTRACTS OF TITLE.

The abstracts of a number of water power properties and of a few mining lands were recorded in this office and copied. Copies of these abstracts also were sent to the Cleveland office and the Land Department, together with maps, tax histories and legal opinions.

The abstracts of the Minnesota properties are still in the hands of Mr. Carl Brewer, who informs me that they have been completed with the exception of a few small items which he hopes to finish shortly.

MICHIGAN STATE TAX COMMISSION.

The maps and estimates of tonnages in the various mines were sent to the Tax Commission at the end of January. Mr. Pardee, the Engineer for the Tax Commission, visited the district later on.

FORCE OF ENGINEERS.

Mr. J. E. Hayden resigned his position as one of the assistant engineers on May 15th to become the Manager of the Copps Reduction & Refining Company's quarry and mill at Randville, Dickinson County.

DEAD RIVER WATER POWER.

Changes in the highways around the storage basin necessitated

some engineering supervision from this office during the year.

CASCADE RANGE.

Extensive surveys were made on Section 27, 47-26, preliminary to explorations by diamond drill, which are now being carried on.

CATARACT FALLS AT GWINN.

Surveys of the land lines near the Cataract Falls on the Escanaba River have been made by the engineers in the Gwinn District. Consultations were held between them and the engineers at this office and also with Mr. Brotherton, of the Land Department. Mr. Charles Cummings of Marquette, County Engineer, was employed to re-establish two of the lost land corners.

CARBON FOR DIAMOND DRILLING.

Carbon for diamond drilling was purchased in December. No carbon has been bought previous to this since 1919.

FIRE AT ENGINEERING BUILDING.

On November 1st, a fire was discovered on the roof of the Engineering Building due to sparks blown by a high wind from the stacks at the mine where a boiler was just being fired. Fortunately, this was put out by the Fire Department before much damage was done. Water came through the building which necessitated the re-decoration of the offices.

CANADIAN IRON RANGES.

A trip was made by E. L. Derby and J. E. Jopling to investigate the discovery of iron ore twenty miles North of Sault Ste. Marie, Ontario, and a report written upon same in November.

THE CLEVELAND-CLIFFS IRON COMPANY.

REPORT OF THE GEOLOGIST FOR THE YEAR ENDING DECEMBER 31, 1924.

STAFF.

The staff of the Geological Department in 1924 is shown in Table I below. Mr. M. C. Drake was added to the personnel of the Department June 2, 1924, as Assistant Geologist. For the past several years he had been in the employ of the Company as a mining engineer in the Gwinn District:

TABLE I.

NAME.	OCCUPATION.	DURATION OF EMPLOYMENT IN 1924.	DAYS LOST. SICKNESS.	VACATION.	% OF WORKING DAYS WORKED.
E.L.Derby,Jr.	Geologist in charge of Department.	Entire year	0	0	100.0
M. C. Drake	Assistant Geologist.	7 months	0	3	98.1
E. A. Allen	Assistant, testing diamond drill holes, collecting & labeling samples, etc.	Entire year	2	13½	94.4
Gustav Afuhs	Draftsman	Entire year	3½	1½	98.2

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

TABLE II.

Total days of eight hours worked, - -	274½ days.
Sundays, - - - - - - - - -	52 "
Days resulting from Saturday afternoons,-	26 "
Holidays, - - - - - - - - -	13½ "
Total,	366 days.

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

TABLE III.

YEAR.	AVERAGE NUMBER OF MEN.
1920	4.06
1921	3.56
1922	3.00
1923	3.00
1924	3.58

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.

E. L. Derby, Jr. Being directly in charge of the Department, the larger part of my time, 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 Ishpeming and Cascade Districts, and the Mesabi Range; underground drilling in the Cliffs Shaft, Morris and Republic Mine; and the geological surveys in the Athens, Barnes-Hecker, Cliffs Shaft, Francis, Holmes, Maas, Morris-Lloyd, Negaunee, Republic, Spies-Virgil and Stephenson Mines. I, personally, made frequent underground geological surveys of the new development work in these mines.

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

In January, I joined with Messrs. Jopling and Jackson in a joint report on the Mary Charlotte and Maroco Mines of the Marquette Ore Company based chiefly on a report on these properties made by Crowell & Murray of Cleveland.

In February, I prepared several tonnage and production estimates in connection with the negotiations for the proposed Race Track-Lake Superior Iron Company transfer. I also went over the Barnes-Hecker Tax Commission tonnage and valuation estimates with Mr. Pardee, Engineer for the State Tax Commission.

In March, April and May, I spent a considerable part of my time collecting and corellating geological information and in other ways assisting Mr. Smyth in the preparation of a special report for Mr. Duncan concerning this Company's mineral estate. This took me to Cambridge, Massachusetts, both in April and May, for several weeks on each occasion.

In June, Mr. Smyth and I spent several days on field examina-

tion work which included the vicinity of the Jackson property at Negaunee, the old St. Lawrence Pit, Northwest of Ishpeming, and the Webster and Portland Mine properties, just West of Michigamme. I also examined the records in J. M. Longyear's office at Marquette covering the drilling done in 1920 by J. M. Longyear, Jr. on Lot 7 Section 20, 43-31 at Mansfield in Iron County, in connection with land offer No.1433 Iron County. A special report covers this subject.

In July, I visited the Ford Motor Company's drilling explorations in the vicinity of Republic in company with Messrs. Reigart and Kronquist of that company. This is also covered by a special report.

In August, and in company with Mr. S takel, I spent a day at the Bates Mine office going over the geological maps and cross-sections of the Bates Mine with Messrs. Lake and Carey of the M. A. Hanna Company. In exchange for this data, we gave them the geological information of our Spies and Virgil properties. Mr. Lake and I have arranged to make a joint geological study of that part of the Menominee Range in which is included the M. A. Hanna Company and our own properties.

In October, Mr. Smyth and I spent several days in the field, both on this Company's and adjoining lands, to collect general geological data and to examine several localities on the Company's lands in quest of lean siliceous ore similar to that being mined at the Richmond Mine on the Cascade Range. As a result of this, we recommended for exploration two localities in the North half of Section 26, 47-27, as well as the old Ogden Mine property.

In November, I spent several days at the old Ogden Pit sampling the face and the Northwest tunnel. We were unable to find the Southeast tunnel, the portal of which had been covered by loose ore. I also spent two days in company with Mr. Jopling on a trip to the Algoma District Ontario, Canada, where we examined an iron ore land offer presented by Mr. J. H. Quinn of Ishpeming. Thisx examination is covered by a special report. The offer was declined.

M. C. Drake. Mr. Drake joined the Department as an assistant geologist June 2nd. Previously, he had been employed as an assistant engineer in the Gwinn District for several years. After becoming familiar with the work of the Department, he made regular underground geological surveys at all the Company's operating mines in Michigan, except those in Negaunee, and posted these surveys on the geological maps and cross-sections. He frequently accompanied and assisted me in the underground geological surveys of the new development work in the various mines. He geologized the outcrops located by the engineers on their topographical survey of the vicinity of the old Ogden Pit in Section 13, 47-27 and assisted in sampling the Northwest tunnel. He assisted Mr. Nicolson of the Engineering Department in making an estimate of the lean siliceous ore available on this property above the present track level. He also made a set of cross-sections of the drilling being done on Section 27, 47-26, Cascade Range.

