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5. GENERAL SURFACE: (CONT'D.)

e. Miscellaneous:

The south pit pole line was extended for 1100 feet across to the hangingwall side to service stripping operations in this area. A 500 foot feeder line was installed to a point 900' southwest of the primary crusher for pit power service.

The 4" oxygen line was extended for 550 feet along the south pit road.

The L. S. & I. Railroad constructed 1900 feet of track for stockpile loading. They also lengthened the Driox service track by 105 feet so that this spur can be used for miscellaneous unloading service.

In April, a drill rig from the Diamond Drill Dept. was used to test for ledge at the site of the proposed pellet plant and mill extension. A backhoe was used for ledge testing on the site of the proposed MOC plant.

6. OPEN PIT:

a. Stripping:

Of the $201,240.00 authorized for stripping, only $129,726.24 was expended on this program during the year. This work was cut to a minimum because of the reduced production for the year compared to the original estimates.

Clean-up earth stripping was done with the dragline equipment over the site of the orebody in the following areas:from coordinates 800 N. to 1200 north; near the footwall area from 1200 N. to 1700 north; and in the hangingwall zone from 2300 N. to 2800 N.

The 1560' stripping bench was continued to the north along the hangingwall for four hundred feet to coordinate 2700 north. The south pit road was extended to the 1520' elevation on the hangingwall side to the vicinity of the old mine office building. A slot was cut through earth and rock easterly from this point to intersect the old No. 6 shaft pit at the 1520' elevation. This pit was then filled to this elevation so it can be used as a mining bench floor. This project is located between coordinates 1800 N. and 2100 N. The map in the back of this report shows the locations of these various work areas.

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6. OPEN PIT: (CONT'D.)

a. Stripping: (Cont'd.)

The following tabulation summarizes the stripping operations:

Month	Cu. Yds. Surface	Cu. Yds. Rock	Total Cu. Yds.	Yards Per Man Days	Man Days	Before Depr'n Cost Per Yd.
January	11200	8240	19440	74.20	262	0.727
February	21080	3440	24520	109.7	223½	0.399
March	30400	30120	60520	107.4	563½	0.418
April	42760	3675	46435	110.5	420¼	0.410
May	12160	9210	21370	69.95	305½	0.684
June	532	735	1267	81.74	15½	1.155
July	4351	5985	10336	64.40	160½	0.574
August	5225	8655	13880	69.22	200½	0.710
September	15029	6825	21854	97.02	225¼	0.520
October	5605	3840	9445	48.87	193¼	0.922
November	22705	0	22705	171.7	132¼	0.238
December	8835	0	8835	102.1	86½	0.464
Total 1957	179882	80725	260607	93.43	2789¼	0.498
Total 1956	361282	35480	396762	133.10	2981	0.474
Total 1955	165635	0	165635	154.37	1073	0.395
Total to Date	706799	116205	823004	120.27	6843¼	0.445

b. Stripping Expenditures:

E&A MI-11:	Amount Authorized	Amount Expended	Amount Unexpended
Stripping	$ 201,240.00	$ 129,726.24	$ 71,513.76
Depreciation	14,000.00	28,494.17	14,494.17
Grand Total	$ 215,240.00	$ 158,220.41	$ 57,019.59

Detail:

	Authorized			Expended		
	Cu. Yds.	Rate	Amount	Cu. Yds.	Rate	Amount
Earth	229000	0.420	$ 96180.00	179882	0.346	$ 62269.19
Rock	102000	1.030	105060.00	80725	0.836	67457.05
Total	331000	0.608	201240.00	260607	0.498	$129726.24
Depreciation			14000.00			28494.17
Total			215240.00			$158220.41

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6. OPEN PIT: (CONT'D.)

c. Open Pit Mining:

The major portion of the crude ore mined during the year was produced from the 1600' bench. Each of the two faces developed the previous year were advanced 200' to coordinates 2000 north and 1100 north.

Approximately 8% of the ore came from the 1640 development cut which started on the footwall contact between coordinates 2300 north and 2500 north.

The jet piercing machine drilled 96% of the tonnage mined. The remaining ore was produced by wagon drilling which was done on shallow cuts and on miscellaneous development work.

Sixteen major field blasts were fired during the year. EP 152 was used as the base powder along with the EP 158 (pellets). Prilled ammonium nitrate was used with good results wherever water conditions permitted.

During the latter part of the year, a four inch submersible pump was used to lower the water level in the drilled holes. This procedure allowed the use of a higher percentage of the prilled ammonium nitrate as a blasting agent.

The Marion 4161 - 5 cu. yd shovel was used for loading the ore into three 34-Ton Euclid end dump trucks for transportation to the primary crusher.

In April, some test work was done with a churn drill in the hope that this unit could be used for collaring and casing holes for the jet piercing machine in broken ground or for drilling in rock stripping. The results in both respects were negative. In October, a 30-J jet piercing machine was tested. It was found to have penetration rates of about one-half that of the standard JPM-3 unit.

The 3½ cu. yd Lima shovel was shipped to the Ore Improvement Plant in May.

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6. OPEN PIT: (CONT'D.)

c. Open Pit Mining: (Cont'd.)

Summary of Pit Production:

	Year 1956	Year 1957
Crude from Pit to Crushing Plant	395,185 Tons	670,240 Tons
Crude from Stockpile to Crushing Plant	-0-	-0-
Total Crude from Pit to Crushing Plant	395,185 Tons	670,240 Tons
Waste Rock, pit to dump - yards	-0-	
Total Footage Drilled - Jet Piercing Machine	15,390 Ft.	22,246 Ft.
Total Footage Drilled - Wagon Drills	22,052 Ft.	29,176 Ft.
Average grade of Crude Ore	39.97 % Iron	37.73 %
Average grade of Crude Ore	42.00 % Sil.	43.10 %
Cost per Ton of Crude Ore	$0.645	.485

Summary of Powder Used:

Primary Blasting

Type	Unit Cost	Amount Used	Total Cost
EP 152	$ .192	133,715 lbs.	$ 25,622.64
EP 158	.192	58,100 lbs.	11,130.00
EP 197B	.095	8,500 lbs.	807.50
Herco-Prill	.045	102,350 lbs.	4,608.55
M.S. Connectors	.508 ea.	300 ea.	152.50
Plastic & Wire Primacord	42.297 M	36,500 ft.	1,543.87
Regular	31.976 M	50,000 ft.	1,598.80
XC45 Boosters	50¢ ea.	1,000 ea.	500.00
Total			$ 45,963.86

Cost per ton of material broken $ 0.075 - 1957
$ 0.082 - 1956

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6. OPEN PIT: (CONT'D.)

c. Open Pit Mining: (Cont'd.)

Summary of Jet Drill Holes Blasted:

Date	No. of Holes	Average Depth	Average Spacing	Powder Factor *	Gross Tons - Ore
2 - 1	26	38.0	17.6x19.2	1.91	28,957
2 - 7	10	32.0	16.1x22.0	2.03	10,496
2 -12	33	39.0	18.5x20.8	1.78	41,116
5 -14	15	37.9	17.9x20.0	1.58	17,158
6 - 7	45	31.2	18.2x18.7	2.45	47,270
6 -19	68	33.5	18.3x18.5	2.18	73,908
7 -15	77	36.1	18.5x18.2	1.97	88,269
8 - 9	27	42.8	17.1x21.9	2.00	44,397
9 -13	34	26.1	17.5x17.1	2.28	29,871
9 -20	59	37.6	18.1x18.1	1.83	70,000
9 -30	16	36.7	19.1x19.3	2.25	20,476
10 - 8	9	35.4	17.4x17.3	2.47	10,630
10 -14	7	33.7	19.4x19.7	4.24	10,337
11 -25	51	39.0	17.6x19.3	1.89	65,000
12 -17	44	24.0	18.0x17.4	1.74	26,000
12 -27	26	33.7	17.3x17.8	2.12	26,000
Total	544			2.01	609,885

* Tons of material broken per pound of powder used.

Est. 19,115 tons produced by wagon drilling.

Summary of Footages Drilled

Month	Joy	Jet Piercing	Wagon Drilling	30-J Jet
January		1388	3656	
February		1138	3768	
March		-	3385	
April		-	2240	
May		1421	2841	
June		3882	2363	
July		3614	2679	
August		-	3125	
September		3023	1304	
October		3407	2514	153
November		1541	50	72
December		2607	1251	
Total - 1957		22021	29176	225
Total - 1956	1731	15390	22052	

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6. OPEN PIT: (CONT'D.)
c. Open Pit Mining: (Cont'd.)

Summary of Jet Piercer Operating Costs

Month	Oxygen	Fuel Oil	Reamer Shells	Kelly & Kelly Ext.	Burner Assembly	Piping	Misc. Sup.	Maint. Sup.	Royalty	Maint. Labor	Optg. Labor	Total
January	5066.58	619.38	200.00	400.00	-	10.08	429.72	2231.04	890.64	1095.10	1622.23	12564.77
February	2531.06	776.97	200.00	200.00	-	30.35	45.78	615.95	678.98	663.64	1138.10	6880.83
March												
April												
May	2531.38	252.56	100.00	200.00	-	6.93	63.51	24.18	498.08	1082.07	746.42	5505.13
June	7849.05	1282.39	200.00	200.00	-	9.16	554.04	1233.29	1699.18	1306.49	2053.52	16387.12
July	7780.50	1312.50	200.00	400.00	-	105.91	145.00	1176.95	1813.95	2118.22	2169.31	17222.34
August												
September	7506.96	949.90	200.00	-	-	2.52	33.68	45.22	1619.24	986.37	2089.81	13433.70
October	8829.60	1010.48	200.00	400.00	-	2.03	149.66	218.25	1766.75	1543.70	2109.43	16229.90
November	3380.00	779.76	200.00	360.00	-	1.46	37.36	1977.86	587.14	904.75	868.07	9096.40
December	3784.83	932.84	200.00	360.00	-	16.55	819.90	1292.62	1279.01	1215.17	1604.15	11505.07
TOTAL 1957	49259.96	7916.78	1700.00	2520.00	-	184.99	2278.65	8815.36	10832.97	10915.51	14401.04	108825.26
TOTAL 1956	46709.57	6912.08	1600.00	2255.25	-	140.25	6486.30	8257.73	7302.18	5439.68	10920.09	96023.13

	Year 1956	Year 1957
Total Drilled Footage Jet Drilled Holes	15390	22021
Cost Per Foot of Drilled Footage	6.239	4.942
Total Tons Drilled Ore and Waste	500299	715007
Total Cost Per Ton Ore Drilled	0.192	0.152
Hours Jet Operated	2442.5	3108.9

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7. PLANT:

a. General:

The operation of the plant progressed smoothly through the year with improvement noted in several respects over the previous year's operation. Feed rates to the concentrator were increased by speeding up grinding mills and by improved crushing. The average operating time for the concentrator for the year was 97% of scheduled operating time.

The grade of concentrate was maintained at the guarantee with respect to iron content and somewhat better than the guarantee in silica and moisture. The budget tonnage was exceeded by 17571 tons of concentrate.

The weight recovery was lower than last year because a greater proportion footwall ores were treated which were lower in iron content and more difficult to treat than the hangingwall ores milled in 1956. This type of ore was mined mostly because of its more favorable pelletizing characteristics.

Grinding steel consumption showed some improvement in 1957 and reagent consumption was also slightly better than in 1956.

b. Production by Months:

Month	Tonnage	% Fe	% P.	% SiO_2	% Sul.	% H_2O
January	25203	62.73	.032	8.79	.007	5.67
February	27735	62.94	.031	8.50	.005	5.67
March	2828	62.50	.034	9.03	.028	5.74
April	-0-	-0-	-0-	-0-	-0-	-0-
May	5123	64.28	.026	7.56	.005	5.18
June	40548	63.21	.027	8.50	.011	5.57
July	42658	63.26	.035	8.38	.007	5.78
August	44161	63.15	.030	8.78	.005	5.83
September	36430	63.08	.038	8.41	.006	6.05
October	35372	62.81	.040	8.66	.005	6.07
November	32447	63.52	.040	8.09	.005	5.80
December	31355	62.99	.033	8.66	.005	6.38
Total - 1957	323860	63.11	.034	8.52	.007	5.86
Total - 1956	217166	63.27	.038	8.03	.066	5.32

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7. PLANT (CONT'D.)

c. Metallurgical Balance:

Product	% Wt.	% Wt. Crude	% Fe	% Fe Unit Recovery	% Fe Unit Recovery (Flot. Circuit)
Concentrator					
Concentrate		48.44	63.14*	81.06	
Tailing		51.56	13.85	18.94	
Head		100.00	37.73	100.00	
Unit One					
Concentrate	51.03	49.23	62.99	82.11	84.27
Flotation Tailing	48.97	47.24	12.25	15.32	15.73
	100.00	96.47	38.14	97.43	100.00
Slime Tailing		3.53	27.51	2.57	
Head		100.00	37.77	100.00	
Unit Two					
Concentrate	49.86	47.74	63.31	80.16	82.74
Flotation Tailing	50.14	48.01	13.13	16.72	17.26
	100.00	95.75	38.15	96.88	100.00
Slime Tailing		4.25	27.65	3.12	
Head		100.00	37.70	100.00	

* The slight difference in iron analysis between the yearly production shown under "2. d. and 7. b." compared to the metallurgical balance is due to difference in method of weighting analyses used by shipping department and mill office.

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7. PLANT (CONT'D.)

d. Hourly Operating Rates:

	Tons	Gross Hours of Operation	Net Hours of Operation	LTPH (Gross)	LTPH (net)
Feed to Primary Crusher					
1957	670240	1813.75	1410.68	369.53	475.12
1956	423081	1332.50	974.00	317.50	434.15
Ore for Roads, Etc.					
1957	2320				
Ore in Process					
1957	1734				
Fine Ore Bin to Concentrator					
1957	666184	4330.38	4198.66	153.84	158.67
1956	402468	3312.72	3086.38	121.49	130.40
Fine Ore Bin to Unit One					
1957	328264	4293.74	4100.86	76.45	80.05
1956	207232	3296.72	3001.56	62.86	69.04
Fine Ore to Unit Two					
1957	337920	4292.34	4081.34	78.73	84.30
1956	195236	3105.80	2830.33	62.86	69.72
Concentrates					
1957	323860	4330.38	4198.66	74.79	77.13
1956	220689	3312.72	3086.38	66.62	71.50
Operating Time - Concentrator					
1957	96.96%				
1956	93.17%				
Operating Time - Unit One					
1957	95.51%				
1956	91.05%				
Operating Time - Unit Two					
1957	95.58%				
1956	91.13%				

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7. PLANT (CONT'D.)

e. Monthly Hourly Operating Rates

	Feed to Primary Crusher	Fine Ore Bin to Concentrator	Fine Ore Bin to Unit One	Fine Ore Bin to Unit Two	Concentrates
Long Tons Per Gross Hour					
January	317.08	123.63	61.75	61.96	56.06
February	351.91	134.76	67.52	67.35	57.57
June	339.96	161.40	80.28	82.13	83.58
July	363.19	165.87	80.73	85.44	85.49
August	386.18	153.46	75.99	77.72	82.43
September	441.01	164.20	79.89	84.56	77.65
October	407.09	161.40	81.51	81.31	73.07
November	385.77	159.17	81.61	85.77	84.37
December	351.05	162.60	80.48	84.38	72.91
Year	369.53	153.84	76.45	78.73	74.79
Long Tons Per Net Hour					
January	405.28	125.34	64.66	63.88	56.84
February	405.80	135.75	68.30	69.32	57.99
June	441.01	165.83	83.80	85.49	85.88
July	507.90	173.58	85.12	90.51	89.46
August	528.79	171.05	84.84	87.25	91.87
September	551.85	165.94	81.44	87.06	78.47
October	498.58	163.48	82.77	83.83	74.01
November	520.74	162.99	88.29	91.53	86.39
December	448.73	165.95	82.84	88.27	74.41
Year	475.12	158.67	80.05	84.30	77.13

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7. PLANT (CONT'D.)

f. Pit-Crusher Time Distribution:

	Hours	Percent of Delays	Percent of Total Working Hours
Pit	77.07	19.12	4.25
Primary Crusher	40.67	10.09	2.24
Secondary Crusher	14.59	3.62	0.80
Tertiary Crusher	13.08	3.25	0.73
Pan Feeder	3.50	0.87	0.19
Screens	21.08	5.23	1.16
Conveyors	14.58	3.62	0.80
Chutes, Feed Boxes, Etc.	53.92	13.38	2.97
Electrical	14.25	3.53	0.78
Dust Collection	1.25	0.31	0.08
Power Failure	3.00	0.74	0.16
Water Failure	1.00	0.25	0.06
Picking steel & wood from belts	6.01	1.49	0.33
Miscellaneous	1.67	0.41	0.09
	265.67	65.91	14.64
Surge Bin Full	124.90	30.99	6.89
Fine Ore Bin Full	12.50	3.10	0.69
	137.40	34.09	7.58
Total	403.07	100.00	22.22

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7. PLANT (CONT'D.)

g. Concentrator Time Distribution - Unit I:

