

MAAS MINE  
ANNUAL REPORT  
YEAR 1957

UNDERGROUND (Cont'd.)

Statement of Timber Used

	<u>Amount - 1957</u>	<u>Amount - 1956</u>
Cribbing	\$ 1,962.11	\$ 6888.81
Stulls	21,627.64	10,394.38
Lagging	11,678.28	16,323.95
Poles	4,182.42	5,335.73
Steel Beams	46,852.54	19,022.47
Steel Sets (Circular)	<u>14,403.54</u>	<u>17,981.96</u>
Total	\$100,706.53	\$75,947.30

Total Cost of Timbering, Lagging, Poles, etc.

<u>Year</u>	<u>Amount</u>	<u>Per Ton</u>
1957	\$100,706.53	.2044
1956	75,947.30	.1925
1955	69,510.79	.1845
1954	86,984.40	.2169
1953	120,479.05	.2052
1952	112,197.18	.2254
1951	90,270.45	.1267
1950	78,273.14	.1236
1949	82,105.72	.1361
1948	99,949.06	.1485

Explosives

Statement of Explosives Used During 1957

	<u>1957</u>		<u>1956</u>	
	<u>Quantity</u>	<u>Amount</u>	<u>Quantity</u>	<u>Amount</u>
Total Powder Used	237,466#	\$48,630.80	241,308#	\$45,045.09
Total Caps, Fuse etc.Used		<u>23,740.50</u>		<u>17,819.59</u>
Total		\$72,371.30		\$62,864.68
<u>Product</u>		492,725		394,329
Pounds Powder per ton of Ore		.482		.612
Tons of Ore per pound of Powder		2.075		1.634
Cost per Ton for Powder		.099		.114
Cost per Ton for Fuse, Caps, etc.		.048		.045
Cost per Ton for All Explosives		.147		.159

Pumping

Since the Bunker Hill - Maas consolidation, Maas Mine water is directed through the second level connecting drift to sumps at the Bunker Hill Shaft, where it is pumped on an automatic basis.

MAAS MINE  
ANNUAL REPORT  
YEAR 1957

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

There were six active E & A's at the Maas Mine during 1957.

<u>Reference</u>	<u>Prior Year's Expenditures</u>	<u>1957 Expenditures</u>	<u>Total Expenditures</u>
E & A CC-870, Undg. Develop.		\$263,112.50	\$263,112.50
E & A CC-871, Drill Machines	\$ 5,940.00	13,320.00	19,260.00
E & A CC-873, Scraper Hoists		12,838.00	12,838.00
E & A CC-910, Chain Conveyors		112,870.04	112,870.04
E & A CC-874, Diamond Drilling		63,675.62	63,675.62
E & A CC-872, Scraper Hoists		27,268.20	27,268.20
<b>Total</b>	<b>\$ 5,940.00</b>	<b>\$493,084.36</b>	<b>\$499,024.36</b>

Comparative Mining Costs

	<u>1957</u>	<u>1956</u>	<u>Increase</u>	<u>Decrease</u>
Product	492,725	394,329	98,396	
Underground Costs	3.422	3.882		.460
Surface Costs	.535	.465	.070	
General Mine Expense	<u>.683</u>	<u>.558</u>	<u>.125</u>	
Cost of Production	4.640	4.905		.265
Depreciation	.361	.101	.260	
Taxes	.295	.277	.018	
Loading and Shipping	.082	.112		.030
Miscellaneous	<u>.030</u>		<u>.030</u>	
Total Cost at Mine	5.408	5.395	.278	
Budget Estimated Cost Per Ton	5.178	5.415		.237

Number of Days Operated

1 - 8 hour	1		1
2 - 8 hour	234	228	6

<u>Proportion of Labor and Supplies</u>	<u>1957</u>	<u>%</u>	<u>1956</u>	<u>%</u>
Labor Cost Per Ton	3.184	68.6	3.584	73.1
Supplies Cost Per Ton	<u>1.456</u>	<u>31.4</u>	<u>1.321</u>	<u>26.9</u>
Total	4.640	100.0	4.905	100.0