E. A. Allen. Mr. Allen continued as an assistant in the Department throughout the year. At times, however, he assisted several of the engineers with their surveys and drove the truck. The major part of his time was employed in collecting, sampling and filing diamond drill samples from the current explorations. He assisted both Mr. Drake and me in underground geological surveys and frequently accompanied me on my trips into the field. He made the regular monthly carbon reports and the annual inventory of diamond drill equipment. He also made the density determination tests on the new carbon which was purchased early in December.

Gustav Afuhs. Mr. Afuhs continued as draftsman throughout the year. His work, as heretofore, 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 Company's operating mines on the Michigan Ranges, making new maps and cross-sections as they become necessary. He spent considerable time

completing the mapping of the large number of Canadian land offers in our files on a series of special maps which will serve as a permanent record. He also made a number of maps for Mr. Smyth's special report. He made maps for use in connection with the Race Track-Lake Superior Iron Company transfer negotiations and maps of the Spies-Virgil property for use by the Cleveland office in a prospectus which it prepared. He continued the work of making cross-sections showing the records of all old drill holes on forms which we now use for the current drilling. He made a map of the vicinity of Atkinson in Iron County for Mr. Prickett of Sidnaw, correlating on it all the geological information on record in this office. He also made a surface geological map of the Bates and Spies-Virgil properties which I shall use as a base map for a detail study of the Mineral Hills section of the Iron River District. He posted the Tax Commission set of geological cross-sections of the Morris-Lloyd and Negaunee Mines. He colored all the annual and Tax Commission report sheets of this Company'a drilling for the year and the legend sheets to accompany them. He also made copies of drill results, for our outside exploration files, of all the important land offers that were received and spent the rest of his time on the routine work of the office.

SURFACE GEOLOGICAL SURVEYS.

A geological survey of the surface in the immediate vicinity of the old Ogden Pit was made in November. A preliminary examination was made of the large outcrops of lean siliceous ore in the North half of Section 26, 47-27 in search of a deposit of lean ore similar to that being mined by the M. A. Hanna Company at their Richmond Mine on the Cascade Range.

UNDERGROUND GEOLOGICAL SURVEYS.

Before Mr. Drake joined the Department, I had to depend on the several engineers for a large amount of current underground geological data in our operating mines, particularly in the areas previously developed. Since then, however, the Department has carried on this work at regular intervals and has also been able to cover some of the areas which necessarily had been omitted temporarily.

ATHENS MINE.

The Athens Mine worked six day shifts per week until July 30th when work was reduced to four day shifts per week. Five day shifts per week were worked beginning with December 1st. Practically all the work in the mine was confined to mining. A South crosscut was started on the 4th level in Mitchell Lot 11 from which raises will be put up to mine the so-called second block East of the hanging on the 4th. A Southeast crosscut was also started on the 8th level, called the 830 crosscut and located midway between crosscuts 810 and 850. Raises will be put up from this crosscut for mining down from the 6th level. Several raises were put up and short crosscuts driven to improve the ventilation of the mine. Both the geological maps and cross-sections were posted regularly from the information furnished us by Mr. Nicolson, Engineer at the property, and formerly an assistant geologist.

BARNES-HECKER MINE.

This mine was operated six shifts per week until May 6th. From then on there were twelve shifts per week. This mine absorbed the surplus labor from the Salisbury Mine after the latter was closed on June 30th.

The ore on the East sideof the 100' sub, above the 1st level, was followed upward by raises. At 1115' it was outlined and mining commenced. Although ore continues upward from this point, it was thought unsafe to start mining at a higher elevation. The South drift of the 1st level was extended East for 130' and another raise put up to the 1115' sub. The 2nd level was extended East for 300',

part of which was in good ore that we believe will extend through to the 1st level. A raise from the 3rd to the 2nd level, all in ore, proves that this ore extends through to the 3rd level. The 6th level Morris was extended Northwesterly on to the Barnes-Hecker lease for a distance of 600' from the South boundary. This becomes the 4th level and will eventually connect with the shaft. Work in the rest of the mine was confined principally to mining the ore already developed. Geological surveys have been made regularly.

CLIFFS SHAFT MINE.

The Cliffs Shaft operated six shifts per week until July 30th when operations were reduced to five shifts per week, which have been maintained since then. Practically all work has been confined to mining, although considerable new ore was discovered by drilling and has been partially developed on the 6th and 7th levels "A" Shaft, both on the North and Eastx sides of the levels, as well as on the Southeast side. The ore discovered by drilling from the West end of the 15th level also is being developed. It is proving to be relatively flat in dip and pitch, which will tend to give it a larger horizontal area than we anticipated. Since Mr. Drake joined the Department, we have made regular geological surveys of all current extensions and have caught up with some of the back work which necessarily had to be omitted the past three years.

FRANCIS MINE.

Regular geological surveys were made at the Francis Mine until it was closed down and abandoned April 30th. The amount of water coming into the mine increased steadily towards the end of operations and all ore was removed that could be taken economically. Approximately 115,000 tons remain.

HOLMES MINE.

This mine operated six shifts per week until July 30th. From then until December 1st four shifts per week were worked. After December 1st the mine operated five shifts per week. All work was confined to

mining the ore ~~body~~ already developed and geological surveys were made regularly.

MAAS MINE.

The Maas worked six shifts per week until July 30th, then four shifts per week until December 1st. Since then five shifts per week have been worked. All work was confined to mining ore already developed. A so-called trench stope is being introduced in mining the ore between a portion of the 245' sub and the 3rd level. The geological maps and cross-sections have been posted regularly from data furnished us by Mr. Hayden before he resigned and since then by Mr. Moulton, both engineers at this property.

MORRIS-LLOYD MINE.

This mine worked six shifts per week until July 30th, then four shifts per week until December 1st. Since then operations have been on a five shift per week basis.

In the Lloyd and East Lloyd Mines, all work was confined to mining in ore areas already developed. This was also true of the Morris above the 4th level and of a part of the territory between the 4th and 6th levels.

Several lenses of ore were discovered by drilling on the 7th level and development work on them commenced. A trench stope has been introduced at one point on the 7th level and has followed the ore up at each end to its top, about 40' above the 215' sub. Development during the year has proved in most cases that the ore areas on the 6th level, where of appreciable size, have ore connections with ore areas on the 7th level. Both the 215' and 250' sub-levels have been extended appreciably and several others opened up. Geological surveys have been made at regular intervals.

NEGAUNEE MINE.

The Negaunee Mine continued to be the largest producer on the Range. It worked six shifts per week until July 30th, then four shifts per week until December 1st. Since then it has worked five shifts per

week.

With the exception of a small cut-out in the shaft at the elevation of the proposed 13th level, all work at this mine was confined to mining ore already developed. The geological maps and cross-sections have been posted regularly from data furnished us by Mr. Moulton, Engineer at this property.