Operational	Hours	Percent of Delays	Percent of Total Working Hours
Start-up and shutdown	43.66	22.64	1.02
Ball Mill - Hydroscillator loaded	5.74	2.98	0.13
Rod Mill - Loaded	0.46	0.24	0.01
Rod Mill - Charge	3.40	1.76	0.08
Rod Mill - Tangle	16.17	8.38	0.38
Power Failure	5.90	3.06	0.14
Out of Feed	43.35	22.47	1.01
Out of Feed (work on primary crusher)	24.00	12.44	0.56
Out of Feed (work on #1 screen)	26.75	13.87	0.62
	169.43	87.84	3.95
Equipment			
Rod Mill	7.82	4.05	0.18
Hydroscillator	1.25	0.65	0.03
Pumps	4.75	2.46	0.11
Fresh Water Pumps	1.00	0.52	0.02
Reuse water pumps	0.75	0.39	0.02
Thickener	1.50	0.78	0.03
Tailing Line	2.00	1.04	0.05
Chutes, feed boxes, etc.	3.71	1.92	0.09
Electrical	0.17	0.09	0.00
Miscellaneous	0.50	0.26	0.01
	23.45	12.16	0.54
	192.88	100.00	4.49

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7. PLANT (CONT'D.)

g. Concentrator Time Distribution - Unit II:

Operational	Hours	Percent of Delays	Percent of Total Working Hours
Start-up and shutdown	39.32	18.64	0.92
Ball Mill - Hydroscillator loaded	9.46	4.48	0.22
Rod Mill - loaded	0.05	0.03	0.00
Rod Mill - Charge	2.59	1.23	0.06
Power Failure	5.81	2.75	0.14
Out of Feed	35.34	16.75	0.82
Out of Feed (work on primary crusher)	24.00	11.37	0.56
Out of Feed (work on #1 screen)	27.00	12.80	0.63
	143.57	68.05	3.35
Equipment			
Rod Mill	21.68	10.27	0.51
Ball Mill	0.67	0.32	0.02
Hydroscillator	7.50	3.55	0.17
Pumps	9.43	4.47	0.22
Conveyors	1.92	0.91	0.04
Conditioners	2.83	1.34	0.07
Fresh Water Pumps	1.00	0.47	0.02
Reuse water pumps	0.75	0.36	0.02
Thickener	4.49	2.13	0.10
Flotation Cells	1.33	0.63	0.03
Chutes, feed boxes, etc.	10.20	4.83	0.24
Electrical	3.46	1.64	0.08
Tailing Line	2.00	0.95	0.05
Miscellaneous	0.17	0.08	0.00
	67.43	31.95	1.57
Total	211.00	100.00	4.92

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7. PLANT (CONT'D.)

h. Monthly Rod, Ball, Reagent & Power Consumption

Month	Rods	Unit One #	Unit One #/Ton	Unit Two #	Unit Two #/Ton
January		42745	1.540	45180	1.624
February		42745	1.314	40945	1.264
May		12450	-	3514	-
June		51045	1.319	35655	0.901
July		43160	1.071	51298	1.207
August		42340	1.041	49800	1.197
September		60210	1.606	41500	1.049
October		48375	1.229	61005	1.573
November		50455	1.704 *	37110	1.174
December		46455	1.356	35678	0.908
Total		439980	1.340	401785	1.189

* rod tangle

	Balls				
January		45577	1.642	42896	1.542
February		37534	1.154	39067	1.206
June		42896	1.108	37534	0.948
July		53620	1.330	56301	1.324
August		45577	1.121	48258	1.160
September		45577	1.216	42896	1.084
October		56280	1.430	42880	1.106
November		37534	1.267	34840	1.103
December		34840	1.017	35678	1.127
Total		399435	1.217	380350	1.126

	Fatty Acid				
January		27492	0.990	29916	1.075
February		28630	0.880	34117	1.053
March		2742	-	2503	-
June		41573	1.074	64964	1.641
July		44916	1.114	63029	1.483
August		51100	1.257	64588	1.553
September		44100	1.177	51938	1.313
October		41923	1.000	50013	1.210
November		35207	1.189	37266	1.179
December		28310	0.827	37040	1.038
Total		345993	1.054	435374	1.288

7. PLANT (CONT'D.)

i. Plant Testing

Crushing

Samples were collected in January and February of fine ore bin feed at different settings for the secondary and tertiary crushers. This indicated that tight crushers would greatly improve the rod mill feed. A Gilson testing screen was installed in June to provide for actual size control on the crusher products. The fine ore bin feed is checked twice per day in this manner, and crusher adjustments made accordingly.

Watt-hour meters were installed on all crushers for better evaluation of their performance.

Profiles were made on secondary and tertiary crusher manganese to determine wear patterns. Redesigned liners are being tested in 1958 on the basis of these studies.

Time sheets were kept on crusher changes to attempt to improve the mechanics of this periodic maintenance.

A Hardinge 2' x 6' Cascade mill was tested extensively during the spring.

Grinding

Fine ore bin feeders were alternated in their use to minimize the effect of segregation in the bin.

The rod and ball mills were charged with different size grinding media for comparison. The rod sizes were 3", 3½", and 4" diameters. The ball sizes were 1¼" and 1½" diameters.

The recleaner tails were pumped to the ball mill in unit one for a time to try to liberate locked particles.

Profiles were made of the lifter bars removed from the rod mills.

Monthly structure analyses were performed on grinding circuit products.

Desliming

The densifier in unit one was used to treat cleaner and recleaner tails in an attempt to wash out fine silica. The separation made was not clean.

Five 3" Heyl and Patterson cyclones were installed in the fall to be compared with the 6" cyclones now used. This was done as part of the program to increase the density in conditioning and improve recovery of micron material.

Conditioning

The conditioners were speeded up from 1700 FPM to 2100 FPM. A fifth conditioner was added to unit two later in the year.

7. PLANT (CONT'D.)

i. Plant Testing (Cont'd.)

Conditioning (Cont'd.)

Batch flotation tests were run on conditioned products.

The point of addition of secondary cyclone underflow to conditioning was varied.

The point of addition of frother was changed to #4 pump instead of to #1 conditioner.

Flotation

A system of non-deslimed flotation was tested extensively on a plant scale. The addition of caustic soda and reagent to various parts of the grinding, conditioning, and flotation circuits was part of this program.

A system of floating the coarse primary cyclone underflow separately from the fine secondary cyclone underflow was tested extensively in unit two.

The 60,000# of red oil on hand since the start of operations was used almost entirely during the summer. It was added to the 3rd conditioner with the fines.

During the summer, 60,000# of Acintol F.A. #1 were used. It was evident that the lower cost reagent could be utilized during the warm weather.

In Unit One the speed was reduced on some cells in the cleaning circuit to improve wear and improve grade.

In Unit Two extensive alterations were made on the Denver cells. Two Type "M" mechanisms were installed in the scavenger circuit. The first two cleaner cells in each line were converted to "hog trough" from "cell-to-cell" flow. The depths of all scavenger cells were reduced. Weirs were installed between cells 3 and 4 in the rougher lines. Smaller recirculation ports were tried for a time in one line of roughers. Some cells were converted to single overflow for testing. Surface baffles were put in the scavenger cell tanks to minimize swirl.

A college student was available in the summer to perform batch flotation tests. This work covered:

a) standardization of batch test procedure
b) percent solids effects
c) pH variation
d) impeller speed variation
e) temperature variation
f) organic additive effects
g) inorganic additive effects
h) comparison of fatty acid collectors

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7. PLANT (CONT'D.)

i. Plant Testing (Cont'd.)

Flotation (Cont'd.)

i) collectors other than fatty acids
j) secondary collectors
k) comparison of frothers
l) flotation of different mill products

This work is summarized in Metallurgical Report #217.

Monthly structures and analyses were performed on flotation circuit products.

General

The metallurgical results were plotted on a daily basis on the pit map. In 1956, shovel position was plotted on a weekly basis.

Various plant results were averaged on a pit area basis in addition to the usual monthly averages.

Part of the Cascade mill product was shipped to Germany for MOC testing.

Rougher and recleaner concentrates were produced for Research Laboratory MOC tests and for shipment abroad.

Some tests were performed on settling of plant tailing solids.

Monthly checks were made on water consumption.

Regrind

During the regrind period, various methods were worked out to minimize loss of fines. Data was collected on power requirements, and calculations made for the size of regrind mills required at the pelletizing plant.

8. MAINTENANCE, REPAIR AND CHANGES:

a. Pit:

Shovels

The hoisting rope was changed two times and a new door was installed on the dipper of the #104 shovel.

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8. MAINTENANCE, REPAIR AND CHANGES:

a. Pit:

Shovels (Cont'd.)

The intermediate crowd shaft was changed two times. The dipper was changed, two hoisting ropes were changed, and the motor generator set was sent in to the shop for repair on the #101 Marion.

There were no major repairs to the #97 Bucyrus-Erie 54-B shovel.

Tractors

On the D-8, the engine was overhauled, new front idlers were installed, the track pads were repaired with grouser bars and rebuilt track rollers were installed.

On the Linde JPM-3 Piercer, the kelly was changed twice, a new scroll and fan was installed and a new propelling sprocket was installed.

Cranes & Dropball

A new set of sheaves and bearings was installed on the boom point of the Brownhoist crane. A new wheel assembly was installed on the crane carrier, as the lugs stripped on the old wheel. Four dropball cables were used.

Trucks

There were 6 engines, 6 converters, and 2 transmissions overhauled in the Euclid truck fleet. All the torque rods on the #75 - 79 trucks were repaired or replaced. Three truck boxes were relined with wearplates.

The engine of the Pettibone-Mulliken loader and the engine of a portable welder were overhauled.

b. Plant

January

Installed cleats and railings - #1 conveyor.
Rebuilt gravity take-up cart - #3 conveyor.
Installed guard railings - crusher rock boxes.
Remove shovel tooth - tertiary crusher.
Recover #2 filter.
Install new constriction plate seal - both hydroscillators.
Install higher speed pinion - #2 rod mill.

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8. MAINTENANCE, REPAIR AND CHANGES: (CONT'D.)

b. Plant (Cont'd.)

February
Changed secondary crusher manganese.
Changed tertiary crusher manganese.
Welded seams in fine ore bin.
Motorized pocket storm doors.
Changed one micarta sleeve - #2 rod mill.
Changed two micarta sleeve - #2 ball mill.
Installed heavier duty drives on both thickeners.
Recovered #1 filter.

March
Installed new keepers on micarta sleeves - rod and ball mills.
Converted rod mills to ball mills for regrind.
Converted circuits for regrind, installed pumps, etc.
Repaired agitator arm - #2 filter.
Converted filters to "back" feed.
Set up experimental Cascade circuit.

April
Replaced submerged bearings - both densifiers.
Replaced bushings - spare filter.
Began spraying stockpile.

May - June
Converted unit back to regular production from regrind.
Furnished repair crews for pellet plant.
Built parts for pellet plant at mine.
Installed higher speed pinion - #2 ball mill.
Replaced bushings - #1 and #2 filters.
Recovered #1 and #3 filters.
Replaced 6" cyclone apex valves.
Installed new bearings in 300 HP tertiary crusher motor.
Installed eccentric bearing on float side - #1 screen.
Began to use reuse water pumps.
Installed by-pass from primary cyclone direct to #1 conditioner.
Renewed entire spare parts inventory and revised.

July
Replaced pinion shaft and bushings - secondary crusher.
Replaced secondary crusher bowl liner.
Replaced tertiary crusher manganese.
Revised flow alarms on primary crusher lubrication system.
Replaced bearing on snub pulley - #2 conveyor.
Installed new dust lines - Rotoclone.
Replaced surge bin feeder belt.
Recovered #1 and #2 filters.
Installed higher speed pinions - #1 rod and ball mill.

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8. MAINTENANCE, REPAIR AND CHANGES: (CONT'D.)

b. Plant (Cont'd.)

August
Replaced secondary crusher mantle.
Replaced tertiary crusher manganese.
Replaced primary crusher concaves - lower two rows.
Replaced eccentric bearings, housings, and wedge rings - #1 screen.
Changed tripper carriage to use heavier, standard wheels.
Install new tramp oversize chutes on rod mill discharge.
Recovered spare filter.
Replace valve on spare filter.

September
Install new dead-bed under primary crusher.
Replace countershaft-pan feeder.
Install new dust seal on west side of tripper.
Replace lifter bars - #2 rod mill.
Piped line from recleaner tails to hydroscillator rake.
Installed new constriction plate seal - both hydroscillators.
Installed new connecting rod yoke assemblies - #1 hydroscillator.
Installed Type "M" mechanism on center scavenger #2 - Unit 2.

October
Replace tertiary crusher manganese.
Replace secondary crusher manganese.
Replace lifter bars - #1 rod mill.
Recover #2 filter.
Add weir to east Denver rougher cells - Unit two.
Install micarta sleeve - #1 ball mill.
Install 3" cyclones.
Began furnishing repairmen and clean-up crews to pelletizing plant.

November
Replaced lower mantle - primary crusher.
Replaced spider bushing - primary crusher.
Build up main shaft - primary crusher.
Change oil - primary crusher lubrication system.
Overhauled compressor.
Moved controls on tripper to east side.
Added weight to take-up - #10 conveyor.
Two rod mill tangles.
Add fifth conditioner - unit two.
Add weir to west Denver rougher cells - Unit two.
Install new parts in 3" cyclones.
Recover #1 & #2 filter.
Replaced motor on east cleaner cell #1 - Unit one.
Install connecting rod yoke assembly - #2 hydroscillator.
Concrete around reuse pump house.

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8. MAINTENANCE, REPAIR AND CHANGES: (CONT'D.)

b. Plant (Cont'd.)

December

Built support for spare head for tertiary crusher.
Assemble spare head for tertiary crusher.
Install steam heat to transfer house.
Overhaul secondary dust collector.
Replace parts in dust pump.
Install new dust seal on east side of tripper.
Install 12" cyclone on flotation circuit middlings.
Install 6" Krebs cyclone.
Install Type "M" mechanism in center Denver scavenger #1 - Unit two.
Repipe RCO line from #1 hydroscillator.
Replace lower bearing on left-hand crank - #2 hydroscillator.
Replace valve on #2 filter.

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9. E & A's:

a. Construction and Stripping E&A's:

		1956 Expenditures	1957 - Total Expenditures	Total Expenditures
MI-1	Program covering moving of 26 Houses	$ 90380.20	$ 166.80	$ 90547.00
MI-2	Building Up Tailings Dam Dikes	56537.48	-0-	56537.48
MI-3	Dipper for Marion Shovel	-0-	11448.04	11448.04
MI-4	Trailer Tank for Pit	16573.01	-0-	16573.01
MI-5	Pellet Plant - Republic Mine	11397.97	99593.53	110991.50
MI-6	Preliminary Design - Republic Mine	2827.41	47355.86	50183.27
MI-7	Oscillator Assembly for Hydroscillator	-0-	5605.29	5605.29
MI-8	First Addition to Republic Townsite	17816.39	122010.41	139826.80
MI-9	Marion Electric Shovel	1182.23	265688.13	266870.36
MI-11	Stripping Republic Mine - Year 1957	-0-	158220.41	158220.41
MI-13	MOC Testing	16838.59	158255.96	175094.55
MI-14	Dragline Equipment	-0-	9934.08	9934.08
MI-15	(One) 34-Ton Euclid	-0-	56522.01	56522.01
MI-16	(Six) 34-Ton Euclids (Used)	126000.00	-0-	126000.00
MI-17	Empire Mine, Cost of Field Work, etc.	-0-	77082.57	77082.57
MI-18	House Moving & School Removal	-0-	361324.09	361324.09
MI-19	Pick-up Truck	-0-	1663.73	1663.73
MI-20	Service Truck	-0-	4094.53	4094.53
MI-21	Rotary Drill	-0-	-0-	-0-
MI-22	Spare Main Shaft & Mantle for Tertiary	-0-	30164.83	30164.83
MI-24	Hardinge Cascade Mill Test	-0-	14211.96	14211.96
MI-27	Tailings Pipeline	-0-	24906.12	24906.12
MI-31	Clamshell Bucket	-0-	2487.89	2487.89
MI-32	Stripping - 1958	-0-	-0-	-0-
MI-34	(Six) Conditioners	-0-	-0-	-0-
MI-35	Removal of 24 Houses	-0-	-0-	-0-
MI-36	Storm Sewer First Addition	-0-	7462.13	7462.13
	Total	$ 339553.28	$1458198.37	$1797751.65

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10. COST OF PRODUCTION

a. General

Comparing costs from 1956 to 1957, the cost per hour of labor increased .217 or 8.6%, whereas the labor cost per ton of concentrate increased from $1.07 to $1.10 or 2.8%. The supply cost was actually lower in 1957 than in 1956 by .067 per ton of concentrate or 3.1%. The cost of power increased from 1956 to 1957 by .162 per ton or 42.2%. Comparing the cost of production during these two years, the cost per ton of concentrate increased .069 or 1.8% in 1957, whereas the cost per ton of crude ore decreased .209 or 9.9%.

b. Operating and Stockpile Regrind Costs:

	1956 Operating	1957 Operating	1956 Regrind	1957 Regrind
Pit Expense	1.173	.997	.333	.110
Crushing & Screening	.497	.517	.195	.151
Milling Expense	1.445	1.761	.777	.629
Tailings Disposal	.091	.039	.011	.003
Stocking Expense	.073	.083	.000	.045
General Mine Expense	.500	.439	.662	.272
Telephones and Safety	.009	.010	.008	.004
Holiday	.021	.026	.042	.018
Vacation	.022	.028	.034	.022
Cost of Production	3.831	3.900	2.062	1.254
Shipping Expense	.026	.069	.058	.018
Total Cost	3.857	3.969	2.120	1.272

c. Detail of 1957 Operating Costs:

	Jan.	Feb.	Mar.	Apr.	May	June
Pit Expense	.854	1.216	1.456	.000	1.747	.978
Crushing & Screening	.523	.608	1.764	.000	.107	.350
Milling Expense	1.657	1.683	2.425	.000	.903	1.407
Tailings Disposal	.066	.019	.001	.000	.003	.039
Stocking Expense	.217	.119	.130	.000	.139	.111
General Mine Expense	.454	.561	.646	.000	.333	.381
Telephones and Safety	.011	.009	.114	.000	.000	.008
Holiday	.049	.000	.000	.000	.043	.000
Vacation	.044	.044	.043	.000	.026	.030
Shipping Expense	.000	.000	.000	.000	.179	.067
Total Cost	3.875	4.259	6.579	.000	3.480	3.371

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Pit Expense	1.056	.664	.862	1.006	.975	1.336	.997
Crushing & Screening	.672	.513	.454	.498	.425	.589	.517
Milling Expense	2.367	1.532	1.790	1.881	1.763	1.782	1.761
Tailings Disposal	.027	.105	.010	.034	.036	.011	.039
Stocking Expense	.108	.097	.030	.005	.038	.033	.083
General Mine Expense	.228	.336	.389	.401	.395	.956	.439
Telephones and Safety	.012	.007	.011	.006	.012	.011	.010
Holiday	.040	.000	.046	.000	.053	.054	.026
Vacation	.029	.028	.034	.035	.038	.020	.028
Shipping Expense	.063	.094	.052	.134	.066	.102	.069
Total Cost	4.602	3.376	3.678	4.000	3.801	4.854	3.969

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10. COST OF PRODUCTION

d. Detail of 1957 Stockpile Regrind:

	Jan.	Feb.	Mar.	Apr.	May	June	Total Year
Pit Expense (load & haul concentrate)	.081	.000	.136	.088	.128	.000	.110
Crushing & Screening	.111	.000	.169	.145	.154	.000	.151
Milling Expense	1.424	.000	.719	.561	.625	.000	.629
Tailings Disposal	.013	.000	.009	.003	.000	.000	.003
Stocking Expense	.000	.000	.021	.063	.035	.000	.045
General Mine Expense	.355	.000	.585	.203	.225	.000	.272
Telephones and Safety	.000	.000	.001	.004	.006	.000	.004
Holiday	.036	.000	.000	.021	.021	.000	.018
Vacation	.032	.000	.046	.017	.018	.000	.022
Shipping Expense	.052	.000	.030	.013	.015	.000	.018
Total Cost	2.104	.000	1.716	1.118	1.227	.000	1.272

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11. TAXES

DESCRIPTION		1957 VALUATION	1957 TAXES
HUMBOLDT TOWNSHIP			
Parcel in SW¼ of SW¼, Sec. 9, 46-29	20 A.	500	12.88
W½ of NW¼, Sec. 16, 46-29	80 A.	2,000	51.50
SE¼ of NW¼, Sec. 16, 46-29	40 A.	500	12.87
N½ of SW¼, Sec. 16, 46-29	80 A.	2,000	51.50
(Republic Tailings Basin)			
			128.75
Collection Fee			1.29
TOTAL HUMBOLDT TOWNSHIP		5,000	130.04
Tax Rate		25.75	
REPUBLIC TOWNSHIP			
REPUBLIC MINE, including stockpile, supplies & equipment as placed by State Mine Appraiser:			
Real Estate		1,190,000	29,750.00
Personal Property		570,000	14,250.00
			44,000.00
Collection Fee			440.00
Total Republic Mine		1,760,000	44,440.00
Parcel in SE¼ of NE¼, Sec. 7, 46-29		1,000	25.00
Part of NE¼, Sec. 7, 46-29		200	5.00
Part of NE¼, Sec. 7, 46-29		200	5.00
Govt. Lot 6, Sec. 8, 46-29		300	7.50
SE¼ of NE¼, Sec. 18, 46-29	40 A.	200	5.00
Part of SE¼ of NW¼, Sec. 19, 46-29	10 A.	500	12.50
NE¼ of SW¼, Sec. 19, 46-29, except Plat of Republic		400	10.00
SE¼ of SW¼, Sec. 19, 46-29	40 A.	600	15.00
Govt. Lot 3 & Part Govt. Lot 4, Sec. 19, 46-29, except Plat of Republic	24 A.	400	10.00
SE¼ of NW¼, Sec. 20, 46-29	40 A.	150	3.75
REPUBLIC IRON CO'S 2ND ADDITION TO VILLAGE OF IRON CITY:			
Lot 86		400	10.00
Lot 87		400	10.00
Lot 88		500	12.50
Lot 89		725	18.13
Lot 90		1,000	25.00
Lot 92		1,000	25.00
Lot 100		700	17.50
Lot 102		700	17.50
Lot 104 and Part of Lot 105		650	16.25
Lot 106		100	2.50
Parcel in NE¼, Sec. 7, 46-29		200	5.00
PLAT OF REPUBLIC:			
Lots 1 thru 11 - 11 lots at 500		5,500	137.50
Lots 14, 15, 21, 24, 25, 33, 34, 45 thru 50 - 18 lots at 250		4,500	112.50
Lots 60, 61, 62 - 3 lots at 100		300	7.50
PERSONAL PROPERTY:			
Parcel 475, Park City		300	7.50

REPUBLIC MINE
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11. TAXES (CONT'D.)

DESCRIPTION	1957 VALUATION	1957 TAXES
PERSONAL PROPERTY (Cont'd.)		
Parcel 485, Park City	Exempt	
Parcel 450, Park City	550	13.75
Parcel 461, Park City	500	12.50
Parcel 519, Park City	600	15.00
		564.38
Collection Fee		5.65
	22,575	570.03
TOTAL REPUBLIC TOWNSHIP	1,782,575	45,010.03
Tax Rate		25.00

12. ACCIDENTS AND PERSONAL INJURY:

Report No.	Name	Date of Injury	Days Lost	Nature of Injury	Compensation Paid
5	Arvid Olander	1-31-57	29	Fracture of 3rd metatarsal	$ 216.00
-	Earl Johnson	2-26-57	1	Arc burn to eyes	Non-compensable
6	Carl A. Nord	3-4-57	34	Fracture of 2nd metatarsal	$ 260.00
7	Douglas Koski	9-6-57	40	Fracture of left ankle	$ 282.00
8	Edwin Niemi	11-19-57	7	Flash burns, hands & face	$ 42.50
-	Robert Skewis	12-9-57	1	Contusion left leg	Non-compensable
-	Larry Kirker	9-26-57	1	Contusion right toes	Non-compensable

		Year 1957	Year 1956
Compensable Injuries	-	4	3
Non-compensable 1 - 7 days	-	3	1
Compensable days lost	-	110	34
Days lost non-compensable	-	3	5

13. EXPLORATION:

No exploration work was done in 1957.

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14. PROPOSED NEW CONSTRUCTION:

Preliminary design for plant expansion under E&A MI-6 continued during the year but no major construction program was initiated. Process development studies and pilot plant testing are continuing both in respect to magnetic oxide conversion and pelletizing. As soon as sufficient information has been obtained so that the best process and equipment can be selected, it is expected that a major plant expansion will be started at Republic, which will lead to doubling and eventually tripling of the present 600,000 ton annual capacity in the near future. The first step in the expansion may well be the addition of crushing, grinding and flotation capacity, within the present buildings, bringing the capacity to 800,000 tons per year. Along with this phase, a pelletizing plant will be added, preferably at the mine.

The house moving program proposed for 1958 consists of the removal of 21 houses in the Park City - West Republic area and three houses along M-95 on the north end of the pit.

Power lines and oxygen piping will be extended as needed in the pit. A permanent north pit road will be built up from stripping material.

The 20" tailing line will require some revisions and repairs.

15. EQUIPMENT RECEIVED AND PROPOSED NEW EQUIPMENT:

a. Equipment Received:

1 - Dipper for Marion Shovel
1 - Oscillator Assembly for Hydroscillator
1 - Marion 4161 Electric Shovel
1 - Dragline Equipment for 54-B Shovel
1 - 34-Ton Euclid Truck
1 - Pick-up Truck
1 - Service Truck
1 - Spare Main Shaft & Mantle for Tertiary
1 - Clamshell Bucket for Brownhoist
1 - Tailings Pipeline Extension with Cyclones and Pump

b. Proposed New Equipment:

6 - Conditioners	1958
1 - Pick-up Truck	"
1 - Automatic Feed Rate Compensator for Jet	"
1 - Truck Tail-gate Hoist	"
2 - Mill Pumps	"
1 - Mill Gear Lubricating System	"
1 - Car Puller	"
1 - Mill Control Room Ventilation	"

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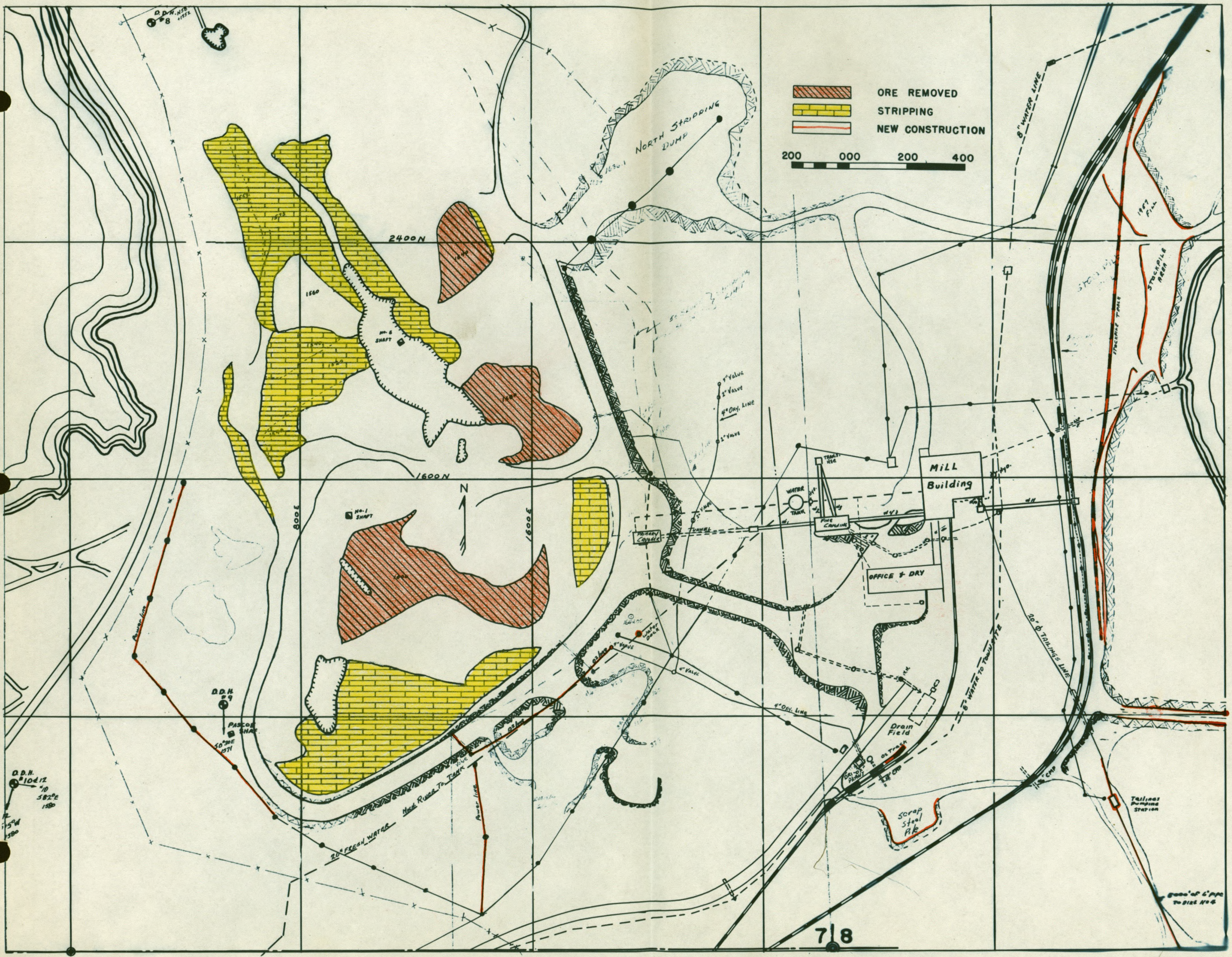
15. EQUIPMENT RECEIVED AND PROPOSED NEW EQUIPMENT: (CONT'D.)

b. Proposed New Equipment: (Cont'd.)

1 - Auxiliary Drill	1959
1 - Additional Rod Mill	"
1 - Tertiary Crusher	"
1 - D-8 Tractor	"
1 - 4½" Drill without carriage	"

Any major expansion program would be in addition to the above items which are carried on the cash forecast.


ORE REMOVED
STRIPPING
NEW CONSTRUCTION
200 000 200 400
North Stripping Dump
2400N
1600N
800E
1600E
N
No. 1 Shaft
No. 6 Shaft
Mill Building
Office & Dry
Water Tank
Fine Crushing
Tunnel
Primary Crusher
Drain Field
Scrap Steel Pile
Tailings Pumping Station
8" Water Line
8" Water to Townsite
20" Ø Tailings Line
Stockpile Area
Stockpile Track
4" Valve
4" Dry. Line
Power line
Pascoe Shaft
D.D.H. #9
D.D.H. #10 & 12
20" Fresh Water
Haul Road to Tank
7 8

TILDEN MINE
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1. INTRODUCTION:

Crusher repair and primary drill crews started work on March 25. Production of Tilden silica commenced on April 16 from the lower bench of the West Pit. A major breakdown of the primary crusher occurred on April 30 resulting in the suspension of production efforts and the moving of men and equipment to the Ohio Mine. Crusher repairs and surface stripping continued at the Tilden Mine until May 6.

Production at the Tilden was resumed on September 4 on a three-shift schedule.

A separate stocking area for the low phos ore was completed prior to the production season.

2. PRODUCTION, SHIPMENTS AND INVENTORIES:

a. Ore Statement

	Tilden Silica	Tilden Low Phos	Total
On hand - January 1, 1957	39,499	18,367	57,866
Output for Year	198,792	2,369	201,161
Total	238,291	20,736	259,027
Shipments	189,371	3,156	192,527
Balance on hand-December 31,1957	48,920	17,580	66,500

b. Shipments (Gross Tons)

	Pocket	Stockpile	Total
Tilden Silica	40,851	148,520	189,371
Tilden Low Phos	-	3,156	3,156
Total	40,851	151,676	192,527

c. Comparison of Shipments - Nine-Year Period (1949-1957)

Year	Tons Silica	Tons Low Phos	Total Year
1949	69,446	9,373	78,819
1950	91,510	23,926	115,436
1951	78,627	9,959	88,586
1952	64,590	15,859	80,449
1953	83,896	19,497	103,393
1954	77,781	-	77,781
1955	101,437	-	101,437
1956	140,401	25,027	165,428
1957	189,371	3,156	192,527

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2. PRODUCTION, SHIPMENTS AND INVENTORIES: (Con't.)

d. Production Data

	Days Operated	Shifts Operated	Average Tonnage Per 8-Hour Shift	Total Tons
Total Year	38	89	2,260	201,161

e. Production by Pits

	West Pit Lower Bench	West Pit Upper Bench	East Pit Lower Bench	Summit Pit	Total
Season to Date	155,037	2,368	23,520	20,236	201,161

* 20,236 tons of low phos ore (from the Summit Pit) were produced during 1957. However, 17,867 tons of this total were transferred to Tilden silica production.

3. ANALYSIS:

a. Grading Department Analysis

Grade	From	To	Tons	Iron	Phos.	Sil.	Sul.	Moist.
Tilden Silica		Stockpile	119,999	40.47	0.045	40.61	0.005	-
" "	Pocket	Presque Isle	39,084	41.35	0.043	39.24	0.005	3.37
" "	Stockpile	Presque Isle	136,128	40.43	0.035	41.12	0.005	2.56
" "	Pocket	Edison Industries	103	37.93	0.045	44.56	0.005	3.01
" "	Stockpile	Edison Industries	337	40.00	0.035	41.02	0.006	2.35
" "	Stockpile	Inland Steel	237	39.93	0.050	42.11	0.005	2.21
" "	Stockpile	Sealtight Insulation	173	38.60	0.023	43.32	0.005	1.60
Low Phos		Stockpile	20,236	35.45	0.014	47.82	0.005	-
" "	Stockpile	Presque Isle	2,400	35.75	0.012	47.82	0.005	3.20

b. Composite Analysis of Shipments

	Tons	Iron	Phos.	Sil.	Mn.	Al.	Lime	Mg.	Sul.	Loss By Ig.	Moist.
Tilden Silica											
Dried	189,371	40.60	0.035	40.57	0.06	0.71	0.15	0.17	0.005	0.20	2.71
Low Phos											
Dried	3,156	35.80	0.012	47.83	0.07	0.66	0.08	0.08	0.005	0.16	3.20

c. Analysis of Ore Remaining in Stockpile (Estimated)

Grade	Tons	Iron	Phos.	Sil.	Sul.
Tilden Silica	48,920	40.38	0.043	40.58	0.005
Tilden Low Phos	17,580	35.45	0.014	47.82	0.005

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4. LABOR AND WAGES:

a. Comments

Labor relations between the Cleveland-Cliffs Iron Company and the Union Local #4681 remained very good throughout the year.

b. Statement of Product

	Year - 1957
Production	201,161
Number of Days Operated	38
Number of Shifts Operated	89
Average Daily Product (Tons)	5,294
Average Product Per Shift (Tons)	2,260
Average Number of Men Employed	51½
Product Per Man Per Day	90.08

Average Number of Men (Operating Only)

Mine Payroll		General	
Hourly	Salaried	Payroll	Total
47½	2	2	51½

c. Grievances

(None)

5. OPEN PIT OPERATIONS:

a. Stripping

The East Pit stripping program under E&A CC-788 was completed. This stripping exposed additional Tilden silica ore on the north side of the East Pit.

b. Open Pit Mining

The principal source of ore was the lower bench of the West Pit. A small tonnage of Tilden silica was secured from the upper bench of the West Pit and the lower bench of the East Pit. A total of 20,236 tons of low phos ore was produced from the Summit Pit.