174

MAAS MINE  
ANNUAL REPORT  
YEAR 1957

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

Cost of Production

	<u>1957</u>		<u>1956</u>	
<u>Underground Costs:</u>	<u>Amount</u>	<u>Per Ton</u>	<u>Amount</u>	<u>Per Ton</u>
Development	\$ 232,956.77	\$.473	\$ 232,378.68	\$.589
Mining	598,955.93	1.216	486,314.83	1.233
Tramming	315,700.52	.641	278,770.90	.707
Auxiliary Hoisting	8,774.80	.017	70,331.09	.178
Ventilation	22,713.07	.046	18,783.10	.048
Pumping	60,694.43	.123	82,301.66	.209
Compressors and Air Lines	51,943.97	.106	55,435.95	.141
Crushing and Screening - UG	15,720.98	.031		
Underground Superintendence	106,529.73	.217	81,704.27	.207
Maint: Pockets and Chutes	3,814.45	.007	2,185.10	.006
" Mining Equipment	74,580.82	.151	79,604.10	.202
" Levels and X-Cuts	46,091.73	.093	24,181.70	.061
" Shaft	16,124.49	.033	13,488.88	.034
Telephones and Safety Devices	20,271.53	.041	14,061.43	.036
Holiday Pay	30,852.09	.063	21,338.76	.054
Vacation Pay	80,816.84	.164	69,969.14	.177
Wage Adjustment	217.89			
<b>Total Underground Cost</b>	<b>\$1,686,324.26</b>	<b>\$3.422</b>	<b>\$1,530,849.59</b>	<b>\$3.882</b>
<u>Surface Costs:</u>				
Hoisting	\$ 70,087.99	\$.142	\$ 63,744.71	\$.161
Crushing and Screening - Surf.	5,043.75	.010		
Stocking	70,305.68	.143	38,721.47	.098
Timber Yard	28,693.33	.058	24,802.78	.063
Dry House	13,769.68	.028	17,594.43	.045
Policing	10,796.93	.022	10,181.39	.026
General Surface	21,391.53	.044	11,985.91	.030
Maint: Headframe Bldg. & Equip.	5,138.57	.010	291.87	.001
" Other Mine Buildings	11,734.39	.024	1,460.72	.004
Telephones and Safety Devices	1,655.94	.003	471.78	.001
Holiday Pay	5,753.64	.012	3,889.59	.010
Vacation Pay	19,070.00	.039	10,281.18	.026
<b>Total Surface Cost</b>	<b>\$ 263,441.43</b>	<b>\$.535</b>	<b>\$ 183,425.83</b>	<b>\$.465</b>
<u>General Mine Expenses:</u>				
Electrical Engineering	\$ 3,983.04	\$.008	\$ 2,254.07	\$.006
Geological Department	5,710.06	.012	1,860.56	.005
Mining Engineering Department	24,070.90	.049	12,245.96	.031
Mechanical Engineering Department	3,427.83	.007	386.25	.001
Safety Department	5,018.29	.010	4,698.94	.012
Research Laboratory	1,663.24	.003	2,592.31	.007
Analysis and Grading - Laboratory	24,825.24	.050	20,273.12	.051
" " " - Shipping	2,397.74	.005	3,573.04	.009
Research Department	4,767.84	.010		
Design Department	125.50			
Special Expense - Pensions	64.80		64.77	
" " - Retirements	2,886.55	.006	2,856.73	.007
" " - Hygiene Clinic	3,456.70	.007	1,002.06	.003
" " - Employment Office	984.15	.002	757.67	.002
Ishpeming Office	62,494.84	.127	54,398.40	.138
Mine Office - Supt. and Clerks	38,195.90	.077	25,141.71	.063
Central Warehouse Overhead	14,941.14	.031	10,619.52	.027
Insurance - Property	1,501.61	.003	1,626.58	.004
" - Group, Health & Life	27,799.03	.056	14,449.53	.037
" - Group Annuity	7,070.32	.014	6,216.20	.016
" - Catastrophe	2,794.35	.006	2,907.50	.007
Personal Injury - Comp. & Doctors	20,974.09	.043	14,573.44	.037
Storehouse Obsolete Supplies	1,887.24	.004		
Mine Obsolete and Spare Parts	4,765.20	.010		
Supplemental Unemployment Benefits	21,032.88	.043		
Taxes - Unemployment Insurance	17,631.62	.036	6,268.11	.016
" - Old Age Benefit	26,760.65	.054	21,633.84	.055
Employees Insurance and Comp.	4,705.32	.009	12,591.84	.032
Power Credit			3,769.10	.010
Supply Inv. Adj.	657.74	.001	698.26	.002
Insurance - Auto			76.76	
<b>Total General Mine Expenses</b>	<b>\$ 336,593.81</b>	<b>\$.683</b>	<b>\$ 219,998.07</b>	<b>\$.558</b>
<b>Cost of Production</b>	<b>\$2,286,359.50</b>	<b>\$4.640</b>	<b>\$1,934,273.49</b>	<b>\$4.905</b>