REPUBLIC MINE.

This mine operated on a two shift basis six days a week until July 30th. From then until December 1st two shifts were worked four days per week. Since then operations have been conducted on a full time, or two shifts six days per week. The mine was closed, however, from October 17th to November 8th, inclusive, on account of damage to the No.9 shaft. This was due to the slabbing off of a large chunk of wall rock.

Pascoe Shaft was sunk another level and development work commenced on this elevation, the 2770' level. The drift being driven towards No.9 shaft on the 2670' level was extended 250'. There remains 460' to go. This work has been delayed on account of low air pressure but a new booster compressor is now being installed to correct this trouble.
A drift was driven Northwesterly along the hanging wall contact on the 2570' level Pascoe Shaft for a distance of 400'. Thus far no ore has been encountered. This drift, which is now stopped, will be continued in the near future. A drift 400' long was driven through hanging wall quartzite on the 2050' level to get around an old stope on account of the cracking of a floor pillar. This drift is on the main ~~track~~ line of tramming between the Pascoe and No.9 shafts. New ore on the South side of the 1570' level Pascoe Shaft, which was being developed at the beginning of the year, was completely outlined and mined.

A nice body of ore was found by drilling and developed on the Southwest side of the 1850' level Pascoe Shaft. A body of ore found by drill hole No.469 drilled in 1921 from the Southwest side of the 1950' level Pascoe Shaft is now being developed.

GEOLOGICAL DEPARTMENT.

We have made regular geological surveys of all current operations and practically completed surveys of the areas necessarily neglected before Mr. D rake was added to the Department.

SPIES-VIRGIL MINE.

This property was operated six shifts per week until January 10th. Since then two shifts have been worked six days a week. The principal work has consisted of completing the shaft plats on both the 4th and 5th levels, and opening the 4th level for approximately 1400' and the 5th level 1450'. Both are still in footwall slates. A small exploratory sub-level was opened about 23' above the 4th level and crosscutted approximately 145' of rich iron formation.

A few contracts mined ore in the Spies from the North lens and the territory between that and the main stope. A small amount of ore was developed above the 3rd level, Southwest of the main stope. Geological surveys of all this work were made regularly.

STEPHENSON MINE.

The Stephenson Mine was operated six shifts per week until July 30th. From then until December 1st four shifts per week were worked. After December 1st the operations were on a five shift per week basis. With the exception of a few pillars which were removed on sub-levels below the 3rd and 4th levels, mining was confined to the territory between the 5th and 6th levels. The winze which was being sunk from the Southeast side of the 6th level at the end of 1923 was completed and two levels started. The 7th level was cut out 65' below the 6th and 180' of drifting in footwall rocks done. The 8th level was cut out at 127' below the 6th and 150' of drifting done, also in footwall rocks. Geological surveys of all this work have been made at frequent intervals. We are indebted to Mr. Sterling, Engineer at the property, for additional geological data from sections of the mine inaccessible to us at the times of our surveys.

EXPLORATIONS.

Drilling explorations were carried on during 1924 in the following districts and mines:

FROM SURFACE.

DISTRICT.	RANGE.
Ishpeming	Marquette
Cascade	Cascade
Hibbing	Mesabi.

FROM UNDERGROUND.

MINE.	DISTRICT.
Cliffs Shaft	Ishpeming
Morris	North Lake
Republic	Republic.

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

Options Nos.108 and 109, situated in Section 12, 138-25 Crow Wing County, Cuyuna Range, Minnesota, expired in July and June 1924, respectively, and were not renewed.

Lease No.22 on the Francis Mine at Gwinn was surrendered as of May 1, 1924.

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 $5.45 per foot, excluding certain items which are not actually drilling expense but which are charged to the explorations. By including these items, the average cost was $6.69 per foot. The average cost of underground drilling in the same way was $2.86 per foot and $3.16 per foot, respectively. The average cost of all drilling was $3.54 per foot and $4.10 per foot, respectively.

The cost of surface drilling was considerably higher than in 1923, due chiefly to the fact that most of the drilling was done at the Cascade and Salisbury and consisted of a relatively large number of shallow holes, from 50' to 150' in depth, requiring frequent dismantlement, removal and erection of equipment. In fact, drilling

of this nature often costs twice as much as in the case where the holes are 1000' or more in depth. The cost of underground drilling on the other hand was from 10% to 15% less than in 1923, principally due to the increased footage and the length of individual holes. There was 8082' drilled in 1924 as against 6495' in 1923.

Table V, also shown below, gives a comparative cost per foot of total drilling for the past five years:

TABLE IV.

SUMMARY OF DRILLING FOR 1924.

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".
SURFACE DRILLING.														
Boeing Mine Pit,	15	47	27	0	540	15	555	163	258	82	$1362.81	$2.46	$1158.06	$2.09
Cascade,	27	47	26	308	52	1169	1529	0	0	478	14147.76	9.25	10797.98	7.06
Salisbury,	6	57	20	112	0	729	841	0	0	0	4064.38	4.83	3973.07	4.72
Total Surface Drilling,				420	592	1913	2925	163	258	560	$19574.95	$6.69	$15929.11	$5.45
UNDERGROUND DRILLING.														
Cliffs Shaft Mine,	9 & 10	47	27			2402	2402	458	354	276	$7976.16	$3.32	$7212.87	$3.00
Morris Mine,	1 & 2	47	28			3266	3266	207	85	260	9432.38	2.89	8163.92	2.50
Republic Mine,	7	46	29	6		2414	2414	118	18	84	8154.25	3.38	7703.01	3.19
Total Underground Drilling,						8082	8082	783	457	620	$25562.79	$3.16	$23079.80	$2.86
Grand Total Drilling,				420	592	9995	11007	946	715	1180	$45137.74	$4.10	$39008.91	$3.54

NOTE:- Cost "A" includes taxes, office expense, engineering, analysis, legal and personal injury.
Cost "B" excludes " " " " " " " " " (to comparewith contract price).

The only contract drilling for the year was the surface drilling in the Boeing Mine Pit and was done by the Carlson Exploration Company.

TABLE V.

SUMMARY OF FOOTAGE DRILLED AND COST PER FOOT OF DRILLING FOR PAST FIVE YEARS.

YEAR.	TOTAL FEET DRILLED.	COST PER FOOT "A".	COST PER FOOT "B".
1920	26,638	$5.41	$4.81
1921	16,011	5.14	4.37
1922	7,634	3.79	3.44
1923	9,091	3.65	3.38
1924	11,007	4.10	3.54

SURFACE EXPLORATIONS.

MARQUETTE RANGE.

ISHPEMING DISTRICT.

SECTION 15, 47-27, SALISBURY MINE SURFACE.

Drilling had just been started at the beginning of the year to test two depressions in the upper greenstone sheet Southeast of the Salisbury Mine. The first area is about 300' Southeast of the old shaft, No.13, and an equal distance Northeast of the center of the section. Two holes, Nos.70 and 73, were drilled and nothing but greenstone encountered.