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5. OPEN PIT OPERATIONS: (Con't.)

b. Open Pit Mining (Con't.)

Truck Haulage

Location	Material	Loads	Shifts	Loads Per Shift	Type Truck
Pit to plant	Tilden Silica	4,934	57	86.6	24-ton
" "	" "	751	11	68.3	"
" "	" "	849	10	84.9	"
" "	Low Phos.	731	11	66.5	"
Total		7,265	89	81.6	
Plant to Stockpile	Tilden Silica	3,952	80	49.4	22 and 24-ton
" "	Low Phos.	668	13	51.4	" "
Total		4,620	93	49.7	

6. ESTIMATE OF ORE RESERVES:

a. Summary of Estimate of Ore Reserves

	Proven	Prospective	Total Tons
Ore Reserves as of January 1, 1957	4,131,400	2,735,500	6,866,900
Less 1957 Production	201,161	-	201,161
Ore Reserves as of December 31, 1957	3,930,239	2,735,500	6,665,739

b. Expected Average Analysis of Ore Reserves

	Tons	Iron	Phos.	Sil.	Mang.	Sul.	Moist.
Tilden Proven	3,930,239	39.74	0.028	43.51	0.090	0.009	2.50
Tilden Prospective	2,735,500	36.90	0.026	42.90	0.090	0.009	2.50
Total	6,665,739						

c. Proven Ore (Developed)

1. West Pit - Above Floor at 1430 Feet
(Assumption: 13 cubic feet equals one ton)

	Tons
Proven as of January 1, 1957	963,715
Mined during 1957	157,405
Total Remaining December 31, 1957	806,310

2. East Pit - Above Floor at 1440 Feet
(Assumption: 14 cubic feet equals one ton)

	Tons
Proven as of January 1, 1957	2,854,574
Mined during 1957	23,520
Total Remaining December 31, 1957	2,831,054

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6. ESTIMATE OF ORE RESERVES: (Con't.)

c. Proven Ore (Developed) (Con't.)

3. Summit Pit - Above Floor at 1620 Feet
(Assumption: 14 cubic feet equals one ton)

	Tons
Proven as of January 1, 1957	313,111
Mined during 1957	20,236
Total Remaining December 31, 1957	292,875

4. Total Proven Ore as of December 31, 1957

	Tons
West Pit	806,310
East Pit	2,831,054
Summit Pit	292,875
Total	3,930,239

d. Total Prospective Ore

	Tons
West Pit	500,000
East and Summit Pits	2,235,500
Total Prospective Ore as of December 31, 1957	2,735,500

e. Guaranteed Grade - 1957

Grade	Iron	Phos.	Sil.	Mang.	Alum	Lime	Mag.	Sul.	Loss	Moist.
Tilden Silica										
Dried	39.00	0.040	42.30	0.07	0.69	0.25	0.20	0.010	0.35	-
Natural	38.30	0.040	41.54	0.07	0.68	0.25	0.20	0.010	0.34	1.80
Tilden Low Phos										
Dried	36.00	0.015	46.90	0.07	0.66	0.20	0.20	0.010	0.30	-
Natural	35.50	0.015	46.24	0.07	0.65	0.20	0.20	0.010	0.30	1.40

7. TAXES:

Description:	1957 Valuation	1957 Taxes	1956 Valuation	1956 Taxes
Tilden Mine:				
N½ of Sec. 26, 47-27, 320A	$105,000	$2,740.50	$75,000	$1,961.26
Personal Property, Equipment & Supplies	180,000	4,698.00	140,000	3,661.00
Total Tilden Mine	$285,000	$7,438.50	$215,000	$5,622.26
Collection Fee		74.39		56.22
TOTAL TILDEN MINE	$285,000	$7,512.89	$215,000	$5,678.48

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8. PERSONAL INJURY:

There were no compensable or lost-time accidents at the Tilden Mine during the year.

9. PROPOSED NEW CONSTRUCTION:

(None)

10. EQUIPMENT RECEIVED AND PROPOSED NEW EQUIPMENT:

a. Equipment Received

1 - 10-ton electric hoist for servicing secondary crusher
1 - 54-B Bucyrus-Erie electric shovel to replace shovel shipped to Republic Mine
1 - Esco dragline equipment for use in stripping on irregular ledge surfaces

b. Proposed New Equipment for 1958

(None)

11. GENERAL SURFACE:

a. Buildings and Repairs

Toilet facilities were added to the dry during 1957.

b. Roads, Transmission Lines, Etc.

An extension of a 2300-volt power line to the newly-built low phos ore stocking area was completed to provide a convenient electrical outlet for the shovel.

c. Stocking Area

The relocation of the stockpile spurr track and the grading of a stocking area to provide room for a separate low phos stockpile was completed.

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12. COST OF OPERATIONS:

a. Cost of Production - 1957

	Tons - 1957	Tons - 1956
Production	201,161	186,349
Pit Operating	**Amount**	**Rate**
Primary Drilling	$ 8,681.57	$ 0.048
Primary Blasting	11,261.10	0.062
Secondary Breaking - Drilling	1,746.87	0.010
Secondary Breaking - Blasting	710.66	0.004
Deferred Drilling	11,453.00	0.063
Power Shovels	6,129.93	0.034
Power Shovels - Rental Only	-	0.000
Haulage Trucks	11,022.14	0.060
Tractors	7,441.64	0.041
Tractors - Rental Only	-	0.000
Pit Roads and Ramps	126.81	0.001
Pumping and Drainage	46.68	0.000
Supervision	4,231.32	0.024
General Pit Expense	3,127.93	0.017
Stocking Lean and Waste Material	130.26	0.001
Rental of Equipment	6,637.64	0.037
Repairs and Maintenance of Equipment	-	0.000
Total Pit Expense	$ 72,747.55	$ 0.402
Crushing		
Crushing	$ 21,536.02	$ 0.118
Total Crushing	$ 21,536.02	$ 0.118
Pumps and Housing	-	0.000
Stocking Expense	3,695.62	0.020
General Mine Expense	17,723.89	0.099
Winter and Idle Expense	50,000.00	0.276
Holiday Pay	1,830.89	0.010
Cost of Production	$167,533.97	$ 0.925
Taxes	$ 7,485.00	$ 0.041
Depletion and Depreciation	28,140.47	0.155
Shipping Expense	14,369.79	0.079
TOTAL COST AT MINE	$217,529.23	$ 1.200

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12. COST OF OPERATIONS: (Con't.)

b. Comparison of 1957 and 1956 Costs

	Cost Per Ton 1957	1956
Pit Expense	$ 0.402	$ 0.463
Crushing and Screening	0.118	0.089
Milling Expense	-	0.002
Stocking Expense	0.020	0.021
General Mine Expense	0.099	0.090
Winter and Idle Expense	0.276	0.221
Holiday Pay, Miscellaneous	0.010	0.001
Cost of Production	$ 0.925	$ 0.885
Taxes	$ 0.041	$ 0.030
Depletion	0.005	0.005
Depreciation	0.097	0.080
Amortization of Stripping	0.053	0.053
Shipping Expense	0.079	0.043
TOTAL COST AT MINE	$ 1.200	$ 1.096

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1. GENERAL

Production from the Bunker Hill Mine in 1957 totaled 503,604 tons. This is an increase of 14.8% over the 438,678 tons produced in 1956. The increase in production was a result of the increase in the number of days the mine operated during the year, and the increase in productivity realized through greater mechanization of mining operations. Production for the year was realized from the 10th and 12th Levels.

Shipments during the year increased 58,672 tons, from 382,354 tons in 1956 to 441,026 tons in 1957.

The mine operated on a 5-day, 2-shift schedule until November 3, 1957, at which time a 4-day, 2-shift schedule was effected. A small skeleton crew was employed on the midnight shift to tram ore and supplies.

The average natural iron analysis of ore shipped increased from 50.08 in 1956 to 51.14 in 1957. During the same period, the average moisture content decreased from 12.87 to 11.68. As a result of the high moisture content of the ore, all ore, with the exception of those pocket shipments made to the Ore Improvement Plant, was stockpiled.

The proven ore reserves, as submitted to the State Tax Commission, show a substantial increase over the figures reported in 1956. The increase of 1,356,084 tons is the result of exploration of the Boundary Orebody in the Bunker Hill property. A very small reduction is noted in the Athens reserves.

Labor relations between management and employees continued to be very satisfactory during 1957. Of the three formal grievances submitted during the year, two were dropped in Step 2, and one in Step 3.

General wages increased 3.3% during 1957.

The year 1957 saw the completion of several projects directed toward providing the surface facilities necessary to the Bunker Hill - Maas consolidation. Construction of the new garage building and the warehouse addition to the shop building was completed. The north parking lot was graded and filled to increase parking capacity and facilitate drainage. A fourth air compressor and an auxiliary motor-generator set were installed in the engine house, and the band brake on the cage hoist was replaced by a post-type hydraulic brake. Changes to the headframe flow sheet were completed by replacing the 3' x 10' Telesmith apron feeder with a 4' x 12' Hewitt-Robins oscillating feeder to provide a more even feed to the lower headframe conveyor belt.

Underground operations during 1957 were characterized by a greatly increased degree of mechanization. Yieldable arch steel supports and drag-chain conveyors were used to an increasing extent during the year, and several long, costly rail trams were eliminated through the utilization of belt conveyor systems. Tons per man day increased from 7.69 to 7.96 in 1957. This 3.5% increase in tons per man day becomes increasingly significant when viewed together with the fact that 44.9% of the year's production was realized from the Upper 10th Level Orebody. The structural nature of the Upper 10th Level Orebody renders it extremely difficult to mine, and the increase in production realized from this orebody can be attributed largely to the more complete mechanization of the ore handling system.

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1. GENERAL (Cont'd.)

Exploration during the year was concentrated in the following areas:

1. Extending the known reserves of the Boundary Orebody westward.

2. Outlining the North Orebody between 12th and 14th Levels.

3. Checking the outline and grade of the South Orebody along the 2600-W coordinate.

Pumping continued on an automatic basis with very satisfactory results.

There were 13 active E & A's during the year, and a total of $1,176,084.38 was expended under these capital expenditure authorizations.

The total valuation for the Bunker Hill - Athens properties increased $55,500 over the 1956 valuation.

There was an increase in the number of days lost due to personnel injury. The frequency and severity rates for 1957 were 44.23 and 9.847 as compared with 30.29 and .632 in 1956. This was due to a fatality which occurred in January, 1957.

The cost of electric power per kilowatt hour decreased from $.00894 in 1956 to $.00642 in 1957.

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2. PRODUCTION:

a. Production by Grades and Months:

Month	Athens	Mitchell	Bunker Hill	Total	Rock
January	10,068		14,832	24,900	2,556
February	19,980		29,352	49,332	8,715
March	16,416		37,284	53,700	9,598
April	13,362		31,560	44,922	9,696
May	9,256		42,191	51,447	6,612
June	15,358		34,812	50,170	6,420
July	8,112		20,520	28,632	2,592
August	17,088		30,192	47,280	5,244
September	23,035		20,902	43,937	5,580
October	12,912		30,396	43,308	9,657
November	17,412		16,896	34,308	6,708
December	15,060		16,608	31,668	6,636
Total	178,059		325,545	503,604	80,014
Stockpile Overrun	------		------	------	------
Total 1957	178,059		325,545	503,604	80,014
Total 1956	155,376	53,987	229,315	438,678	106,327
Increase	22,683		96,230	64,926	
Decrease		53,987			26,313

b. Shipments:

Grades:	Pocket	Stockpile	1957 Total	1956 Total
Athens	4,737	156,857	161,594	148,969
Mitchell Lease	-----	13,101	13,101	53,284
Bunker Hill	9,449	256,882	266,331	180,101
Total	14,186	426,840	441,026	382,354
Total Last Year	------	382,354	382,354	-------
Increase in Shipments	14,186	44,486	58,672	
Decrease in Shipments				

c. Ore Statement:

	Athens	Mitchell Lease	Bunker Hill	Total 1957	Total 1956
On Hand January 1, 1957	62,197	13,101	76,006	151,304	94,980
Product for Year	178,059	------	325,545	503,604	419,800
Stockpile Overrun	------	------	------	-------	18,878
Total	240,256	13,101	401,551	654,908	533,658
Shipments	161,594	13,101	266,331	441,026	382,354
Balance on Hand	78,662	------	135,220	213,882	151,304
Increase in Output	22,683		96,230	64,926	
Decrease in Output		53,987			22,280
Increase in Ore on Hand	16,465		59,214	62,578	56,324
Decrease in Ore on Hand		13,101			

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2. PRODUCTION: (Cont'd.)

c. Ore Statement: (Cont'd.)

Operating Schedule:

Year	Days Per Week Mine Operated
1957	5 days through November 1st -- 4 days balance of year.
1956	5 days entire year.
1955	4 days through April 17th -- 5 days balance of year
1954	5 days January to April 4th -- 4 days April 5th through December
1953	5 days entire year

d. Division of Product by Levels:

	1957		1956	
	Tons	Percent	Tons	Percent
6th Level				
7th Level			71,966	17.1
10th Level	226,269	44.9	107,662	25.6
12th Level	277,335	55.1	240,172	57.3
Total	503,604	100.0	419,800	100.0

e. Production Delays:

The Mine was idle through January 16th for the installation of the skip hoist.

3. ANALYSIS:

a. Average Mine Analysis on Output:

	1957					1956				
Grade:	Tons	Iron	Phos.	Sil.	Sul.	Tons	Iron	Phos.	Sil.	Sul.
Athens-Bunker Hill & Mitchell Lease	503,604	57.86	.112	9.19	.014	438,678	57.80	.112	8.79	.006

b. Average Analysis of Shipments:

Grade:	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
Athens-Bunker Hill & Mitchell Lease	57.90	.113	9.35	.68	3.31	.52	1.20	.013	1.70	
Natural	51.14	.099	8.26	.60	2.92	.46	1.06	.011	1.50	11.68

c. Average Analysis of Ore in Stock:

Grade:		Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
Athens-Bunker Hill & Mitchell Lease	213,882	58.05	.115	8.92	.68	3.31	.52	1.20	.011	1.70	
Natural		51.258	.102	7.88	.60	2.92	.46	1.06	.010	1.50	11.70

d. Straight Cargo Shipments:

No Shipments.

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4. ESTIMATE AND ANALYSIS OF ORE RESERVES:

Developed Ore:

Athens:

The total ore reserve based on the figures submitted to the Michigan State Tax Commission is considered to be developed ore.

Bunker Hill:

All of the ore reserves above 10th Level, with the exception of any ore north of the 3000-S coordinate, and all reserves east of 2600-W coordinate and south of the 3000-S coordinate on 12th Level are considered developed. The remaining ore is considered undeveloped.

The ore reserves in the following table are based on figures submitted to the Michigan State Tax Commission.

	Athens	Bunker Hill	Total
Ore Reserves - Dec. 31, 1956	519,388	4,226,542	4,745,930
Ore Production - 1957	178,059	325,545	503,604
Ore Reserves - Dec. 31, 1957	333,141	5,265,269	5,598,410
Tonnage Proven in 1957	8,188	1,364,272	1,356,084
6th Level to 8th Level		367,549	367,549
8th Level to 10th Level		2,002,799	2,002,799
10th Level to 12th Level	303,467	1,989,783	2,293,250
12th Level to 14th Level	161,698	1,617,939	1,779,637
Total Gross July 31, 1957	465,165	5,978,070	6,443,235
Less 10% for Mining and Rock	46,517	597,807	644,324
Net Total as of July 31, 1957	418,648	5,380,263	5,798,911
Less Production July 31, 1957 to December 31, 1957	85,507	114,994	200,501
Net Total as of Dec. 31, 1957	333,141	5,265,269	5,598,410

Expected Average Natural Analysis of Ore Reserves:

The following analysis is based on the figures submitted to the Michigan State Tax Commission.

Iron	Phos.	Sil.	Mang.	Alum.	Lime.	Mag.	Sul.	Loss	Moist.
50.50	.100	8.00	.39	2.75	.36	.80	.011	1.40	13.40

The remaining Athens reserves are confined to the North Orebody between 10th and 14th Levels. An increase in the reserves between 12th and 14th Levels is due to a greater rate of plunge of this structure than was anticipated. However, this increase is offset by a decrease in the reserves above 12th Level as a result of classifying as unavailable several pyramid-shaped areas, which cannot be economically mined.

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4. ESTIMATE AND ANALYSIS OF ORE RESERVES: (Cont'd.)

Continued exploration of the Boundary Orebody during 1957 has resulted in a significant increase in the Bunker Hill reserves. Diamond drilling has also resulted in a slight increase in the ore reserves of the South Orebody due to the westward continuation of the ore section paralleling the Main Athens Dike. However, the Upper 10th Level Orebody, as drilled along the 3200-W coordinate, is rapidly decreasing in thickness to the west.