MAAS MINE  
ANNUAL REPORT  
YEAR 1957

9. TAXES

	<u>1957</u>		<u>1956</u>	
	<u>Valuation</u>	<u>Taxes</u>	<u>Valuation</u>	<u>Taxes</u>
Maas Mine	\$1,820,000	\$ 76,440.00	\$2,135,000	\$ 88,602.50
Race Course	25,000	1,050.00	55,000	2,282.50
Pioneer-Arctic	885,000	37,170.00	240,000	9,960.00
Stockpile and Equipment	345,000	14,490.00	695,000	28,842.00
Miscellaneous Parcels	11,930	501.06	11,930	495.12
Total Maas Mine	<u>\$3,086,930</u>	<u>\$129,651.06</u>	<u>\$3,136,930</u>	<u>\$130,182.12</u>
Collection Fee		1,296.51		1,301.82
<b>Total</b>	<b>\$3,086,930</b>	<b>\$130,947.57</b>	<b>\$3,136,930</b>	<b>\$131,483.94</b>
 Tax Rate		42.00		41.50
Maas Mine Rented Houses	\$ 138,805	\$ 5,829.81	\$ 141,005	\$ 5,851.87
Mineral Lands	22,380	939.96	13,110	544.11
Total Houses and Lands	<u>\$ 161,185</u>	<u>\$ 6,769.77</u>	<u>\$ 154,115</u>	<u>\$ 6,395.98</u>
Collection Fee		67.69		63.95
<b>Total</b>	<b>\$ 161,185</b>	<b>\$ 6,837.46</b>	<b>\$ 154,115</b>	<b>\$ 6,459.93</b>

10. ACCIDENTS AND PERSONAL INJURY

There were a total of 20 lost time accidents in 1957 as compared with 18 in 1956.

	Fatal	None
Time Lost Over 4 Months	3	
Time Lost 1 to 4 Months	10	
Time Lost Less Than 1 Month	7	

<u>Date of Accident</u>	<u>Name</u>	<u>Injury</u>	<u>Days Lost</u>
1/8/57	John E. Campagnola	Fractured finger	T.C.-200
2/14/57	Jack E. Lintula	Laceration-forehead	7
3/9/57	John E. Blanck	Fracture-left knee	200 Est.
3/11/57	Lawrence Armatti	Broken hand and contusions right foot	250 Est.
3/18/57	Kenneth Giddings	Smashed right hand	36
3/19/57	John Fortini	Bruised right ankle	8
3/26/57	Gilbert S. Johnson	Fractured toe	39
4/15/57	John H. Stolnack	Lacerated thumb	28
4/15/57	Waino E. Hahka	Bruised right knee	9

MAAS MINE  
ANNUAL REPORT  
YEAR 1957

ACCIDENTS AND PERSONAL INJURY (Cont'd.)

<u>Date of Accident</u>	<u>Name</u>	<u>Injury</u>	<u>Days Lost</u>
5/8/57	Harold F. Longtine	Spinal concussion	13
5/18/57	Swan N. Maki	Fracture-left foot	54
6/7/57	Jack Aho	Bruised right foot	48
6/10/57	Arne E. Heino	Bruised right leg	34
8/23/57	Norman Powers, Jr.	Broken finger	30
9/20/57	Gunnard Anderson	Kink in back	10
10/7/57	Leslie Cady	Bruised head, arm, leg	14
10/8/57	Casper Ruokalainen	Rupture	55
12/3/57	Norman Powers, Jr.	Fracture right knee cap	100 Est.
12/13/57	Oscar F. Karhi	Fracture right leg	60 Est.
12/23/57	Clarence Sharp	Fracture left thumb	30 Est.
TOTAL INJURIES -- 20			1,225

The accident statistics compiled by the Safety Department show the following rate for the past five years.

<u>Year</u>	<u>Frequency</u>	<u>Severity</u>
1957	69.38	2.827
1956	67.60	1.739
1955	22.38	.934
1954	19.51	3.420
1953	31.83	.731

11. POWER

Electric power for the Maas Mine since consolidation, is purchased on the Bunker Hill Mine account and pro-rated back to the Maas cost sheet.