The second area is that lying beneath the North half of Grass Lake in the Southeast quarter of the section. Two holes also were drilled here. The first, No.71, encountered 71' of iron formation on top of the greenstone but no enrichment. The second, No.72, found only two feet of iron formation on the greenstone. These tests concluded the drilling at the Salisbury Mine.

CASCADE RANGE.

CASCADE DISTRICT.

SECTION 27, 47-26, CASCADE EXPLORATION.

In August it was decided to explore this Company's holdings in Section 27, 47-26 near the East end of the Cascade Range, comprising all of Section 27 except the SW¼. It is hoped that we may discover a body of lean siliceous ore similar to that being mined from the Maitland and Richmond Pits in the same District, and so situated that it can be mined economically by an open pit.

Most of this property is ideally situated for open pit operation lying adjacent to and considerably above the Northwestern Railway Company's branch into Palmer. Also, the surface material is comparatively shallow over this area. Several million tons of this class of ore have been developed by M. A. Hanna Company on the SW¼ and stripping operations already have begun.

The plan being followed in our drilling is to locate holes 200' apart North and South and 400' apart East and West. The iron formation and ore that it may contain is always more uniform in character along its strike, which in this case is approximately East and West, hence the greater distance between holes in this direction.

Five shallow holes were drilled and the sixth started in the N½ of the Section not far from the C. & N. W. track and near the North-South center line. The surface of the SW¼ of the SE¼, which lies immediately East of the ore developed by the Hanna Company, is not owned by the Company. A six months option to purchase it was obtained early in October and since then our drilling has been confined to this area. The W½ of the forty is high enough above the railroad to make an open pit operation simple.

Nine shallow holes, Nos.7 to 15 inclusive, have been drilled in this area thus far and No.16 started. The plan of arrangement of the holes is the same as that adopted in the North part of the section.

The results of the Hanna Company drilling show the ore to be at least 600' wide along the West boundary of this forty North from the South quarter corner of the section, but they also indicate that the North limit of ore is trending Southeasterly. Our drilling to date has confirmed this trend, which apparently continues in this direction across the forty under option. On account of this, but before all the holes planned to test it have been drilled, I anticipate that the ore on this forty will not be more than 150' or 200' wide on the East boundary. Some ore undoubtedly extends on to the property immediately South, which is owned by Otto Eger of Ishpeming. All told, there may be a body of this siliceous ore from 600' to 800' wide on the West end extending Southeasterly for a quarter of a mile with a width of 400' to 600' at the East end, which would be applicable to open pit mining. Mr. Eger's property would have to be acquired for such an operation.

GEOLOGICAL DEPARTMENT.

This ore is limited on the North by a zone of quartzite which may be interbedded with the iron formation. To the North of this, however, the greater part of the section is underlain by iron formation well located for an open pit operation. During the coming months our drills will test this area.

M E S A B I R A N G E.

HIBBING DISTRICT.

SECTION 6, 57-20, BOEING MINE SURFACE.

Early in October it was decided to drill several vertical holes in the Boeing open pit to determine the depth and quality of ore below the bottom of the present ore cut at the Southeast end of the pit. Ore of unexpectedly high alumina content was encountered the past summer in this locality and it was essential to know what to expect in the next cut.

Eleven shallow holes, Nos.424 to 434 inclusive, were drilled and most of them bottomed in taconite or very lean ore. The results indicate an average of at least 20' of ore of Boeing grade, and reasonably low alumina content, below the present cut. Drilling was done by the Carlson Exploration Company on a cost plus basis and was completed early in December.

U N D E R G R O U N D E X P L O R A T I O N S.

CLIFFS SHAFT MINE.

One diamond drill continued to operate in this mine throughout the year. Seventeen holes were completed and another hole started. All holes were drilled horizontally with one exception.

Hole No.327, which was drilled due South from the South drift of the 11th level "A" Shaft to explore for the main South vein being mined on the 10th level, was drilling in dike at 49' on the first of the year. Iron formation was encountered from 50' to 57', after which the drill again cut dike. This proved to be the footwall

greenstone and the hole was bottomed in it at a depth of 200'. Hole No.330 tested this same ground again 200' farther East but did not find ore.

Two holes, Nos.328 and 329, were drilled North from the North drift on this level and 150' apart. They encountered two lenses of good ore. Two more holes, Nos.331 and 332, were drilled from the East end of the South drift to test the ground approaching the old Incline Mine workings on the East. No.331 was drilled due East and No.332 N. 45° E. Both encountered encouraging footages of good ore. There were 82' in the first and 110' in the second, divided into three or four separate lenses in each case.

Two holes, Nos.333 and 334, were next drilled from the East end of the 12th level "A" Shaft to explore on this level the same general territory tested by holes Nos.331 and 332 on the level above. No.333 was drilled due East and No.334 N. 45° E. They both encountered good ore but in relatively narrow seams, ~~xxx~~ from 10' to 12'.

The next three holes were drilled from the Southeast side of the 5th level "A" Shaft. Two of these, Nos.335 and 337, were drilled due South to test the ground to the South boundary of the property. The first hole cut a lens of ore 14' wide and the second, two lenses aggregating 12' in width. The other hole, No.336, was drilled N. 35° E. from the extreme East end of the same drift and encountered two lenses of ore, one from 8' to 16' and the other from 60' to 91'. The latter ore is in contact with the slate hanging wall.

The drill was next moved to the East end of the 7th level "A" Shaft and three holes drilled there. The first, No.338, drilled N. 52° W., tested the fault zone and territory North of the level drift. Considerable enrichment was found but no commercial ore. Hole No.339, drilled N. 19° E. from practically the same point, also failed to find ore. In a further attempt to encounter the downward extension of ore above in this vicinity, hole No.340 was drilled with an upward inclination of +29° S. 72° W. and found 49'

of good ore. The last 9' were separated from the rest by a 16' dike.

Four holes, Nos.341 to 344 inclusive, were next drilled from the South side of the 6th level "A" Shaft. Three holes, Nos.341, 342 and 344, were drilled due South to test the ground as far as the South boundary of the property. They were located approximately 200' apart East and West. Hole No.341, the Westernmost hole, had good ore from 0 to 5' and from 113' to 135'. The hole was stopped in this ore at 135', a short distance over the property line. Hole No.342 had good ore from 0 to 6' and from 72' to 82', and hole No.344, which is still drilling, had good ore from 35' to 45'. This hole was drilling in greenstone at a depth of 70' on the last of the year. Hole No.343 was drilled due North to the slate hanging from a point in the drift opposite hole No.342. Good ore was encountered from 0 to 23', making the ore at this point, including that removed by the drift and included in hole No.342, approximately 49' wide.

MORRIS MINE.

Drilling was continued in the Morris Mine throughout the year with one drill. Seventeen holes were completed and another partially drilled. All but two are horizontal holes.

Hole No.77, which was drilled with a dip of -40° N. 25° W. from the 6th level near the 2200 meridian to determine the trend of the main sub stope ore body on its pitch below this level, was drilling in jasper at 95' on the first of the year. The ore body was cut from 125' to 195' and the hole bottomed at 215'.