Because a natural iron of 51.50% is required during 1958, the above reserves would be necessarily reduced to the amount of ore which could be recovered by maintaining this average analysis.

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5. LABOR & WAGES:

Labor Relations:

During 1957, there were three formal grievances submitted. All three grievances were dropped by the aggrieved employees, two in Step 2, and one in Step 3. Although there were three formal grievances in 1957 compared to none in 1956, labor relations between management and employees were considered to be excellent.

Employment:

The average number of statistical employees in 1957 was 272, as compared with 229 in 1956.

There were 203 separations during 1957--174 transferred, 1 drafted, 5 quit, 3 discharged, 4 retired, 3 died, and 13 laid off. There were 5 hired and 133 transferred during 1957.

Number of Men Beginning of Year	364
Added During Year	138
Separations	203
Total End of Year	299

The Mine was idle January 1st through January 16th due to the installation of the new skip hoist, and July 1st through the 14th for vacation.

The following tables give data pertinent to paid vacations and holidays.

Vacations - 1957

	Number of Men	Number of Hours	Amount	Rate Per Hour
One Week	15	614	$ 1,451.18	$2.363
Two Weeks	109	9233	24,992.39	2.707
Three Weeks	209	26564½	72,857.92	2.743
Total	333	36411½	$99,301.49	$2.727

Paid Holidays - 1957

	Number of Men	Number of Hours	Amount	Rate Per Hour
New Years Day	246	1968	$ 4,744.65	$2.411
Good Friday	261	2112	5,385.72	2.550
Memorial Day	277	2216	5,686.38	2.566
Fourth of July	310	2304	5,940.69	2.578
Labor Day	304	2344	6,181.47	2.637
Thanksgiving	308	2264	5,973.61	2.639
Christmas Day	291	2272	6,040.73	2.659
Total	285	15480	$39,953.25	$2.581

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5. LABOR AND WAGES: (Cont'd.)

Statement of Wages:

Average Wages Per Day	1957	1956	Increase	Decrease
Surface	$ 22.34	$ 21.26	$ 1.08	
Underground	24.38	23.26	1.12	
Total	$ 23.86	$ 22.70	$ 1.16	
Average Wages Per Month				
Surface	$454.84	$455.32		$ .48
Underground	496.38	498.16		1.78
Total	$485.79	$486.16		$ .37
Average Days Worked Per Month				
1957 - 18.67				
1956 - 16.50				
Tons Per Man Per Day				
Surface	31.66	27.13	4.53	
Underground	10.63	10.74		.11
Total	7.96	7.69	.27	
Labor Cost Per Ton				
Surface	.706	.784		.078
Underground	2.292	2.167	.125	
Total	2.998	2.951	.047	

6. SURFACE

Athens Shaft

The Athens shaft was inspected periodically during the year and continued to show slight movement in the upper part of the shaft. The Athens shaft is presently being used for exhaust ventilation and a second outlet.

Construction

Construction of the new garage building and the warehouse addition to the general shop building was completed during the year by the mine surface department.

During the mine vacation period, a 60' x 20' x 15" heated reinforced concrete slab was poured under the rock pocket at the Bunker Hill shaft. This slab will more uniformly distribute point loads around the shaft, and facilitate the removal of ice build-up and spillage under the rock pocket.

The north parking lot was graded and filled with approximately three inches of crushed rock to increase the parking area and facilitate drainage.

A six-inch water line was installed from the mine entrance to the dry building.

The Reliable Painting Company repainted the stocking trestles during the year.

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6. SURFACE (Cont'd.)

Equipment

Changes to the Bunker Hill headframe flow sheet were completed during the July vacation period with the installation of a new 4'x 12' Hewitt-Robins oscillating feeder, replacing the former 3' x 10' Telesmith apron feeder.

A fourth air compressor and an auxiliary motor-generator were installed in the Bunker Hill Mine engine house.

The manually operated band brake on the cage hoist was replaced by a post type hydraulic brake.

7. UNDERGROUND

Underground mining operations during 1957 were conducted in the North, South, and Upper 10th Level Orebodies by the block-caving method of mining. Yieldable arch steel supports and drag chain conveyors were used to an increasing extent throughout the year, and results have indicated that greater efficiency can be attained through their use, especially in areas where heavy ground conditions exist. Also during 1957, the main ore tramming system at the Bunker Hill Mine was improved considerably through the installation of belt conveyor systems in critical areas, where they serve to replace extensive amounts of costly rail haulage. Operation of the 14th Level conveyor system commenced on a regular schedule in January 1957, and since that time, the majority of the Bunker Hill Mine production has been conveyed over this installation to the Bunker Hill Shaft. Since the completion of the 10th Level conveyor system in April, all but a very minor portion of the 10th Level production has been conveyed over this installation to an ore pass in the north footwall, where it is transferred to the 14th Level system. The increase in tons per man day from 7.69 in 1956 to 7.96 in 1957 resulted largely from the increase in efficiency realized through more complete mechanization of the Bunker Hill operation.

Mining operations in the Athens Lease consisted of block caving in the eastern portion of the North Orebody above the 12th Level. The majority of Athens production was realized from two block caves located on the -1100 sub-level, and in one of these block caves, a very satisfactory rate of production was realized from the exclusive use of drag chain conveyors as primary ore movers in the slusher drifts and main transfer drift. Production from two block caves located on the -1180 sub-level was completed early in the year. At the end of the year, development operations were well underway for the mining of that portion of the North Orebody remaining above the 14th Level in the Athens Lease.

The mining above the 10th Level in the Bunker Hill property was confined to block caving in the Upper 10th Level Orebody, and during the year 44.9% of the Bunker Hill - Athens Mine production was realized from this orebody. The Upper 10th Level Orebody presents a difficult mining problem

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7. UNDERGROUND:(Cont'd.)

as a result of its structural irregularities, low mining height, and the tendency for lenses of lean ore and jasper to occur in the ore section. Wherever conditions permitted, drag chain conveyors were utilized as feeder systems for the main 10th Level belt conveyor in an effort to reduce ore handling and rail haulage to a minimum. This increase in the mechanization of the 10th Level ore handling system contributed largely to the increase in production realized from the 10th Level during 1957. During the year, five block caves were active in the Upper 10th Level Orebody.

In the Bunker Hill property above the 12th Level, the majority of the production was realized from two block caves located in the South Orebody west of the 2400 cross-cut. Production from a block cave in the North Orebody west of the 2400 cross-cut and a block cave in the South Orebody east of the 2400 cross-cut, was completed during April. At the end of the year, two block caves were under development in the South Orebody. The north and south main-line drifts were advanced 183 and 504 feet respectively. The 2500 cross-cut was holed through to the north main drift, while in the 2600, 2800, and 2900 cross-cuts, advances of 108, 153, and 108 feet were realized.

On the 14th Level, the 4100 cross-cut was driven to the 1640-W coordinate. This cross-cut will serve to develop the portion of the North Orebody remaining above the 14th Level in the Athens Property.

The following is a resume of main-level drifting done in 1957:

Level	Ore Drift	Rock Drift	Total
10th Level		713	713
12th Level	82	1605	1687
14th Level	—	652	652
Total	82	2970	3052

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7. UNDERGROUND: (Cont'd.)

Exploration:

Athens:

Geological mapping incidental with development was the extent of exploration in the Athens property during the year. This mapping, combined with two Bunker Hill drill holes along the 2000-W coordinate, has indicated that the North Orebody plunges westward more steeply than previously supposed.

Bunker Hill:

A full-time diamond drill program continued throughout the year and resulted in an appreciable increase in the ore reserves. This exploration program was concentrated in three areas.

1. Extending the known reserves of the Boundary Orebody westward.
2. Outlining the North Orebody between 12th and 14th Levels.
3. Checking the outline and grade of the South Orebody along the 2600-W coordinate.

Two holes were drilled from 10th Level, one as a power cable hole from 10th to 12th Levels, and the second as a water drain for the chain conveyor incline.

The following table gives the amount of ore cut and the total footage drilled during 1957:

1957 Holes	First Class Ore	Footage Drilled	
No. 71*	0'	228'	
72*	40'	260'	
73*	73'	319'	
74	Power Cable Hole	194'**	
75	90'	360'	
76	Water Drain	216'**	
77	5'	390'	
78	41'	188'	
79	0'	140'	
80	18'	175'	
81	111'	190'	
82	63'	220'	
83	100'	335'	
84	40'	214'	
85	50'	193'	
86	87'	187'	
87	45'	217'	
88	0'	160'	
89	98'	410'	
	861'	4,186'	Footage Drilled For Ore Exploration
		410'	Holes 74 & 76
		4,596'	Total Footage Drilled

*Holes which extended into Pioneer-Arctic--Footage is B. Hill portion.
**Not included in footage drilled for ore exploration.

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7. UNDERGROUND: (Cont'd.)
Exploration: (Cont'd.)
Bunker Hill: (Cont'd.)

The following is a summary by levels and north-south sections of the drilling program.

12th Level:

2800-W Section:

Exploration along this coordinate was designed to outline the westward plunging Boundary Orebody in order to extend the known reserves of this ore structure to the west. U.H. Numbers 71, 72, 73, and 75 were drilled for this purpose.

Because the Bunker Hill-Pioneer-Arctic property line cuts diagonally NE-SW across this ore structure, the above drill holes did not intersect much ore on the Bunker Hill side. However, this drilling benefits a larger proportion of the Bunker Hill property to the east.

The exploration along this coordinate significantly increased the Bunker Hill ore reserves.

Since a sharp decrease in reserves has been realized in the North Orebody along the 2400-W coordinate, U.H. #77 was drilled along the 2800-W coordinate to check for a possible change in this condition. Very little first-class ore was intersected by this hole, therefore indicating no appreciable increase in ore concentration.

2200-W Section:

A NE-SW striking fault intersects the North Orebody at about the 2100-W coordinate. U.H. Numbers 80 and 81 were drilled to determine the outline of the ore section west of this fault. This drilling indicates that less height but more width occurs in the ore section west of the fault, thus benefiting 14th Level more than 12th Level. The ore-footwall contact was intersected further north than was expected, indicating the displacement along the NE-SW fault.

2645-W Section:

Drilling along this coordinate was directed toward testing the grade and the outlining of the very narrow tabular-like section of the South Orebody occurring between the Bunker Hill Fault and the Main Athens Dike.

U.H. Numbers 82 and 84 were drilled for this purpose. Both holes intersected a zone of second class ore within the ore section and indicate that the ore is about 30 feet farther north on the 12th Level elevation than was expected.

7. UNDERGROUND: (Cont'd.)
Exploration: (Cont'd.)
Bunker Hill: (Cont'd.)

2600-W Section:

U.H. #89 was drilled along this coordinate to determine a position on three dikes associated with the Boundary Orebody and to test for a zone of iron-formation occurring along the south side of this structure.

Two intrusives occurring within the ore section were located. The iron-formation zone was not intersected.

14th Level:

2000-W Section:

In order to facilitate mining development from 14th Level, U.H. #78 and #79 were drilled into the North Orebody in order to locate the footwall-ore contact and a thick dike which bisects the ore section.

As a result, it was learned that this V-shaped ore structure plunges westward at a greater angle than was expected. The dike which bisects the ore section appears to be nearly vertical.

2200-W Section:

A complex fault system coupled with the thick intrusive which bisects the ore section divides the North Orebody into several small sections between 12th and 14th Levels. U.H. #83 and 85 were drilled in order to outline any mineable ore along this coordinate. This drilling and the 12th Level drilling along this same coordinate, outlined a significant section of ore located on the west side of the NE-SW fault.

The argillite footwall occurred further north along this section than was anticipated, thus indicating displacement along this fault.

2300-W Section:

To determine the westward extent of the ore drilled on the 2200-W section, three holes were drilled along the 2300-W coordinate. U.H. Numbers 86, 87, and 88 located a fault which limits the ore just west of the 2300-W coordinate.

The results of the 1957 exploration program indicate the following:

1. The Boundary Orebody becomes increasingly larger as it plunges westward. The Pioneer-Arctic - Bunker Hill property line cuts diagonally NE-SW across this ore structure, thus causing the Bunker Hill portion of the reserves to wedge out to the west at about the 3000-W coordinate. This structure plunges at about 22° nearly due west. Three small dikes

7. UNDERGROUND: (Cont'd.)
Exploration: (Cont'd.)
Bunker Hill: (Cont'd.)

cut the ore section, two of them striking NW-SE across the structure and the largest striking east-west nearly bisecting the structure. A horizon of high-sulphur ore occurs above the -900 elevation along the 2400-W coordinate; however, this ore appears to be limited to the upper and eastern portions of this structure, as little high sulphur ore was indicated by drilling along the 2800-W coordinate.

2. The North Orebody between 12th and 14th Levels is cut into small ore areas by intrusives and faulting. A rapid decrease in ore concentration is observed west of the westernmost cross-fault on the 2300-W coordinate. Drilling along the 2800-W coordinate verified this lack of ore enrichment in the North Orebody as it plunges to the west.

3. The South Orebody west of the 2400-W coordinate is restricted to a narrow tabular-shaped area between the nearly vertical Bunker Hill Fault and Main Athens Dike. Between 10th and 12th Levels, this ore section is interrupted by lenses of second-class ore and small intrusives. Between 12th and 14th Levels, drilling has shown a generally high iron analysis and few interruptions in the ore section.

Statement of Timber Used:

	Amount - 1957	Amount - 1956
Cribbing	$ 1,426.70	$ 4,727.87
Stulls	10,251.79	9,983.53
Lagging	7,578.31	17,166.26
Poles	2,857.25	5,802.68
Steel Beams	48,739.58	28,329.55
Steel Sets (Circular-Arch-Yielding)	68,244.78	42,326.41
Total	$139,098.41	$108,336.30

Total Cost of Timber, Lagging, Poles, etc.:

Year	Amount	Per Ton
1957	$139,098.41	.2762
1956	108,336.30	.2470
1955	126,503.03	.2744
1954	97,254.14	.2210
1953	117,991.28	.1903
1952	69,794.67	.1404
1951	69,080.92	.1097
1950	64,244.24	.1050
1949	68,774.23	.1250
1948	79,243.23	.1564

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7. UNDERGROUND (Cont'd.)

Explosives:

Statement of Explosives Used During 1957

	1957		1956	
	Quantity	Amount	Quantity	Amount
Total Powder Used	175,123#	$36,020.78	113,957#	$22,295.92
Total Caps, Fuse, etc.		20,857.52		21,078.36
Total		$56,878.30		$43,374.28
PRODUCT		503,604		438,678
Pounds per ton of ore		.3477		.2597
Tons of Ore per pound of powder		2.876		3.849
Cost Per ton for powder		.0715		.0508
Cost per ton for fuse, caps, etc.		.0414		.0480
Cost per ton for all explosives		.1129		.0988

Pumping:

The following table shows the average number of gallons pumped per minute for the last five years:

Month	1957	1956	1955	1954	1953
January	2125	911	1124	1115	1341
February	2130	811	1057	1083	1361
March	2113	923	1023	1060	1351
April	2166	901	1002	1150	1395
May	2229	937	1014	1150	1457
June	2252	914	1053	1234	1541
July	2067	981	1053	1191	1583
August	2118	1020	1011	1238	1740
September	2326	944	999	1091	1598
October	2007	1030	961	1164	1551
November	2046	1020	963	1142	1498
December	2068	1017	880	1129	1526
Average	2137	956	1012	1146	1495

The following statement shows the average number of gallons pumped for the past ten years:

Year	Gallons Per Minute
1957*	2137
1956	956
1955	1012
1954	1146
1953	1495
1952	1493
1951	1539
1950	1593
1949	1214
1948	1077

* Beginning with 1957, the figures include Maas water as well as Bunker Hill since both are pumped through the Bunker Hill shaft.

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8. COST OF OPENING, EQUIPPING, DEVELOPING AND OPERATING:

There were 13 active E & As at the Bunker Hill Mine during 1957:

	Prior Year's Expenditures	1957 Expenditure	Total
E&A CC-619 Relocated Cage Hoist and Deep Wells	$1,757,715.00	$ 11,582.66	$1,769,297.66
CC-685 Alterations Shop Bldg.	28,835.96	23,924.35	52,760.31
CC-782 Chain Conveyors	44,770.00	215,652.22	260,422.22
CC-794 New Garage	43,174.00	29,032.50	72,206.50
CC-875 Transformers & Cable	13,812.00	6,166.06	19,978.06
CC-717 Install Shaft Sets		19,348.00	19,348.00
CC-869 Undg. Development		522,552.84	522,552.84
CC-876 Communication System		3,745.99	3,745.99
CC-877 Scrapers & Hoist		24,708.20	24,708.20
CC-878 Diamond Drilling		39,366.89	39,366.89
CC-911 Vibrating Feeder		17,319.18	17,319.18
753-662 Rehabilitate Engine House, Etc.	1,624,430.00	262,685.49	1,887,115.49

Comparative Mining Costs:

	1957	1956	Increase	Decrease
Product	503,604	438,678	64,926	
Underground Costs	3.497	3.553		.056
Surface Costs	.537	.520	.017	
General Mine Expense	.850	.752	.098	
Cost of Production	4.884	4.825	.059	
Depreciation	.336	.245	.091	
Taxes	.032	.031	.001	
Loading & Shipping	.103	.087	.016	
Administration, Cleveland Office, etc.	.105	.099	.006	
Total Cost at Mine	5.460	5.287	.173	
Budget: Estimated Cost At Mine	5.329	4.902	.427	
Number of Shifts & Hours	1-1/8 Hr. 223-2/8 Hr.	199-2/8 Hr.	1-1/8 Hr. 24-2/8 Hr.	
Number of Days Operated	224	199	25	
Average Daily Product	2254	2204	50	

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8. COST OF OPENING, DEVELOPING, EQUIPPING AND OPERATING: (Cont'd.)