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

1. GENERAL:

Production at Mather "B" exceeded all previous yearly records. This was attained despite a production cut-back effective in November.

Production for the year was 1,296,499 tons. Of this tonnage, 168,019 tons were produced from the 6th Level; 308,084 tons from the 7th Level; 811,932 tons from the 8th Level and 8,464 tons from the 10th Level.

Analysis on production was very good throughout the year.

Average Mine Analysis on Output (Inc. Stockpile)

<u>Grade</u>	<u>Iron</u>	<u>Phos.</u>	<u>Silica</u>	<u>Sulphur</u>
Mather Standard	58.61	-	9.13	.048
Mather Special	57.14	-	8.06	.867

The shipping season commenced on April 1st and continued to November 8th. The early closing of shipping season was due to a softening in the iron ore market toward the close of the year. Shipments from the stockpile and pocket totalled 1,248,311 tons.

Average Analysis on Shipments (Total Average)

<u>Grade</u>	<u>Iron</u>	<u>Phos.</u>	<u>Silica</u>	<u>Sulphur</u>
Mather Standard	58.44	.094	9.56	.050
Mather Special	56.90	.094	8.62	.800

The cost of production increased \$0.24 above last year. The increase in cost was largely due to a wage and cost of living increase effective July 1st. The cost of living adjustment amounted to \$0.07 per hour and supplementary unemployment benefits amounted to \$0.043 per ton. Coupled with the wage increases was a proportional increase in cost of supplies.

Labor relations continued to be good, as only four grievances were initiated by the Union during the year. Three of the grievances were dropped by the Union and one was allowed by the Company.

One additional pump was installed in the Partridge Creek area to accelerate the dewatering of the overburden above the underground workings. The water table in this area has been lowered a total of 15' 6" since pumping began.

To aid in determining the vertical extent and the East limit of the underground cave above the mining blocks, a new hole was drilled from surface to a point directly over the cave area. This hole will be used for plotting the cave progress and for microseismic work. Three surface holes are now being used for microseismic purposes, which will aid in tracing the cave progress.

The 6th Level crusher system was placed in operation in 1957. As anticipated, crushing the ore from block 63-B to pocket size has brought about an appreciable reduction in mining cost. All of the remaining ore above 6th Level will pass through this crusher system.

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

1. GENERAL: (Cont'd.)

Work continued on the 10th Level crusher-conveyor system. Driving the main conveyor drift and discharge excavation was completed and installation of the drive equipment on the discharge end was started. During the year, the crusher trench was also concreted.

On the 9th Level, driving of the north and east conveyor drifts was completed. Installation of the north and east belts was also completed in December. Mining from the 9th Level will begin during the first quarter of 1958.

The emergency pumping system was completed early in the year. By means of this system, 2500 g.p.m. can be pumped from the 10th Level to the surface. Any additional water can be diverted to the Mather "A" Shaft via the 6th Level footwall drift.

There was no main level work done on the 5th Level during the year.

The 9th Level drifting consisted of advancing the cross-cuts to the footwall contact and starting a south extension of the main line west of the Cambria-Jackson Fault. The cross-cuts advanced were the 9000, 9100, 9200, 9300, 9400, 9500, 9600, 9700, and 9800. The total cross-cut footage was 1,733' and main line south extension was 350', for a total of 2,083'. All of the drifts required steel support.

The 10th Level main line was advanced 1,865'. At year end, this heading was 1,195' west of the "A" and "B" Shaft boundary. The 10900 "A" Shaft cross-cut was advanced 450' and the 10400 cross-cut was driven 945'. The "A" Shaft 10600 North cross-cut was advanced 231'. The total main line and cross-cut footage was 3,491' and was all driven with steel support.

During the year, yieldable steel sets were used almost exclusively in the block cave mining areas. From a standpoint of repair work, these sets proved to be more economical than straight leg sets, because the yieldable sets telescope from weight before deformation takes place. This also allowed the blocks to be drawn faster, as there was less hindrance from repair work.

Chain conveyors were introduced in the mining areas this year. By use of a chain conveyor in a transfer drift, it was possible to mine from the transfer at a faster and more economical rate than with a scraper and a slusher hoist. The chains have also been applied to secondary scraping in eliminating long, costly, cross hauls with scrapers.