The drill was now moved back to the 7th level to continue testing the formation at regular intervals, both towards the foot and towards the hanging. A series of thirteen holes, Nos.78 to 90 inclusive, were drilled. Hole No.78 was drilled due South from near the 5500 meridian and No.79 due North from the same set-up. No enrichment was encountered in No.78 and but 5' of ore in No.79. Hole No.80 was drilled due South 100' East of these two without encouraging results.

GEOLOGICAL DEPARTMENT.

Hole No.81 was drilled from the same point as No.80 but on a course of S. 45° E. and encountered 62' of good ore between 60' and 130', there being an 8' dike from 89' to 97'. This ore undoubtedly connects with that encountered in the main drift close by and a development drift is now being planned to open it up.

Hole No.82 was drilled due South from close to the West end of the level near the 6200 meridian in a final attempt to locate the downward extension of ore encountered in this vicinity on the 6th level. No ore was found. Hole No.83 was then drilled due South 300' East of No.81. Holes Nos.84 and 85 were also drilled due South and at 200' intervals, the first hole being 200' East of No.83. No ore was discovered in any of these three holes.

Holes Nos.86 and 87 were drilled due North to the slate footwall, the first hole opposite No.85 and the second opposite No.84. Hole No.86 had ore from 0 to 5' but that was the only discovery in either hole.

Two additional holes, Nos.88 and 89, were drilled from the same point as No.85 to further explore for the possible downward continuation of ore above on the 6th level. No.88 was drilled S. 50° W. and No.89 S. 45° E. Unfortunately neither hole encountered ore, although No.89 passed through rich iron formation. Hole No.90 was then drilled due South from a point 300' East of these holes. Fifty feet of good ore was encountered from 25' to 75'.

The drill was now moved to the 4th level to drill one inclined hole, No.91. It was drilled with a dip of -51°30' N. 15° E. from the South drift near the 1100 meridian to explore for the downward continuation of a lens of ore near the footwall on this level about which we have no information below this elevation. No ore was encountered, indicating that the lens is of no importance at an appreciable distance below this level.

The drill was then moved back to the 7th level and hole No.92 drilled N. 13° E. to the slate footwall from a point 100' West of

hole No.90 to test for a possible fault crotch in the slate. The hole proved to be a little too far to the East and another attempt will be made in the future to find ore here. Hole No.93 was then drilled due South from a point 200' East of No.90 to follow up the ore in the latter hole. Fifteen feet of good ore was encountered from 5' to 20'. The development of this ore is now being planned.

Several holes were now planned on the 4th level to finish exploring territory which might not be easily accessible after mining in the present ore areas is completed on this level. Hole No.94 is being drilled due South from the end of the main drift extending South from the shaft. The principal object here is to locate what we believe to be the Southwesterly extension of the fault dike which forms the East and Southeast boundaries of the Lloyd Mine ore, and to explore for possible ore at other points along this dike. The dike had just been cut from 241'to 256' at the end of the year. The formation was decidedly enriched but no ore was found at this point. Other tests will be made along this dike from this level.

REPUBLIC MINE.

The diamond drill operated continuously in this mine throughout the year with the exception of the period in which No.9 shaft was being repaired following a fall of rock and referred to previously in this report. A total of 2414' was drilled. This is only a little over half as much as the year before on account of the reduced schedule of operations in the mine the greater part of the year, the delay referred to above, and because of the comparatively small amount of the softer rocks encountered.

The work consisted in completing hole No.540, which was drilling at a depth of 29' on the first of the year, drilling holes Nos. 541 to 558 inclusive, and in deepening old holes Nos.471 and 527. The latter hole was drilling in jasper at a depth of 67' on the last of the year.

All but three holes were drilled horizontally and all of them

from current or recently worked levels in the Pascoe Shaft according to the plan of systematic exploration that has been followed here for several years past. This resolves itself into first making an attempt on all levels to locate the downward extension of known ore lenses where they are not found by drifting along the quartzite hanging contact but presumably have dropped back into the jasper footwall. Secondly, the hanging contact zone is explored for new ore bodies by drilling 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 has been the experience in this mine that all important ore bodies lie within this zone.

Hole No.471, drilled due West from the South end of the 2050' level in 1921, was deepened from 137' to 184' but only a small amount of enrichment was encountered.

Holes Nos.540 and 552 were drilled N. 83° W. and S. 25° W., respectively, from the South side of the 1710' level. The first was drilled to test for a possible widening of the seam of ore encountered in holes Nos.532 and 533. The results were discouraging. The second hole explored for a possible downward continuation of ore being mined in the stope on the 1570' level.

Hole No.541 was drilled N. 68° W. from a point 50' West of the shaft plat on the 1850' level to explore between old holes Nos.281 and 282 which cut narrow seams of good ore. Ore was cut in hole No.541 at 118' but it was only 4' wide.

Holes Nos.542, 547 and 548 were located on the West side of the 2670' level. The first was drilled S. 16° W. into the footwall to explore for a possible downward extension of ore on the level above. Only narrow seams of ore were encountered. Holes Nos.547 and 548 were drilled N. 43° E. and N. 17°40' E., respectively, to explore the quartzite hanging contact on the North limb of the main fold. No ore was encountered.

Holes Nos.543, 544 and 553 were drilled S. 26° E., S. 28°28' E. and S. 30° E., respectively, and 50' apart from the main Southwest drift on the 1335' level to explore the footwall formation. The first hole encountered 12' of excellent Bessemer ore from 23' to 35' but Nos.544 and 553 had only lean ore and jasper. This ore developed into only a relatively small stope above the level but may be larger in its downward extension.

Holes Nos.545 and 546 were drilled vertically from the floor of the stope on the South side of the 1570' level to determine the thickness of the floor pillar before too much ore was broken on to it from the stope above. Ten feet of ore was cut in No.545 and 14' in No.546.

Holes Nos.549, 550 and 551 were drilled due East, S. 68°24' W. and N. 68°39' E., respectively, from the North drift on the 2570' level. Nos.549 and 551 explored the footwall territory and No.550 the hanging contact. No ore was found in any of these holes.

Holes Nos.554 and 555 were drilled approximately S. 66° W. and S. 21° W., respectively, from the West side of the shaft plat on the 2770' level to explore for the downward extension of the ore on the 2670' level occurring West of the shaft. Good ore was encountered in No.554 from 51' to 72' and in No.555 from 25' to 74'6", except for seams of jasper from 27' to 28' and 58' to 64'.

Holes Nos.556, 557 and 558 were then drilled from the South end of the 1950' level to continue exploring for the downward continuation of ore above on the 1850' level which several other holes had failed to find. Nos.556 and 557 were drilled S. 25° E. and S. 45° E., respectively. Hole No.558 was also drilled S. 45° E. but at an inclination of +35° directly above No.557. The first two holes encountered no ore and No.558 only 3' of ore.

EXPLORATIONS BY OTHER COMPANIES.