Proportion of Labor & Supplies:

Cost of Production	1957	Percent	1956	Percent	Increase	Decrease
Labor	3.247	66.50	3.310	68.60		.063
Supplies	1.637	33.50	1.515	31.40	.122	—
Total	4.884	100.00	4.825	100.00	.059	

Days & Shifts:

Year	Days Mine Operated	Shifts & Hours	Men Employed	Total Shifts Worked
1957	224	1-1/8 Hr. 223-2/8 Hr.	401	447
1956	199	199-2/8 Hr.	386	398
Increase	25	1-1/8 Hr. 24-2/8 Hr.	15	49
Decrease				

8. COST OF OPENING, EQUIPPING, DEVELOPING AND OPERATING (Cont'd)

Cost of Production	1957 Amount	1957 Per Ton	1956 Amount	1956 Per Ton
Underground Costs:				
Development	$ 313,106.15	$ .621	$ 306,749.82	$ .699
Mining	596,538.07	1.185	509,585.13	1.161
Tramming	353,947.85	.703	283,408.97	.647
Ventilation	28,304.94	.056	27,459.73	.063
Pumping	30,330.36	.060	37,034.14	.084
Compressors and Air Lines	36,670.38	.073	43,213.54	.099
Crushing and Screening - UG	27,816.69	.055		
Underground Superintendence	113,802.05	.226	88,963.56	.203
Maint: Pockets and Chutes	7,586.79	.015	3,092.97	.007
" Mining Equipment	65,098.47	.130	69,750.39	.158
" Levels and X-Cuts	58,165.45	.116	43,842.54	.100
" Shaft	16,210.60	.032	21,348.61	.049
Telephones and Safety Devices	24,737.25	.049	21,786.30	.049
Holiday Pay	29,541.88	.059	15,731.83	.036
Vacation Pay	58,815.62	.117	86,713.32	.198
Total Underground Cost	$1,760,672.55	$3.497	$1,558,680.85	$3.553
Surface Costs:				
Hoisting	$ 72,607.65	$ .145	$ 60,957.93	$ .139
Crushing and Screening - Surf.	6,929.99	.014	9,140.13	.021
Stocking	75,715.01	.150	51,921.52	.119
Timber Yard	29,573.40	.059	25,570.09	.058
Dry House	13,466.03	.026	20,280.53	.046
Policing	11,157.48	.022	11,315.37	.026
General Surface	19,641.53	.039	11,626.96	.027
Maint: Headframe Bldg. & Equip.	5,775.64	.011	1,041.90	.002
" Other Mine Buildings	11,946.23	.024	8,969.49	.020
Telephones and Safety Devices	1,069.20	.002	1,201.99	.003
Holiday Pay	4,767.45	.009	3,143.27	.007
Vacation Pay	18,154.00	.036	22,725.00	.052
Idle and Abandoned Properties			76.10	
Total Surface Cost	$ 270,803.61	$ .537	$ 227,970.28	$ .520
General Mine Expenses				
Electrical Engineering	$ 5,926.97	$ .011	$ 5,782.53	$ .013
Geological Department	8,919.51	.018	6,838.26	.016
Mining Engineering Department	29,053.91	.058	20,620.90	.047
Mechanical Engineering Department	5,874.51	.012	11,403.86	.026
Safety Department	5,195.47	.010	6,080.93	.014
Research Laboratory	4,081.90	.008	4,385.02	.010
Analysis and Grading - Laboratory	29,096.59	.058	26,425.83	.060
Design Department	125.50		683.97	.001
Research Department	12,018.19	.024		
Special Expense - Retirements	3,287.87	.006	3,928.28	.009
" " - Hygiene Clinic	4,593.31	.009	5,616.59	.013
" " - Employment Office	986.36	.002	973.83	.002
Ishpeming Office	65,483.66	.130	69,935.93	.159
Mine Office - Supt. and Clerks	42,871.97	.085	43,416.21	.099
Central Warehouse Overhead	15,093.55	.030	16,741.02	.038
Insurance - Property	3,628.77	.007	3,387.69	.008
" - Group, Health and Life	40,434.21	.080	32,455.58	.074
" - Group Annuity	12,608.35	.025	9,715.69	.022
" - Catastrophe	4,378.44	.009	3,241.38	.007
Personal Injury - Comp. & Doctors	39,266.18	.078	11,330.98	.026
Supplemental Unemployment Benefits	29,593.98	.059		
General Storehouse Obsolete Supplies	2,044.30	.004		
Railroad Relocation			2,173.15	.005
Mine Spare and Obsolete Supplies	5,427.63	.011		
Taxes - Unemployment Insurance	20,905.85	.042	9,592.26	.022
" - Old Age Benefit	31,527.77	.063	32,004.88	.073
Employees Insurance and Comp.	5,242.18	.010	6,526.13	.015
Power Department Credit			4,088.26	.009
Supply Inventory Adj.	671.03	.001	698.26	.002
Auto Insurance			200.14	
Total General Mine Expenses	$ 428,337.96	$ .850	$ 330,071.04	$ .752
Cost of Production	$2,459,814.12	$4.884	$2,116,722.17	$4.825

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8. IDLE EXPENSE:

Detailed Idle Cost:

UNDERGROUND COSTS	Idle-Install New Hoist
Development	$ 2,477.25
Mining	10,357.52
Tramming	3,180.27
Ventilation	1,560.57
Pumping	1,988.47
Compressors and Air Lines	1,351.97
Underground Superintendence	5,377.17
Maint: Pockets and Chutes	309.82
" Mining Equipment	1,958.26
" Levels and X-Cuts	11,280.50
" Shaft	1,934.48
Telephones & Safety Devices	1,107.01
Holiday Pay	2,190.13
Total Underground Cost	$45,073.42
SURFACE COSTS	
Hoisting	2,868.12
Crushing and Screening -- Surf.	510.80
Stocking	3,085.79
Timber Yard	1,009.32
Dry House	816.29
Policing	455.78
General Surface	520.40
Maint: Headframe Bldg. & Equip.	62.82
" Other Mine Buildings	111.30
Telephones & Safety Devices	19.18
Holiday Pay	668.95
Total Surface Cost	$10,128.75
GENERAL MINE EXPENSES	
Elec. Engr.	69.23
Geological Department	185.62
Mining Engineering Department	923.28
Mech. Eng. Dept.	51.25
Safety Department	395.00
Analysis & Grading -- Shipping	290.00
Special Expense -- Employment Off.	110.00
Ishpeming Office	4,140.00
Mine Office -- Supt. & Clerks	1,926.16
Central Warehouse Overhead	1,025.44
Insurance -- Group, Health & Life	1,581.40
" -- Catastrophe	107.00
Personal Injury -- Comp. & Doctors	50.63
Research Dept.	249.21
Taxes -- Unemployment Insurance	400.00
" -- Old Age Benefit	1,125.00
Employees Ins. & Comp.	345.00
S.U.B.	1,230.69
Total General Mine Expenses	$14,204.91
COST OF PRODUCTION	$69,407.08

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9. TAXES:

DESCRIPTION	1957 Valuation	1957 Taxes	1956 Valuation	1956 Taxes
ATHENS MINE				
Including Stockpile as placed by State Tax Commission - Real Estate	$295,000	$12,390.00	$590,000	$24,485.00
Personal Property	585,000	24,570.00	111,000	4,606.50
Collection Fee		369.60		290.92
TOTAL ATHENS MINE	$880,000	$37,329.60	$701,000	$29,382.42
Total Rented Buildings	1,540	65.33	1,040	43.59
TOTAL ATHENS IRON MINING COMPANY	$881,540	$37,394.93	$702,040	$29,426.01
BUNKER HILL MINE				
Realty as described and assessed by Michigan State Tax Commission	$1,870,000	$78,540.00	$2,215,000	$ 91,922.50
Personal - Stockpile, Supplies & Equipment	1,060,000	44,520.00	839,000	34,818.50
Personal Property - Furnace Houses	5,050	212.10	5,050	209.58
TOTAL		$123,272.10		$126,950.58
Collection Fee		1,232.72		1,269.51
TOTAL BUNKER HILL MINE	$2,935,050	$124,504.82	$3,059,050	$128,220.09

10. ACCIDENTS AND PERSONAL INJURY:

The following table lists the compensable injuries for 1957:

Fatal	1
Time Lost - Over 4 Months	0
Time Lost - 1 to 4 Months	5
Time Lost - Less than 1 Month	14
TOTAL	20

Date of Accident	Name	Injury	Days Lost
1/27/57	Ellsworth Chapman	Fatal	T.C.-6,000
2/ 7/57	Axel E. Saari	Laceration on nose.	9
3/ 2/57	Toivo Parkkonen	Sprained Ankle	9
3/21/57	Joseph Brisson	Bruised back and leg.	11
3/30/57	Frederick Alderton	Fracture right arm.	92
3/26/57	Raymond Langlois	Strained Back.	8

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10. ACCIDENTS AND PERSONAL INJURY: (Cont'd.)

Date of Accident	Name	Injury	Days Lost
4/16/57	Walter H. Cox	Bruised right leg.	11
4/18/57	Anthony Certo	Bruised leg and back.	7
4/27/57	Alfred S. Longtine	Lacerations on face.	10
5/ 2/57	Ernest J. La Fave	Fracture right foot.	67
6/24/57	Louis E. La Joie	Fracture right leg.	130 Est.
7/26/57	Jalmer P. Pyykkonen	Strained right arm.	120
6/26/57	Rolland F. Juchemich	Strained back.	12
9/ 4/57	Celio DeBernardo	Burns-right hand.	8
9/11/57	James B. Pesenti	Burns on both hands.	15
10/ 8/57	Bruno Zanetti	Laceration right hand.	8
10/ 5/57	Ransom Corkin	Bruised knee and shin.	10
10/29/57	Leonard Tambling	Fracture left ankle.	90 Est.
11/23/57	William S. Kurin	Sprained right ankle.	15
11/27/57	Clarence Emanuelson	Infected Leg.	10
	TOTAL DAYS LOST		6,642

11. POWER:

The Cleveland-Cliffs Iron Company Electric Power Department generates the power and the U. P. Power Company distributes it over their transmission lines. The Average cost per kilowatt hour in 1957 was $.00642, as compared to $.00894 in 1956.

The rate per kilowatt hour is determined by dividing the total operating cost of The Cleveland-Cliffs Iron Company Electric Power Department by the total kilowatt hours sold and charging each consumer proportionately. To this is added a wheeling charge by the U. P. Power Company for distributing the power to the Mine.

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11. POWER: (Cont'd.)

The following table lists the costs of power for 1957:

Hoisting	$18,447.50
Compressor	33,090.00
Electric Haulage	8,824.51
Pumping	17,147.88
Ventilation	8,016.23
Dry House	663.99
Power Shovel	637.11
Shops	1,546.36
Stocking	4,632.62
Heating Plant	824.72
Underground Crusher	1,003.64
TOTAL	$94,834.56

CAMBRIA-JACKSON MINE
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1. GENERAL:

In spite of the adverse factors of low ore heights, which the Cambria was forced to mine due to diminishing reserves, and the costly rehandling of ore underground, the mine was able to show a good per ton profit for 1957. As the mining continued below the 8th Level the dip of the ore body flattened and the ore heights became low. This decreased the number of tons that could be mined from a transfer drift, and increased the development cost per ton. During the year mining started on the -225 Sub, 50' below the 8th Level. The handling of this ore is very costly as it has to be elevated to the 8th Level, loaded into cars and trammed to the conveyor. The conveyor elevates the ore to the 7th Level and then it is trammed to the shaft.

Production for the year was 169,400 tons, which was an average of 722 tons per day.

The working schedule was a five day week until November when the schedule was changed to a four day week. The schedule continued for the remainder of the year.

The total cost at mine was $6.368. This was $0.065 below the budget.

Due to the low ore heights over the mining transfers and the rehandling problem the tons per man decreased to 5.58 from 6.45 last year.

The analysis of product was very good. There was an increase in iron and a decrease in silica over the ore mined the previous year.

Average Mine Analysis on Output: (Incl. Stockpile)

Grade	Iron	Phos.	Silica	Sulphur
Jackson	58.63	.091	8.91	.090

The shipping season opened April 16th and closed on November 7th. Shipments from the stockpile and pocket totaled 176,687 tons of Jackson grade ore with a natural iron analysis of 51.56%. The stockpile was completely loaded out on October 26th.

Average Analysis of Shipments: (Total Average)

Grade	Iron	Phos.	Silica	Sulphur
Jackson	58.35	.088	9.42	.083

The net ore reserves reported to the Tax Commission on December 31, 1957, were 237,760 tons. This showed an increase of 129,442 tons over the previous year. Development of the ore on the -225 Sub, 50' below the 8th Level, was the reason for the increase in reserves over those for the previous year.

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1. GENERAL: (Cont'd)

There were no grievances filed in 1957.

Diamond drilling consisted of five short holes drilled below the 8th Level to outline ore structures in the east deposit and to explore the possibilities of a build-up of ore in the central deposit along the east side of the Cambria-Jackson fault zone dike. The results of the drilling confirmed previous ore outlines in the east deposit and indicated that there is not any mineable ore below the 8th Level center deposit.

One hoisting shift was lost during 1957. This occurred on October 30th when the shaft on the Pioneer Feeder required repairs.

During the vacation period in July, the 8" pipe line from the pump station on the 4th Level to the surface was changed.

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2. PRODUCTION, SHIPMENTS & INVENTORIES:

a. Production by Grade and Months:

	Jackson	Rock
January	17,792	652
February	14,285	364
March	17,005	184
April	14,780	736
May	18,510	332
June	15,162	176
July	8,989	136
August	16,085	460
September	12,605	112
October	16,208	32
November	8,149	-
December	9,645	8
Total	169,215	3,192
Overrun	185	
Total	169,400	

b. Shipments:

	Pocket Tons	Stockpile Tons	Total Tons	Total 1956	Increase or Decrease
Jackson	93,124	83,563	176,687	221,031	44,344

c. Ore Statement:

	1957	1956
On Hand January 1, 1957	22,761	25,792
Output for Year	169,215	205,991
Overrun	185	12,009
Total	192,161	243,792
Shipments	176,687	221,031
Balance on Hand	15,474	22,761
Decrease in Output	36,776	22,201
Decrease in Ore on Hand	7,287	3,031

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2. PRODUCTION, SHIPMENTS & INVENTORIES: (Cont'd)

Working Schedule:

1957 - Five 2-8 hr. shifts per week from January 1, 1957 to November 1, 1957.
Four 2-8 hr. shifts per week from November 4, 1957 to December 31, 1957.

1956 - Five 2-8 hr. shifts per week from January 1, 1956 to December 31, 1956.

1955 - Four 2-8 hr. shifts per week from January 1, 1955 to April 18, 1955.
Five 2-8 hr. shifts per week from April 18, 1955 to December 31, 1955.

1954 - Five 2-8 hr. shifts per week from January 1, 1954 to April 5, 1954.
Four 2-8 hr. shifts per week from April 5, 1954 to December 31, 1954.

1953 - Five 2-8 hr. shifts per week from January 1, 1953 to December 31, 1953.

d. Division of Product by Levels and by Months:

	Jackson Strip		Section I		
	8th Level	Below 8th	8th Level	Below 8th	Total
January	14,230	-	3,562	-	17,792
February	10,150	-	4,135	-	14,285
March	12,320	-	4,685	-	17,005
April	11,199	355	3,226	-	14,780
May	14,101	237	4,172	-	18,510
June	11,628	982	2,552	-	15,162
July	5,588	2,653	748	-	8,989
August	11,910	675	3,500	-	16,085
September	7,072	5,533	-	-	12,605
October	8,092	4,552	-	3,564	16,208
November	1,462	4,166	-	2,521	8,149
December	869	3,836	-	4,940	9,645
Total	108,621	22,989	26,580	11,025	169,215
Overrun					185
Total					169,400

e. Production Delays:

One production delay occurred on October 30th when the shaft on the Pioneer Feeder had to be replaced. This resulted in a loss of one hoisting shift.