A ventilation raise is currently being driven between the 8th and 9th Levels by using the cage raising method. The method is more economical, safer and faster than conventional raising. It is faster because the miners do not have to spend time putting in a stage, since the drilling is done from the top of the cage. It is safer because the miners are hoisted to the working face in a cage and are not exposed to falling chunks.

Efficiency was increased and costs were lowered in two areas of operations when industrial television units were installed. A unit was installed in the skip pit to aid in the removal of spillage and another unit was installed at the 6th Level crusher station. In each case, a man was eliminated.

Ore reserves were increased slightly as a result of the extensive drilling program of 1957.

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

2. PRODUCTION,  
SHIPMENTS &  
INVENTORIES:

a. Production by Grade and Months:

	<u>Standard</u>	<u>Special</u>	<u>Total Tons</u>	<u>Rock</u>
January	111,158	12,639	123,797	13,788
February	109,519	5,087	114,606	10,824
March	113,267	6,114	119,381	12,336
April	92,771	22,815	115,586	14,524
May	85,039	36,045	121,084	14,496
June	65,941	43,084	109,025	13,500
July	43,251	21,703	64,954	8,328
August	93,293	34,036	127,329	17,868
September	75,711	40,846	116,557	11,904
October	94,723	36,956	131,679	15,732
November	62,594	13,018	75,612	12,408
December	51,338	25,551	76,889	16,860
Total	998,605	297,894	1,296,499	162,568

b. Shipments:

	<u>Pocket Tons</u>	<u>Stockpile Tons</u>	<u>Total Tons</u>	<u>Total 1956</u>	<u>Increase or Decrease</u>
Mather Standard	422,048	611,519	1,033,567	1,012,271	21,296
Mather Special	-	214,744	214,744	208,713	6,031
Total	422,048	826,263	1,248,311	1,220,984	27,327

c. Ore Statement:

	<u>1957</u>	<u>1956</u>
On Hand January 1, 1957	212,414	145,354
Output for Year	1,296,499	1,288,044
Total	1,508,913	1,433,398
Shipments	1,248,311	1,220,984
Balance on Hand	260,602	212,414
Increase in Output	8,455	126,229
Increase in Ore on Hand	48,188	67,060



MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

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

Working Schedules:

- 1957 - Five 3-8 hr. shifts from January 1, 1957 to November 3, 1957. Four 3-8 hr. shifts from November 4, 1957 to December 31, 1957.
- 1956 - Five 2-8 hr. shifts from January 1, 1956 to September 9, 1956. Five 3-8 hr. shifts from September 10, 1956 to December 31, 1956.
- 1955 - Four 2-8 hr. shifts from January 1, 1955 to April 14, 1955. Five 2-8 hr. shifts from April 15, 1955 to December 31, 1955.
- 1954 - Five 3-8 hr. shifts from January 1, 1954 to March 31, 1954. Four 3-8 hr. shifts from April 1, 1954 to May 14, 1954. Four 2-8 hr. shifts from May 15, 1954 to December 31, 1954.
- 1953 - Five 3-8 hr. shifts from January 1, 1953 to December 31, 1953.

d. Division of Product by Levels and by Months:

	6th Level	7th Level	7th Level	8th Level	10th Level	Total Tons	
	<u>Special</u>	<u>Special</u>	<u>Standard</u>	<u>Standard</u>	<u>Standard</u>	<u>Standard</u>	<u>Special</u>
January	12,639	-	19,008	91,150	1,000	111,158	12,639
February	5,087	-	22,100	85,669	1,750	109,519	5,087
March	6,114	-	20,150	93,117	-	113,267	6,114
April	22,815	-	22,265	70,506	-	92,771	22,815
May	14,245	21,800	-	85,039	-	85,039	36,045
June	17,342	25,742	-	65,941	-	65,941	43,084
July	12,302	9,401	7,604	35,647	-	43,251	21,703
August	18,297	15,739	16,743	76,550	-	93,293	34,036
September	21,633	19,213	6,768	67,486	1,457	75,711	40,846
October	18,738	18,218	30,148	61,836	2,739	94,723	36,956
November	4,506	8,512	22,444	38,955	1,195	62,594	13,018
December	<u>14,301</u>	<u>11,250</u>	<u>10,979</u>	<u>40,036</u>	<u>323</u>	<u>51,338</u>	<u>25,551</u>
Total	168,019	129,875	178,209	811,932	8,464	998,605	297,894

e. Production Delays:

The underground and surface plant operated at top efficiency during the year, as no major production delays were experienced.