Both Mr. Allen and myself have made occasional visits to explorations of other companies in Upper Michigan. These are covered in detail by special reports. The principal work going on during the year was the drilling by the Ford Motor Company and the Palms-Book Land Company.

The Ford Company practically completed drilling their holdings in Section 19, 46-30, Southwest of Republic, on what was known as the Pumpelly Mine property, and Northwesterly from their Imperial Mine as far as the old Titan Mine. They also have about finished drilling at the old Riverside Mine, Northwest of Republic. They have found no merchantable ore in any of this work. At the Pumpelly they encountered a lean hard ore formation with iron in the form of magnetite extending Northerly and Southerly for several miles. In many places this formation averages from 40% to 45% in iron. The overburden is relatively shallow and at some future date the formation may be stripped, mined by open pit and concentrated. They are now drilling near the old Standard Mine in the Republic trough and at the old Taylor Mine in Baraga County.

The Palms-Book Land Company has two drills exploring the N½ of Section 3, 47-28 near the old Dexter Mine. Several holes have been drilled and a small amount of ore found. Some of this ore averaged from 4% to 5% in manganese.

Since M. A. Hanna & Company assumed control of the Bates Mine, Northeast of our Spies-Virgil property, they have completed an extensive drilling campaign underground. From this and a complete geological survey of all underground workings they claim to have demonstrated the existence of four distinct horizons of iron formation separated by slate. I expect to go over these results in detain in the near future with Mr. Lake, Geologist for the Hanna Company. The complete records of this work are on file in this office.

The Hanna Company completed its drilling on the SW¼ of Section 27, 47-26, Cascade Range, during the past summer. They have developed several million tons of lean siliceous open pit ore of a similar grade to the Richmond Mine. Stripping operations are already under way to prepare the pit for production by the time its lease expires on the Richmond. The complete records of this drilling are also on file in this office.

Mr. Afuhs has continued to copy for our files all outside exploration results of any importance which have come to this office in the form of land offers, etc.

EXAMINATION OF MINERAL LAND OFFERS.

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

No.1433, Lot 7 in Section 20, 43-31, Iron County, Michigan. This is the fractional part of the SW¼ of the NW¼ of the section and lies West of the Michigamme River and a short distance South of the bridge crossing the river at Mansfield. Mr. Jopling and I examined the records of the drilling on this property, done in 1920 by J. M. Longyear, Jr., in the Longyear office at Marquette. We also saw there the results of other drilling and geological records of this vicinity. The offer was declined.

No.1502, Algoma Central, Ontario, Canada. This offer covers land situated near Bellevue and extending the greater part of the distance between mile posts 19 and 21 on the Algoma Central Railway. Mr. Jopling and I made a field examination of this property and found only narrow seams of hematite interbedded in quartzite. The offer was declined.

In addition to these offers, Messrs. Jopling, Jackson and I prepared a detailed report on the Mary Charlotte Mine at Negaunee and the Maroco Mine at Trommel on the Cuyuna Range, Minnesota. These are properties of the Marquette Ore Company and were on the market early in 1924. Most of our data was derived from a report on these properties by C rowell & Murray, Engineers of Cleveland, Chio. I was not

advised that these properties were ever actually offered to this Company.

EXPENSE STATEMENTS.

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 1924.

GEOLOGICAL DEPARTMENT.

	Salaries, - - -	$17,832.99
(1)	Travel, - - -	656.90
(2)	Operating Automobiles,	867.82
(3)	Supplies, - - -	1,200.39
	Office Expenses, -	309.15
	Total,	$20,867.25

EXPENSES OF H. L. SMYTH.

Travel, - - -	$484.05
Supplies, - - -	113.01
Miscellaneous, - -	120.00
Total,	$717.06

SUMMARY.

Expenses of Geological Department, -	$20,867.25
" " H. L. Smyth, - - -	717.06
Grand total,	$21,584.31

(1) DETAIL OF TRAVELING EXPENSES, B - 1.

Traveling expenses, geological surveys, etc,	$645.86
Company horses, - - - - - - - -	11.04
Traveling expenses, outside explorations,	none
Total,	$656.90

NOTE: See next page for further details.

(2) DETAIL OF COST OF OPERATING AUTOMOBILES.

ITEMS.	STUDEBAKER.	½ PROP. DODGE TRUCK.
Gasoline, oil & grease,	$108.77	$34.73
Tires, - - - -	77.54	14.59
Tools, - - - -	none	none
Repairs, - - - -	56.83	36.41
Miscellaneous, - -	23.51	3.62
Insurance, - - -	87.84	18.60
Depreciation, - -	331.82	73.56
Total,	$686.31	$181.51

(3) THE MORE IMPORTANT CHARGES TO SUPPLIES.

Annual Report, - -	1/3 proportion,	$262.08
Blue print paper, -	" "	21.93
Tracing cloth, - -	" "	68.20
Printed forms, - -	" "	26.10
Repairs to transit, -	" "	162.43
Measuring tapes, - -	" "	14.99
Brunton Compass, - - - - - - -		30.00
Printed forms, - - - - - - -		13.25
Maas Compass, - - - - - - -		72.00

TABLE VII.

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

	1924.	1923.	1922.
Salaries, - - -	$17,832.99	$16,295.25	$12,279.80
Travel, - - -	656.90	220.98	312.64
Operating automobiles,	867.82	657.20	860.72
Supplies, - - -	1,200.39	1,325.19	881.01
Office expenses, -	309.15	115.00	19.52
Total,	$20,867.25	$18,613.62	$14,353.69
Expenses of H. L. Smyth, i.e., Travel, Supplies, and Miscellaneous,	717.06	528.39	196.88
Grand total,	$21,584.31	$19,142.01	$14,550.57

CLIFFS SHAFT MINE

We have had very little trouble with the mechanical equipment at this mine.

The underground pumps operated in a very satisfactory manner. It was necessary to do considerable repairing on the Prescott centrifugal pump as it was badly worn. The Prescott plunger pumps operated all year without giving us any trouble or delays of any kind.

It is necessary to operate three air compressors for a few hours each day on account of using so many slusher hoists underground. With the exception of one main bearing burning out, we have had no trouble with these machines.

The hoists are in good condition and they have operated the whole year without any delays.

The main crushing plant has operated with only a few minor repairs.

There were no changes or additions to the mechanical equipment during the year.

The installation of several miles of cable for underground scraper equipment has been completed and is satisfactory. The development of scrapers and operation of same has been undertaken by Superintendent and we are not informed as to results.

HOLMES MINE

The mechanical equipment at this mine is in good condition.

The operation of the underground pumps has been very satisfactory, with only a few minor repairs and no delays.

The air compressor has given us no trouble or delays. It was necessary to rewind the rotor on the exciter. A small motor-generator set was installed to take care of the compressor while these repairs were being made.

HOLMES MINE (Cont'd)

The hoists operated in a satisfactory manner. We had one overwind on the skip hoist at noon on October 30th, which caused a delay of about five hours. This accident occurred during the low pressure air period. When the air pressure is loo low to hold up the weight on the emergency brake it is necessary to hold it up with a block of wood. After starting a loaded skip the engineer noticed that the air pressure had gone up. While the skip was in motion he attempted to take out the block, and in doing so he tripped the Lilly controller, cutting the current off from the motor. The loaded skip reversed and the hoist and pulled the empty skip up into the head frame sheave. It was necessary to change the skips as it was considerably damaged.