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3. ANALYSIS:

a. Average Mine Analysis on Output:

Grade	Iron	Phos.	Silica	Sulphur
Jackson	58.63	.091	8.91	.090

b. Average Analysis of Shipments:

Grade	Iron	Phos.	Silica	Sulphur	Moisture	Iron Nat'l.
Jackson	58.35	.088	9.42	.083	11.63	51.56

c. Average Analysis of Ore in Stock:

Grade	Tons	Iron	Phos.	Silica	Mang.	Alum.	Lime	Mag.	Sulph.	Loss	Moist.
Jackson	15,474	58.14	.098	9.46	.29	2.74	.66	.21	.054	2.81	11.63

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4. COST OF OPENING, EQUIPPING, DEVELOPING AND OPERATING:

a. Comparative Mining Costs:

	1957	1956
Product	169,400	218,000
Underground Costs	$ 4.290	$ 3.555
Surface Costs	.623	.519
General Mine Expenses	.837	.575
Cost of Production	$ 5.750	$ 4.649
Depletion:		
Original Cost	.075	.076
Depreciation:		
Plant and Equipment	.021	.052
Movable Equipment	.007	.004
Taxes	.148	.126
Loading and Shipping	.154	.091
Rental of Shaft Facilities	.213	.151
Total Cost at Mine	$ 6.368	$ 5.149
Budget - Estimated Cost Per Ton	$ 6.433	$ 5.171
Number of Shifts and Hours	234½ 2-8	227 2-8
Total 8 Hr. Operating Shifts	469	454
Number of Operating Days	234½	227
Average Daily Product	722	960

Proportion of Labor and Supplies

	Amount	Per Ton	Per Cent
Labor	$ 767,363.48	$ 4.530	71%
Supplies	311,413.29	1.838	29
Total Cost at Mine	$ 1,078,776.77	$ 6.368	100%

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4. COST OF OPENING, EQUIPPING, DEVELOPING AND OPERATING: (Cont'd)

b. Detailed Cost Comparison:

	1957 Amount	1957 Per Ton	1956 Amount	1956 Per Ton
Development	$ 96,453.76	.570		
Mining	275,330.10	1.625		
Tramming	135,534.11	.800		
Auxiliary Hoisting	22,975.45	.135		
Ventilation	6,273.40	.037		
Pumping	15,720.88	.093		
Compressor and Air Lines	21,011.78	.124		
Underground Superintendence	60,086.16	.355		
Maint: Pockets and Chutes	7,050.87	.042		
Mining Equipment	14,426.18	.085		
Levels and Cross-cuts	7,877.77	.047		
Shaft	16,481.97	.097		
Vacation Pay	27,176.09	.160		
Holiday Allowance	13,258.14	.078		
Telephones and Safety Devices	7,467.08	.044		
Wage Adjustment	365.02	.002		
Total Underground Costs	$ 726,758.72	4.290	$ 774,894.15	3.555
Hoisting	$ 29,320.16	.173		
Stocking	19,512.33	.115		
Timber Yard	11,658.32	.069		
Dry House	11,828.87	.070		
Policing	15,871.80	.094		
General Surface	6,771.75	.040		
Maint: Headframe Bldg. and Equipment	1,129.65	.007		
Other Mine Buildings	1,207.25	.007		
Vacation Pay	4,834.00	.028		
Holiday Allowance	3,350.81	.020		
Telephones and Safety Devices	3.19	-		
Total Surface Costs	$ 105,488.13	.623	$ 113,230.74	.519
Geological Department	$ 510.42	.003		
Mining Engineering Dept.	3,535.34	.021		
Mechanical Engineering Dept.	1,328.52	.008		
Safety Department	2,646.51	.016		
Research Laboratory	1,542.76	.009		
Analysis and Grading	15,774.65	.093		
Special Expense	3,757.76	.021		
Ishpeming Office	26,828.32	.159		
Mine Office	19,305.14	.114		
Central Warehouse Overhead	2,409.28	.014		
Insurance	11,889.86	.071		
Personal Injury	5,260.29	.031		
Taxes-Unemployment Insurance	8,165.45	.048		
Old Age Benefit	12,405.03	.073		
Employees Insurance & Comp.	12,533.74	.074		
Electrical Engineering Dept.	1,548.02	.009		
Supplemental Unemployment Benefits	11,050.98	.065		
Operating Research Department	1,324.89	.008		
Total General Mine Expenses	$ 141,816.96	.837	$ 125,279.03	.575
COST OF PRODUCTION	$ 974,063.81	5.750	$1,013,403.92	4.649

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5. ESTIMATE AND ANALYSIS OF ORE RESERVES:

The net ore reserves of the Jackson Strip, reported to the Tax Commission on December 31, 1957, were 237,760 tons. The net ore reserves increased 214,468 tons. Development of the ore on the -225 sub, which is 50' below the 8th Level workings, is the reason for the increase in reserves over the previous year.

	Jackson Strip Sulphurous	Mather Mine "B" Shaft Sulphurous	Total
Between 6th and 7th Levels	84,662	3,073	87,735
Between 7th and 8th Levels	227,683	94,742	322,425
Total Gross as of July 31, 1957	312,345	97,815	410,160
Less Prod. July 31 to Dec. 31, 1957	48,167	14,525	62,692
Total Gross as of Dec. 31, 1957	264,178	83,290	347,468
Less 10% for Mining Loss and Rock	26,418	8,329	34,747
Net Total as of Dec. 31, 1957	237,760	74,961	312,721

Expected Average Natural Analysis of Ore Reserves as of December 31, 1957

Grade	Tons	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sulph.	Loss	Moist.
Jackson	312,721	52.00	.079	7.79	.18	2.41	.57	.30	.131	2.50	12.40

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6. LABOR AND WAGES:

a. Comments:

There were no grievances presented in the last three years, which is an excellent demonstration of the very good labor relations at this property.

Due to the diminishing number of mining areas, thirty men were transferred to other properties this year. These transfers accounted for the major decrease in the number of men on the payroll.

b. Employment Record:

At the end of the year 105 men were employed at the mine, which represents a net decrease of 39 employees for the year.

Number of Men 1/1/57		144
Losses - Deceased	3	
Quit	4	
Retired	2	
Transferred ...	30	
		-39
		105
Gains - None		
Total on Payroll 12/31/57		105

c. Vacations and Holidays:

The men benefited by seven paid holidays which were as follows: New Year's, Good Friday, Memorial Day, Independence Day, Labor Day, Thanksgiving and Christmas. This was in accordance with the provisions of the labor contract.

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6. LABOR AND WAGES: (Cont'd)

d. Comparative Statement of Wages and Product:

	1957	1956	Increase or Decrease
Average Wages Per Day:			
Surface	$ 22.61	$ 21.13	$ 1.48
Underground	24.67	23.10	1.57
Total	$ 24.19	$ 22.64	$ 1.55
Average Wages Contract Miners:	$ 25.29	$ 24.10	$ 1.19
Average Wages Per Month:			
Surface	$ 441.80	$ 436.05	$ 5.75
Underground	482.05	476.70	5.35
Total	$ 472.67	$ 467.21	$ 5.46
Tons Per Man Per Day:			
Surface	24.12	27.76	3.64
Underground	7.27	8.40	1.13
Total	5.58	6.45	.87
Labor Cost Per Ton:			
Surface	$ .938	$ .761	$ .177
Underground	3.395	2.752	.643
Total	$ 4.333	$ 3.513	$ .820

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7. SURFACE:

During the year the 8" discharge line from the 4th Level pumphouse to surface was replaced. The shaft was sheeted between the 6th and 7th Levels. The south stocking trestle was completely repaired during the year.

8. UNDERGROUND:

a. General:

Of the tonnage produced during 1957, 135,201 tons or 79.8% was mined from above the 8th Level and 34,014 tons or 20.2% from below the 8th Level.

Due to the decreasing number of mining areas, the number of mining contracts were reduced from eight to five during the year.

Mining above the 8th Level in the East Deposit was completed in November with the sub caving of a small pillar above the 850 Cross-cut.

All of the ore mined from below the 8th is scraped up an incline to the 8th Level and trammed to the 8th Level storage trench. It is then transferred to the 7th Level by a 30" conveyor belt. The ore is then trammed from a storage bin to the 7th Level skip pocket at the shaft.

The shaft on the Pioneer Feeder broke late on the midnight shift of October 29th and work was not resumed until the afternoon shift of the following day.

East Deposit:

Both development work and mining continued in this orebody throughout the year. A total of 153,248 tons of ore was obtained through development work and mining in this area. This deposit starts above the 7th Level and plunges to the southeast towards the Mather Mine "B" Shaft. The sulphur and analysis varies throughout the area, with the upper portion of the deposit being predominantly standard ore and the lower portion high sulphur ore. During 1958, practically all of the Cambria-Jackson production will come from this area.

Central Deposit:

A second cross-haul drift was developed at the end of this year in this small sulphurous deposit on the 8th Level elevation. Production totaled 15,967 tons during the year.

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8. UNDERGROUND: (Cont'd)

b. Diamond Drilling:

The diamond drilling program carried out in 1957 totaled five holes and 540 feet, compared with six holes and 1,074 feet drilled in 1956.

Diamond drilling was confined to the 8th Level East and Center Deposits, all holes being drilled downward to explore for and outline the ore below the 8th Level.

The East Deposit is bounded on the north by a dike and extends downdip into the Mather Mine "B" Shaft 5th Level mining area. This ore body is irregular in shape, the upper portion being standard grade ore and the lower portion being high sulphur ore.

The Center Deposit is located along the footwall and on the East side of the Cambria-Jackson fault zone dike. A total of four holes were drilled in the area indicating that there is not any mineable ore below the 8th Level.

Hole No.	Level	From	Footage	Ore	Total Depth	Location	Purpose
239	8	0	148	120	148	-180 Sub	Outline
240	8	0	126	0	126	8th Level	Explore
241	8	0	130	0	130	8th Level	Explore
242	8	0	49	32	49	8th Level	Explore
243	8	0	87	0	87	8th Level	Explore
5			540	152			

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8. UNDERGROUND: (Cont'd)

c. Timbering:

Statement of Ground Support Material Used Under Development and Mining Accounts

Item	Amount	Cost Per Ton
Cribbing	$ 556.99	.00330
Stull Timber	4,726.88	.02790
Lagging	6,140.30	.03625
Poles	3,441.29	.02031
Steel	3,066.46	.01810
Total	$ 17,931.92	.10586

d. Explosives:

Explosives Used in Breaking 169,400 Tons of Ore in Development and Mining Accounts

Item	Amount	Cost Per Ton
60% High-Pressure Gelatin	$ 1,925.06	.01137
Gelamite 1X	264.63	.00156
Hercomite 2X	18,508.87	.10926
Total Powder	$ 20,698.56	.12219
Blasting Supplies	5,024.70	.02966
Grand Total Powder & Blasting Supplies	$ 25,723.26	.15185
Pounds of Powder Per Ton of Ore		.61865407

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8. UNDERGROUND: (Cont'd)

e. Pumping:

The pumping system at the Cambria-Jackson Mine consists of two automatic, Byron Jackson, vertical, centrifugal pumps located on the 4th and 7th Levels. Because all of the underground water flows towards the shaft, each level has a pump to relay the water to the main pumping station on the 4th Level. During the year, the average flow from all of the levels was 296 G.P.M., as compared with 325 G.P.M. in 1956. Because there is a cave to surface, the rate of pumping is directly proportional to the climatic conditions. The peak pumping period occurred in May with 391 G.P.M., whereas last year, the peak was in the same month with 445 G.P.M. During the vacation period in July, 825' of the 8" discharge line from the 4th Level pumps to the surface was replaced.

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9. TAXES:

	1957		1956	
	Valuation	Taxes	Valuation	Taxes
Cambria Realty S½ of SE¼ of Sec. 35, 48-27) Lots 7&8 of Sec. 35, 48-27) Lots 5,6&7 of Sec. 36, 48-27) - 222.09 Acres)	$100,000	$ 4,200.00	$100,000	$ 4,150.00
Jackson Strip N660' of N½ of NW¼ of Sec. 1) 47-27)	255,000	10,710.00	355,000	14,732.50
Personal Property Stockpiles, Supplies and Equipment	225,000	9,450.00	225,000	9,337.50
Total by Michigan State Tax Commission	$580,000	$24,360.00	$680,000	$28,220.00
Collection Fee	-	243.60	-	282.20
Total Taxes, Negaunee	$580,000	$24,603.60	$680,000	$28,502.20
Division of Payments				
Cambria-Jackson Taxes, Ishp.*	$ 10,000	$ 453.50	$ 50,000	$ 2,040.00
Cambria-Jackson Taxes, Neg.	580,000	24,603.60	680,000	28,502.20
Total	$590,000	$25,057.10	$730,000	$30,542.20

* Cambria-Jackson Mine-Ishpeming

N660' of NE¼ of NE¼ of Sec. 2)
47-27 - 20 Acres)

Tax Rate Per $1,000 of Valuation

	1957	1956
City of Negaunee	$42.00	$41.50
City of Ishpeming	$45.35	$40.80

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10. ACCIDENTS AND PERSONAL INJURY:

The 1957 severity rating at the Cambria-Jackson Mine was the lowest of any Cleveland-Cliffs underground iron mining property on the Marquette Range. The Cambria-Jackson has won the safety award three out of the last four years, which is an indication of the excellent safety practices at this property.

There was one compensable injury which accounted for 33 lost-time days during the year. There were also three non-compensable injuries which added 7 days lost time, for a grand total of 40 days. This results in a severity rate of 165 days lost per million man hours and a frequency rate of 16.50 injuries per million man hours, compared with the Company's averages in underground mines of 3,836 and 46.03. The total hours worked were 242,366, as compared with 276,929 for 1956.

Date	Name	Nature of Injury	Days Lost
8/20/57	Nicholas Picciano	Fractured bone, middle finger, left hand.	33

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11. POWER:

	Consumption K. W. Hours	Cost of Current	Average Price Per K.W. Hour
1957	3,389,897	$ 20,980.10	$ 0.00619
1956	4,061,033	$ 36,253.81	$ 0.00893
1955	3,408,730	$ 35,000.97	$ 0.01027
1954	3,792,000	$ 36,496.51	$ 0.00962

MAAS MINE
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1. GENERAL

Production from the Maas Mine in 1957 totaled 492,725 tons. This is an increase of 98,396 tons over the 394,329 tons produced in 1956. The complete consolidation of Bunker Hill - Maas properties was effected on February 8, 1957, thus eliminating the production bottleneck created by the Maas Mine winze, which is limited in hoisting capacity. Since the Bunker Hill - Maas consolidation, all of the Maas Mine production has been hoisted through the Bunker Hill shaft. All Maas Mine production was realized from the 7th Level.

Shipments during 1957 totaled 363,883 tons, which is a decrease of 75,970 tons under the 439,853 tons shipped during 1956.

The mine operated on a 5-day, 2-shift schedule until November 3, 1957, at which time a 4-day, 2-shift schedule was placed in effect. A small crew was employed on the midnight shift to tram ore and supplies.

The average dry analysis of ore shipped during 1957 was slightly lower than in 1956. As a result of the high moisture content of the ore, pocket shipments were held to a minimum.

The proven ore reserves as reported to the State Tax Commission showed a marked reduction of the tax figures submitted the previous year. The decrease of 1,334,715 tons is the result of estimating only the ore which is expected to be recovered, rather than using a standard 10% mining and rock deduction from the gross estimate. The demand for a higher grade ore in 1958 will necessitate a further reduction of the reserve.

Surface operations during 1957 were confined to minor maintenance work and routine security patrols.

The results of the program to change the mining methods at the Maas Mine from sub-level caving to bulk methods came into prominence during 1957, as during the year, 89.4% of the production was realized from bulk mining methods. The Bunker Hill - Maas consolidation, together with the increased utilization of bulk mining methods, resulted in a very significant increase in the overall efficiency of the Maas operation. This is evidenced by a 22.8% increase in tons per man day, from 6.76 in 1956 to 8.30 in 1957. It is also notable that the cost of production decreased from $4.905 in 1956 to $4.640 in 1957, although during the year, there was a general wage increase of 3.3%.

Exploration of the Maas Mine was directed toward the outlining of the western extension of the Maas Orebody along the 3300-W coordinate, and the initial exploration of the Intermediate Structure along the 3000-W coordinate.

Since the Bunker Hill - Maas consolidation, Maas Mine water has been pumped through the Bunker Hill shaft on an automatic basis.

There were six active E & A's at the Maas Mine during 1957. A total of $493,084.86 was expended under these capital expenditure authorizations.

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GENERAL (Cont'd.)

The total valuation of the Maas Mine decreased $50,000 from the 1956 evaluation.

There was an increase in the number of days lost due to injuries to personnel in 1957. The frequency and severity for 1957 were 69.38 and 2.827 as compared with 67.60 and 1.739 in 1956.

Electric power for the Maas Mine since consolidation is purchased on the Bunker Hill Mine account and prorated back to the Maas cost sheet. The average cost per kilowatt hour in 1957 was .00642, as compared to .00894 in 1956.

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2. PRODUCTION

a. Production by Grades and Months

Month	Maas	Pioneer-Arctic	Race Course	Mulvey	Total	Rock
January	36,775	3,269	1,835		41,879	2,300
February	31,470	4,700	4,413		40,583	6,500
March	32,076	8,364	5,736	1,056	47,232	7,908
April	36,462	7,932	468	924	45,786	6,528
May	32,457	4,086	1,266	13,392	51,201	5,330
June	32,145	3,923	4,606	7,025	47,699	5,264
July	20,408	2,236	1,274	4,662	28,580	3,406
August	28,665	2,028	624	9,295	40,612	6,149
September	23,785	4,031	2,574	10,377	40,767	7,267
October	22,490	5,070	1,794	18,096	47,450	7,202
November	12,480	3,302	1,950	12,922	30,654	6,435
December	15,044	4,290	845	5,213	25,392	5,707
Total	324,257	53,231	27,385	82,962	487,835	69,996
Stockpile Overrun	4,497	219	174		4,890	
Total 1957	328,754	53,450	27,559	82,962	492,725	69,996
Total 1956	371,263		23,066		394,329	28,338
Increase		53,450	4,493	82,962	98,396	41,658
Decrease	42,509					

b. Shipments

Grade of Ore	Pocket Tons	Stockpile Tons	Total 1957	Total 1956
Maas	23,491	248,554	272,045	411,993
Pioneer-Arctic	1,076	31,699	32,775	
Race Course	52	22,121	22,173	27,860
Mulvey	4,513	32,377	36,890	
Total	29,132	334,751	363,883	439,853
Total Last Year	5,212	434,641	439,853	
Increase	23,920			
Decrease		99,890	75,970	

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PRODUCTION -(Cont'd.)

c. Ore Statement

	Maas	Pioneer-Arctic	Race Course	Mulvey	Total 1957	Total 1956
Ore On Hand 1-1-57	45,503		28		45,531	91,055
Product for Year	324,257	53,231	27,385	82,962	487,835	379,819
Stockpile Overrun	4,497	219	174		4,890	14,510
Total	374,257	53,450	27,587	82,962	538,256	485,384
Shipments	272,045	32,775	22,173	36,890	363,883	439,853
Balance on Hand	102,212	20,675	5,414	46,072	174,373	45,531
Increase in Output		53,450	4,493	82,962	98,396	17,555
Decrease in Output	42,509					
Increase in Ore on Hand	56,709	20,675	5,386	46,072	128,842	45,524
Decrease in Ore on Hand						

Operating Schedule

Year	Days Per Week Mine Operated
1957	5 days thru November 1 - 4 days balance of year
1956	5 days entire year
1955	4 days thru April 17 - 5 days balance of year
1954	5 days thru April 4 - 4 days balance of year
1953	5 days entire year

d. Division of Product by Levels

	1957	%	1956	%
Seventh Level	492,725	100.0	394,329	100.0
Total	492,725	100.0	394,329	100.0

e. Production Delays

There were no delays of any consequence during 1957.