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

3. ANALYSIS:a. Average Mine Analysis on Output: (Incl. Stockpile)

<u>Grade</u>	<u>Iron</u>	<u>Phos.</u>	<u>Silica</u>	<u>Sulphur</u>
Mather Standard	58.61	-	9.13	.048
Mather Special	57.14	-	8.06	.867

b. Average Analysis of Shipments: (Total Average)

<u>Grade</u>	<u>Iron</u>	<u>Phos.</u>	<u>Silica</u>	<u>Sulphur</u>	<u>Moist.</u>	<u>Iron Nat'l.</u>
Mather Standard	58.44	.094	9.56	.050	9.35	52.98
Mather Special	56.90	.094	8.62	.800	9.25	51.64

c. Average Analysis of Ore in Stock:

<u>Grade</u>	<u>Tons</u>	<u>Iron</u>	<u>Phos.</u>	<u>Silica</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sulph.</u>	<u>Loss</u>	<u>Moist.</u>
Mather Standard	168,481	58.47	.094	8.98	.32	2.91	.50	.72	.066	2.04	10.10
Mather Special	92,121	57.18	.094	7.88	.36	2.13	1.80	.57	.898	3.08	9.85

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

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

a. Comparative Mining Costs:

	<u>1957</u>	<u>1956</u>
Product	1,296,499	1,288,044
Underground cost	3.045	2.929
Surface cost	.330	.307
General mine expense	.517	.439
Vacation pay expense	.138	.163
Social Security Taxes	.093	.067
Cost of Production	<u>4.123</u>	<u>3.903</u>
Loading and shipping expense	.057	.045
Ad valorem taxes	.317	.243
Depreciation - plant and equipment	.215	.186
Depreciation - movable equipment	.010	.008
Depreciation - office equipment	-	-
Amortization of development	.104	.104
Depletion - preproduction development	.013	.013
Administrative expense	.050	.050
Total Cost, Exclusive of Royalty, etc.	<u>4.889</u>	<u>4.552</u>
Royalty	.500	.500
Pensions	.107	.094
Miscellaneous expense less income	.034	.031
Total Cost	<u>5.530</u>	<u>5.177</u>
<u>Other Charges:</u>		
Amortization of defense facilities	.121	.197
Current year's development	.827	.817
Adjustment of prior years' charges	.012	
Idle expense account of strike	-	.097
<u>GRAND TOTAL COST</u>	<u>6.466</u>	<u>6.288</u>
Number of Shifts and Hours	49 1-8 hr.	18 1-8 hr.
	48 2-8 hr.	165 2-8 hr.
	187 3-8 hr.	60 3-8 hr.
Total 8 Hr. Operating Shifts	706	528
Number of Operating Days	235-1/3	225-1/2

\*Does Not Include \$0.121 Amortization of Defense Facilities

Proportion of Labor and Supplies

	<u>Amount</u>	<u>Per Ton</u>	<u>Per Cent</u>
Labor	\$3,490,447.52	\$2.692	55%
Supplies	2,848,333.50	2.197	45%
Total Cost at Mine	<u>\$6,338,781.02</u>	<u>\$4.889</u>	<u>100%</u>