There have been no changes or additions made to the mechanical equipment at this mine.

SALISBURY MINE

This mine was shut down on June 30th and has been abandoned. The pumping equipment was removed from underground and the mine allowed to fill with water. The pump motors were stored in the Lake Mine change house.

ATHENS MINE

The mechanical equipment at this mine is in good condition.

The underground Prescott plunger pumps gave us a little trouble in January. It was necessary to replace two water cylinders. These pumps have not given us any further trouble since this change was made.

All hoisting and compressor equipment has operated all year without any delays or repairs.

MAAS MINE

At this mine the mechanical equipment operated very satisfactorily during the year.

The pumping equipment did not give us any trouble or delays. It was necessary to install additional pumps on the fourth level as there was

considerable water coming through from the third level. We enlarged the pump station on the fourth level and installed a Gould triplex pump, 300 G.P.M., 400 ft. head, and an Alberger centrifugal pump, 300 G.P.M., 400 ft. head. Both of these pumps were taken from the Morris Mine as they were not in service there.

A larger boiler was installed in the Heating Plant. This plant now furnishes heat for all the buildings at the mine.

The hoisting and compressor equipment has operated all year without causing any delays.

The steam turbine was in operation from February 13th to April 6th on account of low water at the hydro-electric plants.

MAAS CRUSHING PLANT

This plant was put in operation April 26th and closed down on November 21st. Operation was satisfactory, with very little trouble or delays.

NEGAUNEE MINE

There were no changes or additions made to the mechanical equipment at this mine.

It was necessary to replace one of the boilers in the Heating Plant with a larger one. This boiler was taken from the Maas Mine auxiliary plant and originally came from the Imperial Mine.

All mechanical equipment operated in a satisfactory manner, without any trouble or delays.

SOUTH JACKSON CRUSHING PLANT

Not operated during the year.

SOUTH JACKSON MINE

Operations were started in the Pit on April 23rd and suspended on June 14th, and started again on August 29th and suspended in October.

There were no changes or additions to the equipment at this mine. All mechanical equipment operated satisfactorily.

BARNES-HECKER MINE

A new stack was placed on the heating boiler to replace one that was worn out.

The pump at North Lake was stopped on July 22nd in order to let the water raise 8 ft. to see if it would make any difference in the pumping at the mine. The change in the elevation of the water at the Lake did not change the water conditions any in the mine. It was decided to dig a ditch from a point near the Morris Mine up to the Lake so as to hold the water at this elevation and eliminate pumping expense. Work on this ditch was started October 12th. The small Erie revolving steam shovel completed about 700 ft. of this ditch to grade. It was then necessary to raise up to a higher elevation as the shovel could not discharge the material and keep to grade. This shovel continued up to station 29, when it was stopped until spring because of the difficulty of keeping the water pipe from freezing. The locomotive crane was started in at station 7 to completed the ditch to grade. Considerable trouble was experienced at the start with the crane. However, this was finally taken care of and the crane was operated until the weather got too cold to make any progress, when it was closed down for the winter at station 16. This work will be taken up again as soon as the weather will permit.

The mechanical equipment at this mine operated in a satisfactory manner. There was very little trouble and few delays.

LLOYD MINE

There were no changes or additions at this mine during the year. The mechanical equipment operated satisfactorily, without trouble or delays.

MORRIS MINE

It was necessary to install another air compressor at this mine. This installation was completed and machine put in service on August 13th. It is operating very satisfactory. This compressor is an Ingersoll-Rand, Class "PRE", size 18"-29" x 21", capacity 2440 cu. ft. per minute.

The mechanical equipment has given us no trouble and is in good condition.

SECTION 6 SHAFT

The mechanical equipment operated in a satisfactory manner throughout the year. There were no changes or additions to equipment, and no trouble or delays.

GWINN DISTRICT

Throughout the year 1924 only two mines, the Stephenson and Francis, have been operated in the Gwinn District. As the work in connection with them has been routine, nothing out of the ordinary having occurred, there is very little of interest to record.

AUSTIN MINE

This mine was idle the entire year.

FRANCIS MINE

The Francis ore body being depleted, the mine was closed down on April 30th. All equipment was dismantled and removed from the property, with the exception of the steel shaft house and the mine hoists, which were left on their foundations in the engine house. Practically all of the mechanical and electrical equipment was transferred to the Gwinn Mine change house for storage. The Prescott underground plunger pump was sold to the Champion Copper Company.

GWINN MINE

Idle the entire year.

GWINN CRUSHING PLANT

This plant, after undergoing seasonal repairs, gave uninterrupted service thereafter as needed.

GARDNER-MACKINAW MINES

Idle the entire year.

PRINCETON MINE

Idle the entire year.

PRINCETON CENTRAL POWER PLANT

The air compressor at this plant has supplied air to the Stephenson and other mines of the district continuously throughout the year as they required it.

The steam turbine operated 77 days during the months of January, February, March and April, supplying electric current when the hydro-electric plants were short of water.

The boilers and furnaces and all equipment in the boiler room has been put in first class condition and laid up indefinitely.

PRINCETON PUMP STATION

This station operated continuously and satisfactorily during the year 1924.

STEPHENSON MINE

The mechanical equipment at this mine has given a good account of itself for the year 1924. It has operated without breakdown or delays of any importance during this period.

In September a cave in the older workings of the mine caused a portion of the mine water which was going to the 5th level pump station, from where it was pumped to surface, to find its way to the 6th level station, from where it had to be pumped back to the 5th level station and then thrown to surface. The amount of this water gradually increased until it approached the pumping capacity of the 6th level station. In September a 2,000 G.P.M. Platt Iron Works centrifugal pump was taken from North Lake and installed in this station. A 10" discharge line was run along the drift on the 6th level, up the shaft and into the 5th level sump. The purpose of this discharge line was to avoid flooding the haulage tracks on the 5th level by pumping the water to the 5th level and allowing it to flow in the ditches along the haulage tracks to the 5th level sump. The pumping capacity of the 5th level station is now ample to handle all of the mine water should it eventually find its way to the 5th level.

In March the rotary converter for underground haulage was transferred from the Mackinaw Mine to the Stephenson engine room and put in

operation, while the old set in the Central Power Plant formerly serving the Stephenson and Princeton mines was rewound.

A new asbestos brake band was placed on the cage hoist in October, the old one being too badly worn for further use.

BOEING MINE

An 800 G.P.M., 325 ft. head, 6" centrifugal pump, purchased from the Allis-Chalmers Company, was the only new equipment installed during the year. This was installed on April 30th in center of open pit for emergency, but was not needed for the season.

Due to complaint on carbon trouble and valve breakage in compressor a Sullivan Machinery Company expert inspected the machine on July 4th and 5th and found the valve seats badly worn. These were trued up, and after intake pipe was made tight against sand leakage no further breakage developed. It was necessary to babbitt the crank bearings in April and again in December. The machine is now in good shape for another six months.