MAAS MINE
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3 ANALYSIS

a. Average Mine Analysis on Output

		1957				1956			
Grade	Tons	Iron	Phos.	Sil.	Sul.	Iron	Phos.	Sil.	Sul.
Maas	465,166	57.74	.087	8.64	.312	57.68	.072	8.18	.350
Race Course	27,559	57.48	.083	8.63	.323	57.98	.069	7.86	.286

b. Average Mine Analysis on Ore Shipped

Grade	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
Maas	57.50	.086	8.50	.24	3.87	1.08	.35	.356	2.57	11.88
Race Course	57.35	.090	8.81	.24	3.93	1.04	.35	.308	2.51	11.76

c. Average Analysis of Ore in Stock

Grade	Tons	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
Maas	168,960	57.98	.090	8.66	.24	3.67	1.08	.35	.278	2.57	
Natural		51.051	.079	7.63	.21	3.23	.95	.31	.245	2.26	11.95
Race Course	5,414	57.87	.092	9.01	.24	3.43	1.04	.35	.256	2.51	
Natural		50.955	.081	7.93	.21	3.02	.92	.31	.225	2.21	11.95

d. Straight Cargo Shipments

Tons	Iron	Phos.	Sil.	Mang.	Sul.	Moist.
2,696	57.20	.090	8.68	.22	.304	12.24

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4. ESTIMATE AND ANALYSIS OF ORE RESERVES:

Developed Ore:

Maas:

The total ore reserve based on the figures submitted to the Michigan State Tax Commission is considered to be developed ore.

Mulvey:

All of the ore reserves adjacent to the 7500 cross-cut are considered to be developed ore, the remainder being undeveloped.

Pioneer-Arctic:

All of the ore reserves above 2nd Level are considered to be developed.

The ore reserves in the following table are based on the figures submitted to the Michigan State Tax Commission:

	Maas Lease	Race Course Lease	Mulvey	Pioneer-Arctic	Total
Ore Reserves Dec. 31, 1956	2,576,047	38,247	522,746	2,089,500	5,226,540
Ore Production 1957	328,754	27,559	82,962	53,450	492,725
Ore Reserves Dec. 31, 1957	1,706,030	--	286,657	1,406,413	3,399,100
Tonnage Proved in 1957	-541,263	-10,688	-153,127	-629,637	-1,334,715
Above 2nd Level (Formerly Maas 7th Level)	2,709,810	3,000	519,975	2,326,432	5,559,217
Total Gross-July 31, 1957	2,709,810	3,000	519,975	2,326,432	5,559,217
*Expected Recovery - Net Total-August 31, 1957	1,779,829	2,076	333,265	1,423,106	3,538,276
Less Production - Aug. 31, 1957 to Dec.31,1957	73,799	7,173	46,608	16,693	139,176
Net Total-Dec. 31, 1957	1,706,030	--	286,657	1,406,413	3,399,100

* Ore which is expected to be recovered rather than using a standard 10% mining and rock deduction. Figures accepted by State Tax Commission.

Expected Average Natural Analysis of Ore Reserves:

The following analysis is based on the figures submitted to the Michigan State Tax Commission.

Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
50.50	.094	7.50	.18	3.00	.90	.35	.35	2.25	13.50

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ESTIMATE AND ANALYSIS OF ORE RESERVES (Cont'd.)
Expected Average Natural Analysis of Ore Reserves (Cont'd.)

The reduction in ore reserves for the Maas, Mulvey, and Pioneer-Arctic properties is the result of estimating only the ore which is expected to be recovered, rather than using a standard 10% mining and rock deduction from the gross estimate.

Since this estimate was prepared, a demand for a 51.50 Natural Fe. was made of the Bunker Hill group. In order to maintain this average analysis, it will be necessary to further reduce the expected recovery of this ore.

A significant tonnage of ore is indicated to be in the Pioneer-Arctic portion of the Boundary Orebody as explored from the Bunker Hill property. However, because there is no mining agreement outside the Phase I portion of this property, this ore was not estimated for the State Tax Commission.

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5. LABOR AND WAGES

Labor Relations:

During 1957, there were two formal grievances submitted. One grievance was allowed in Step 2 and the other was dropped by the aggrieved employee in Step 3. Generally, the labor relations between management and employees was excellent.

Employment:

The average number of statistical employees in 1957 was 250½ as compared with 234¼ in 1956.

There were 185 separations during the year--157 transferred, 7 quit, 14 retired, 2 died, and 5 laid off. There were 4 men hired and 65 transferred to the Maas during 1957.

Number of Men Beginning of Year	241
Added During Year	69
Separations	185
Total End of Year	125

Vacations - 1957

	Number of Men	Number of Hours	Amount	Rate per Hour
One Week	6	252	$ 579.14	2.298
Two Weeks	56	4,677	12,722.67	2.720
Three Weeks	170	21,740	62,155.72	2.859
Total	232	26,669	$75,457.53	2.829

Paid Holidays - 1957

	Number of Men	Number of Hours	Amount	Rate per Hour
New Year's Day	200	1,608	$ 4,025.84	2.504
Good Friday	143	1,144	2,919.30	2.552
Memorial Day	181	1,448	3,726.63	2.574
4th of July	207	1,616	4,283.78	2.651
Labor Day	224	1,784	4,942.74	2.771
Thanksgiving Day	214	1,712	4,637.96	2.709
Christmas Day	152	1,200	3,279.04	2.733
Total	189	10,512	$27,815.29	2.646

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LABOR AND WAGES (Cont'd.)

Statement of Wages

Average Wages Per Day	1957	1956	Increase	Decrease
Surface	$23.84	$20.93	$2.91	
Underground	24.38	22.90	1.48	
Total	$24.28	$22.54	$1.74	

Average Wages Per Month				
Surface	$487.29	$455.25	$32.04	
Underground	498.33	498.08	.25	
Total	$496.28	$490.25	$ 6.03	

Average Days Worked Per Month

1957 - 20.44
1956 - 19.00

Tons Per Man Per Day				
Surface	51.08	36.49	14.59	
Underground	9.91	8.29	1.62	
Total	8.30	6.76	1.54	

Labor Cost Per Ton				
Surface	.467	.574		.107
Underground	2.459	2.761		.302
Total	2.926	3.335		.409

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6. SURFACE

Hoisting operations through the Maas Shaft were terminated on February 8, 1957, and since that time, surface operations have been confined to minor maintenance work and routine security patrols.

Drainage:

Since the consolidation of the Bunker Hill and Maas Mines, all Maas Mine water is being directed through the 2nd Level connecting drift to a pumping station at the Bunker Hill Shaft, where it enters the Bunker Hill Mine discharge system.

Purchase and Disposal of Dwellings:

The Mining Department made the following property transactions during 1957.

Purchases

Maas House 221, Lot 12, Block 29, Pioneer Plat, Purchased from Alvina Butcher, et al, May 25, 1957.	310 E. Lincoln St. $6,500.00.
Maas House 222, Lot 10, Block 33, Pioneer Plat, Purchased from Elsworth Thiele, May 20, 1957.	314 Brown Avenue $5,630.00.
Maas House 223, Lot 10, Block 33, Pioneer Plat, Same as above.	316 Brown Avenue $6,270.00.
Maas House 224, Lot 10, Block 33, Pioneer Plat, Same as above.	318 Brown Avenue $2,600.00

Houses Moved and Sold

Maas House 93 from Lot 15, Block 36, Pioneer Plat

Maas House 35 from Lot 4, Block 35, Pioneer Plat

Maas House 70 from Lot 16, Block 36, Pioneer Plat

Maas House 210 from Lot 1, Block 35, Pioneer Plat

Maas House 203 from Lot 7 , Block 35, Pioneer Plat

Houses Moved - Not Sold,12/31/57

Maas House 204 from Lot 2, Block 35, Pioneer Plat - Now Lot 34, 4th Addition

Maas House 128 from Lot 3, Block 35, Pioneer Plat - Now Lot 41, 4th Addition

Maas House 176 from Lot 7, Block 35, Pioneer Plat - Now Lot 15-16, Blk.4, 2nd Addn.

Maas House 183 from Lot 6, Block 35, Pioneer Plat - Now Lot 39, 4th Addition

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SURFACE (Cont'd.)

Purchase and Disposal of Dwellings (Cont'd.)

House Sold for Salvage

Maas House No. 209, Lot 1, Block 35, Pioneer Plat

Note: Maas House 215 (big Maas home) was sold in September, 1956.

7. UNDERGROUND

The year 1957 saw a considerable change effected in the underground mining operations at the Maas Mine. Underground and surface changes necessary to the Bunker Hill - Maas consolidation were completed early in January, and on January 18, 1957, the first Maas ore was hoisted through the Bunker Hill Shaft on an experimental basis. On February 8, 1957, the hoisting of Maas ore through the Bunker Hill shaft commenced on a regular schedule, and since that time, all Maas Mine production has been hoisted through the Bunker Hill Shaft. Maas ore is trammed through the 2nd Level connecting drift to the Bunker Hill Shaft, where it is transferred through ore passes to loading pockets on the Bunker Hill 6th Level. The consolidation of the Bunker Hill and Maas Mines, together with the increased utilization of bulk mining methods, has resulted in a notable increase in the efficiency of the Maas operation. This increase in efficiency is reflected in the increase in tons per man day from 6.76 in 1956 to 8.30 in 1957.

Bulk mining methods accounted for 89.4% of the production realized during 1957, with long-hole stoping being the predominant mining method employed. Loss of recovery due to dilution has been the major problem encountered in areas being mined by the block-caving method of mining, and experience has indicated that better recovery can be attained from the long-hole stoping method of mining, whereby all of the ore in the stope is broken by blasting, and a protective pillar is maintained along the hanging wall. The dilution problem results from the tendency of the jasper hanging wall to cave as a fine material, which can readily infiltrate through the voids formed by the comparatively large pieces of broken ore in the block. Throughout the year, several contracts continued to mine by the sub-level caving method in areas not suitable to bulk mining methods, either because of the limited ore height, or the area limitations. All of the Maas production during 1957 was realized from the 7th Level.

A comparison of the proportion of production by mining methods between 1957 and 1956 is shown below:

	1957		1956	
	Tonnage	%	Tonnage	%
Sub-Level Caving	52,229	10.6	76,583	19.4
Block Caving	116,776	23.7	208,824	53.0
Long-hole Stoping	323,720	65.7	108,922	27.6
Total	492,725	100.0	394,329	100.0

Main-level drifting during 1957 totaled 1,737 feet, with the majority of this amount being driven in the 720-east and 720-south cross-cuts. The 720-east cross-cut will serve to develop that portion of the Maas Orebody which extends into the Pioneer-Arctic Property, while the 720-south cross-cut was driven to the 1400-S coordinate for development purposes, and then extended to the 1680-S coordinate for exploratory purposes.

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UNDERGROUND (Cont'd)

The 6th Level conveyor drift was advanced to completion, and by the end of the year, the excavation for the crusher station and trench was completed. However, in accordance with the curtailment of production and labor force effected on December 14, 1957, all work connected with the 6th Level conveyor system was suspended indefinitely.

The major portion of the production obtained during the year was realized from 4 block caves and 6 long-hole stopes. All mining by the block caving method was conducted in the portion of the Maas Orebody remaining between the 7200 and 7300 cross-cuts, and recovery in this area fell somewhat below expectations, as dilution was encountered to some degree in all of the block caves. Future mining in this area will be by the long-hole stoping method of mining. West of the 7300, all production was realized from the long-hole stoping method of mining, with 5 long-hole stopes actively producing in this area during the year. Production from one long-hole stope was completed during April of 1957. At the end of the year, there were 5 long-hole stopes under development.

Exploration:

A continued full time diamond drilling program was concentrated in the following three areas during 1957.

1. Exploration along the 3300-W coordinate for the Maas Orebody.

2. Exploration of the Intermediate structure along the 3000-W coordinate.

3. Development drilling in the 7500 X-cut area.

One hole was drilled from 2nd Level to 6th Level in the vicinity of the 6th Level crusher site to be used for ventilation and cage hoisting cable in the raises from 6th Level.

A total of 360 feet of diamond drill hole was drilled in the Maas property, 183 feet in the Mulvey, and 4,775 feet in the Pioneer-Arctic property.

The following table gives the amount of ore cut and the total footage drilled during 1957.

1957 Holes	First Class Ore	Footage Drilled
No. 71*	183'	223'
72*	224'	314'
73*	198'	356'
101	Raise hole	360'**
102	19'	238'
103	0'	259'
104	2'	146'
105	26'	93'

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UNDERGROUND (Cont'd.)
Exploration (Cont'd.)
Table (Cont'd.)

1957 Holes	First Class Ore	Footage Drilled	
106	180'	281'	
107	179'	284'	
108	0'	312'	
109	0'	507'	
110	0'	932'	
111	29'	403'	
112	65'	184'	
113	10'	426'	
	Total 1,115'	Total 4,958'	Footage for ore exploration.
		360'	Hole #101
		Total 5,318'	

* Bunker Hill Holes,
drilled into Pioneer-Arctic.
** Not included in footage drilled for ore exploration.

The following is a summary by north-south sections of the drilling program. All the holes were drilled from 2nd Level or subs above 2nd Level.

7th Level:

3300-W Section:

Diamond drilling along this coordinate was designed to outline the Maas structure as it extends westward. Four holes, #102, #103, #104, and #108 were drilled for this purpose. A complete lack of ore along this coordinate is indicated by this drilling.

3000-W Section:

General geological conditions indicate that a major fault occurs just south of the Maas Orebody in the Pioneer-Arctic property. Diamond drilling was initiated along this coordinate to explore for a possible ore structure which may be formed by this fault and the north limb of the engine house anticline.

U. H. #109, 110, 111, and 113 were drilled to explore this area. As a result of this drilling, the dip and approximate displacement along the fault have been indicated. The displaced footwall has not been intersected and no appreciable runs of ore have been cut.

Geological mapping in the 720 X-Cut has revealed a second position on this fault, therefore indicating its strike.

UNDERGROUND (Cont'd.)
Exploration (Cont'd.)
7th Level Cont'd.)

2700-W Section:

U.H. #107 was drilled from this coordinate due west along the 985-S coordinate in order to check for the position of the footwall contact and to test for iron formation lenses contained within the ore section.

-185 Sub-level:

2800-W Section:

Evidence of iron formation lenses contained within the ore section were indicated by previous drilling in this area. In order to check for such lenses and the positon of dikes #82 and #83, U.H. #105 and #106 were drilled along this coordinate. A thick zone of iron formation was intersected; however, only one thick intrusive was cut by this hole.

This drilling and geological mapping in the area indicate that dikes #82 and #83 intersect at about this coordinate, thus explaining the thick intrusive in Hole #106.

-100 Sub-level:

2845-W Section:

U.H. #112 was drilled along this coordinate to determine the position of dike #82 and the hanging wall-ore contact. Less ore height than was expected was indicated by this hole. Dike #82 was intersected where anticipated.

The results of the 1957 exploration program indicate the following:

1. The complete lack of ore along the 3300-W coordinate in the Maas structure appears to be the result of a gradual trend of decreasing ore concentration in this orebody from the 2400-W coordinate westward. This condition is the result of a gradual increase in the elevation of the argillite footwall from the 2400-W to the 3300-W coordinate.

2. A major fault, referred to as the Intermediate Fault, occurs just south of the Maas Orebody. This fault dips to the south at about 60° and strikes generally east-west with a trend to a NW-SE strike east of the 3000-W coordinate. The displacement along this fault is 800 + feet as no footwall has been intersected as yet along the down-thrown side. A structure favorable for ore concentration would exist between this fault and an intrusive or the north limb of the engine house anticline. However, no ore has been intersected in the 3000-W drilling.

3. Several lenses of iron formation occur within the ore section of the Maas Orebody from the 2400-W coordinate westward. These lenses of iron formation accompany the general trend of decreasing ore enrichment in the western portion of the structure.

Development drilling and geological mapping in the 7500 X-Cut area has indicated that the two dikes #82 and #83 have intersected at about 2800-W and cause serious complications in the mining development of this area.