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

183

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

	<u>1957</u>		<u>1956</u>	
	<u>Amount</u>	<u>Per Ton</u>	<u>Amount</u>	<u>Per Ton</u>
<b>b. Detailed Cost Comparison:</b>				
Development	\$ 908,543.63	\$ .701		
Mining	1,664,028.06	1.283		
Tramming	542,132.54	.418		
Power Adjustment	1,347.24	.001		
Ventilation	31,091.20	.024		
Pumping	25,559.24	.019		
Compressors and Air Lines	76,426.40	.059		
Crushing and Screening - Underground	56,866.26	.044		
Underground Superintendence	242,822.69	.188		
Maint: Pockets and Chutes	5,195.35	.004		
Mining Equipment	199,578.80	.154		
Levels and Cross-cuts	47,372.36	.036		
Shaft	7,543.50	.006		
Telephones and Safety Devices	71,301.15	.056		
Vacation Pay	155,667.46	.120		
Holiday Allowance	71,785.27	.055		
Wage Adjustment	2,260.37	.002		
Total Underground Cost	<u>\$4,102,306.30</u>	<u>\$3.164</u>	<u>\$3,946,280.63</u>	<u>\$3.064</u>
Hoisting	171,662.01	.132		
Crushing and Screening - Surface	45,423.10	.035		
Stocking	59,141.44	.046		
Timber Yard	43,255.22	.033		
Dry House	38,867.89	.030		
Policing	24,415.62	.019		
General Surface	19,371.50	.015		
Maint: Headframe Bldg. and Equipment	3,299.65	.003		
Other Mine Buildings	11,155.40	.008		
Telephones and Safety Devices	1,358.14	.001		
Vacation Pay	23,260.56	.018		
Holiday Allowance	10,159.72	.008		
Total Surface Cost	<u>\$ 451,370.25</u>	<u>\$ .348</u>	<u>\$ 429,428.72</u>	<u>\$ .333</u>
Geological Department	8,239.91	.007		
Mining Engineering Department	46,628.65	.036		
Mechanical Engineering Department	6,249.99	.005		
Safety Department	12,104.37	.010		
Research Laboratory	8,296.89	.007		
Analysis and Grading - Laboratory	65,702.19	.050		
Analysis and Grading - Shipping	8,227.17	.006		
Special Expense	18,036.22	.014		
Ishpeming Office	148,017.12	.115		
Mine Office - Superintendent and Clerks	80,425.62	.061		
Central Warehouse Overhead	24,578.88	.019		
Insurance	110,323.05	.085		
Personal Injury - Comp. and Doctors	49,943.28	.039		
Taxes - Unemployment Insurance	59,073.15	.046		
Taxes - Old Age Benefit	61,706.01	.048		
Electrical Engineering Department	4,512.96	.003		
Employees' Insurance and Compensation	11,596.57	.009		
Supplemental Unemployment Benefits	56,358.07	.043		
Design Department	569.49	----		
Research Department	10,902.92	.008		
Project Engineering Department	141.15	----		
Total General Mine Expense	<u>\$ 791,633.66</u>	<u>\$ .611</u>	<u>\$ 625,672.15</u>	<u>\$ .506</u>
<b>COST OF PRODUCTION</b>	<b>\$5,345,310.21</b>	<b>\$4.123</b>	<b>\$5,001,381.50</b>	<b>\$3.903</b>

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

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

Capital account expenditures for the year amounted to \$1,957,748.70.

Capital Expenditures for Year:

E&A NM-111	\$ 33,044.95
E&A NM-113	357.00
E&A NM-115	431,940.49
E&A NM-121	126,443.61
E&A NM-123	40,643.26
E&A NM-126	28,522.33
E&A NM-127	326,648.79
E&A NM-128	124,528.19
E&A NM-129	786,648.93
E&A NM-130	15,832.63
E&A NM-136	4,337.36
E&A NM-137	5,515.16
E&A NM-139	<u>34,000.00</u>
	\$1,957,748.70

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

5. ESTIMATE AND  
ANALYSIS OF  
ORE RESERVES:

The net ore reserves reported to the Tax Commission on December 31, 1957, were 12,961,580 tons. This is an increase of 299,488 tons from the previous year.

	<u>Mather Standard</u>	<u>Sulphurous</u>	<u>Total Tons</u>
Above 5th Level		1,686,721	1,686,721
Between 5th & 6th Levels		529,640	529,640
Between 6th & 7th Levels	1,799,364		1,799,364
Between 7th & 8th Levels	3,773,242		3,773,242
Between 8th & 9th Levels	2,717,502		2,717,502
Between 9th & 10th Levels	3,260,625		3,260,625
Below 10th Level	818,229		818,229
Sec. 1 Diamond Drill Hole Estimate	403,172		403,172
Total Gross as of July 31, 1957	<u>12,772,134</u>	<u>2,216,361</u>	<u>14,988,495</u>
Less 10% for Mining & Rock	<u>1,277,213</u>	<u>221,636</u>	<u>1,498,849</u>
Net Total as of July 31, 1957	<u>11,494,921</u>	<u>1,994,725</u>	<u>13,489,646</u>
Less Production July 31 - Dec. 31, 1957	<u>377,659</u>	<u>150,407</u>	<u>528,066</u>
Net Total as of Dec. 31, 1957	<u>11,117,262</u>	<u>1,844,318</u>	<u>12,961,580</u>

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

<u>Grade</u>	<u>Total Tons</u>	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sulph.</u>	<u>Loss</u>	<u>Moist.</u>
By Surface Diamond Drilling	362,855	54.40	.081	5.08	.10	2.62	.58	.60	.017	2.20	11.50
By Underground Development	<u>12,598,725</u>	51.50	.090	8.85	.45	2.62	2.50	.50	.300	2.00	10.50
	12,961,580										

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

6. LABOR AND WAGES:

a. Comments:

Skilled and unskilled manpower was available in sufficient number during the year.