One accident occurred on cage hoist in July, when brakeman overwound and broke rope. A new rope was on hand, also a new brakeman, and no further trouble occurred here. The motor pinion on skip hoist, reported in bad condition last year, is still in operation but making more noise due to additional wear on teeth. A requisition for new pinion will be placed soon. On November 25th both skip cables broke due to wear and rust on onterior of ropes. To stop this breakage it is now planned to reverse ends every two years and discard the rope after four years wear.

Changes made in shaft house last fall gave no trouble during the winter season of stockpiling. The wood in top tram cars was in bad shape and it was necessary to frame new timbers at the Hill-Trumbull shops and use the steel from the old cars on them.

There was no let-up in sand conditions in underground sump. What could not be cleaned out with skips was stirred up and pumped out. The impellers and bushings in underground centrifugal pump were replaced in May

and again in October. The pump valves and seats in Aldrich triplex pump were changed in February, June and December.

No. 28 steam shovel started stripping in Pit on March 21st and was shut down on November 17th. A main rotating pinion broke in May and was replaced; in June a new set of asbestos brake blocks was put on; in September the hoisting cable was changed and another new set of brake blocks put on of a different make. After closing down in November boiler repairs were made, one ballast compartment cleaned out and inspected to be sure excessive rust was not developing, and two new racking pinions put on as one old one had a tooth broken out. A new dipper door is being made as the old one is in bad shape. By weighing the coal several days in August it was found that Egg Splint coal was more economical to use than Youghiogheny Screened Lump and a change was made to the splint. The electric dipper trip was not a success and after proving this to the Marion Steam Shovel Company they allowed full credit when it was returned to them.

The only trouble experienced with the new American locomotives, No's. 104, 105 and 106, was in the flues. In January the three machines were shipped to the Hill-Trumbull Mine and all flues removed and re-tipped. Due to excessive scale formation about 140 flues were removed from each locomotive in November. In September the scale in water legs got so bad five additional wash out plugs were added to each machine to remove it. Locomotive #19 was shipped to Hill-Trumbull Mine on January 30th, but was returned to Boeing Mine in August, when a small Thew revolving shovel on caterpillar tractors was rented for clean-up work.

The boom on stockpile shovel #20 was in such bad shape at end of season it was necessary to re-drive all rivets. A new stack was the only improvement added here.

CROSBY MINE

Some additions were made at the Washing Plant by M. A. Hanna & Co. A stockpile trestle and conveyor belt were added to the west side of plant.

An Aldrich triplex belt driven pump was set up in engine house and the Allis-Chalmers centrifugal pump discarded.

The three 75 K.V.A. transformers and other equipment in Substation were moved and stored at Hill-Trumbull Mine.

HILL-TRUMBULL MINE

The Washing Plant was started April 25th and closed down on September 13th, operating day shift only and washing 287,146 tons of concentrates. Due to cold weather in January and February no repair work was attempted at plant until March, when excavation for tailings pump house was started. This pump installation was not complete when mill started, and it was not until August that the tailings pump started steady operation. The 15 H.P. motors first purchased for this work were found to be too small and were replaced with a 50 H.P. motor secured from the Boeing top tram. After securing permission the 15 H.P. motors were returned to the General Electric Company for credit.

Repairs to mill in the Spring were as follows: On tables, the worn out wood parts, which were made in the shop; the armature on 100 H.P. motor driving belt conveyor was trued up and ran much better; the bearings on pan conveyor drive were bored out and equipped with brass shells, which gave no trouble for the season.

Two accidents occurred to belt conveyor. On May 14th a rock caught and ripped 5" from one side for a distance of 70 ft. On June 14th a second rip, 50 ft. long, occurred. To eliminate this trouble the opening between the top and return belt was closed with planking so that chunks falling off cannot get on return belt.

Two 14" rollers broke under pan conveyor in receiving pocket. These breaks occurred when the pocket was empty and a car of ore dumped in. To cushion this blow a timber "A" frame was built at top of pocket directly over pan conveyor. The 14" rollers were welded and used again.

The spur gear and pinion driving belt conveyor caused excessive vibration at top of plant. A herringbone gear was ordered to replace these

and will be installed ready for next seasons operation.

During October and November a 4 ft. dyke of tailings sand was built around tailings basin, and three 15" drain pipes about 100 ft. long put in to carry off the water. With this scheme it is hoped to eliminate the water cutting action on dyke, which causes breaks and allows flows of tailings sand into the lake.

The sixteen 20-yd. dump cars were sandblasted and painted in the shops.

New flues were put in #26 steam shovel as the old ones were in bad shape. While overhauling #22 shovel, the crown sheet was found to be sprung and seventeen staybolts had to be replaced.

In August the #3½ Keystone churn drill was changed from gasoline drive to electric and used in the pit the rest of the season.

An air operated fire door was added to locomotive #101 in May.

In the Pit #27 shovel started clean-up work April 23rd. Shovel #22 was put in Pit May 26th on track grade work. In October this shovel was moved to Boeing Mine for track and clean-up work there. No. 26 shovel was moved into Pit in May, but only used when #27 shovel was idle. No. 19 shovel was kept in the direct shipping section of the pit for the season. On July 24th the boom on 40 ton locomotive crane buckled and had to be moved to the shops and re-built. This buckle was due to a kink previously put in lower member of boom when bumped by a locomotive tender. On June 16th a right rear side rod on locomotive #103 broke and this bent main and side rods on the opposite side. Locomotive was repaired in shop, the side rod was welded and gave no more trouble.

WADE-HELMER MINE

With the exception of regular mine pumping, no work was started until April, when a small crew was put on re-timbering underground. The compressor was overhauled and top tram equipment put in shape. In May the motors were placed in one underground locomotive and some ore was hoisted, but com-

pressor was not started until May 26th. All the engine house equipment then operated when needed until completion of sump cleaning in October.

In August stockpile loading started in Helmer Pit and locomotive, shovel and incline hoist were operated until November, when all equipment was moved from this Pit across the line on to Wade Mine property. The sump pump, telephones, cables, etc., were stored in Helmer Mine engine house.

REPUBLIC MINE

The mechanical equipment at this mine operated in a satisfactory manner throughout the year. There were no additions or changes.

SPIES MINE

Practically all our electric wiring has been changed in order to provide the necessary additional capacity. This is now in armored cables and is in excellent condition. A new signal system was installed.

The underground haulage system has been completed on two levels. The motor-generator set formerly at the Crosby Mine was installed underground on the 5th level. Locomotives were also from the Crosby Mine.

Two Prescott triplex pumps were installed on the 5th level. These are $6\frac{1}{4}$" x 10", vertical, single acting, 75 R.P.M., geared to General Electric 690 R.P.M. motors. Capacity is 300 G.P.M. each against 1200 ft. head.

The Ingersoll-Rand air compressor formerly used at the Francis Mine was installed complete.

All the apparatus is in good condition and giving satisfactory service.