There were four grievances initiated by the Union during 1957, three of which were later dropped by the Union, and one allowed by the Company. In addition to the above, there were three grievances carried over from 1956. One concerned contract earnings, one a disciplinary action, and one involved the transfer of an employee to other work because of a refusal to work on Sunday. All of these were dropped by the Union in the 4th Step.

b. Employment Record:

At the end of the year, 635 men were employed at the Mine. This represents a net decrease of 48 employees for the year.

Number of Men 1/1/57 .....	683	
Losses - Drafted .....	1	
Deceased .....	3	
Quit .....	21	
Retired .....	3	
Transferred to other properties .....	2	
Laid Off .....	155	
Discharged .....	<u>1</u>	
		<u>186</u>
		497
Gains - Transferred from other properties .....	128	
Service Returnees .....	<u>10</u>	
		<u>138</u>
Total on Payroll 12/31/57 .....	635	

c. Vacations and Holidays:

The Mine was shut down from the 1st to the 15th of July, which was the regular vacation period.

The men were paid for seven holidays--New Year's Day, Good Friday, Memorial Day, Independence Day, Labor Day, Thanksgiving, and Christmas. This was in accordance with the provisions of the labor contract.

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

6. LABOR AND WAGES: (Cont'd)

d. Comparative Statement of Wages and Product:  
(Operating Only - Not Including E&A Work)

	<u>1957</u>	<u>1956</u>	<u>Increase or Decrease</u>
<u>Average Wages Per Day:</u>			
Surface	\$ 21.83	\$ 21.25	\$ .58
Underground	<u>25.06</u>	<u>23.12</u>	<u>1.94</u>
Total	\$ 24.43	\$ 22.82	\$ 1.61
<u>Average Wages Contract Miner:</u>	\$ 27.22	\$ 24.28	\$ 2.94
<u>Wages Per Month of 19½ Days: (1956 Based on 21 Days)</u>			
Surface	\$425.69	\$446.25	\$20.56
Underground	<u>488.67</u>	<u>485.52</u>	<u>3.15</u>
Total	\$476.39	\$479.22	\$ 2.83
<u>Tons Per Man Per Day:</u>			
Surface	51.07	58.96	7.89
Underground	<u>12.27</u>	<u>11.31</u>	<u>.96</u>
Total	9.89	9.49	.40
<u>Labor Cost Per Ton:</u>			
Surface	\$ .427	\$ .360	\$ .067
Underground	<u>2.043</u>	<u>2.044</u>	<u>.001</u>
Total	\$ 2.470	\$ 2.404	\$ .066



MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

7. SURFACE:

Buildings:

All of the buildings remained in excellent condition. Very little maintenance work was necessary.

New Installations and New Equipment:

One additional pump was installed in the Partridge Creek area. There now is a total of four pumps dewatering the area above the underground workings. At the No. 7 Shaft site, a hole was drilled to intersect the shaft - thus allowing removal of the pump down in the shaft which was replaced with a deepwell pump in the new hole.

Engine House:

During the Labor Day weekend, the worn clutch ring and spider on the skip hoist was replaced with a new 4-arm spider and ring. The old clutch and spider had shown wear to the point where replacement became imperative.

Headframe and Stocking:

Painting of the stocking trestle supporting tubes was started this year--a total of three tubes were completed. The remaining tubes will be painted when the stockpile is loaded out.

The east skip was taken out for repairs on January 26th and again on July 27th. The west skip was changed on April 13th. No production was lost due to these changes, as they were made on week-ends.

Pumping:

Pumping of the North Jackson Mine underground workings continued throughout 1957. The average rate of pumping was 235 g.p.m., as compared to 400 g.p.m. in 1956. The purpose of the pumping is to dewater the old workings over mining areas.

Of the four pumps in the Partridge Creek area, three are running full time and one part time, pumping an average of 600 g.p.m. The water table has been lowered 15'6" since the installation of these pumps.

Subsidence:

A diamond drill hole was drilled from surface to a point directly above the expected cave area. This hole will be used for microseismic work and for direct measurement of the cave progress when the cave reaches the bottom of the hole. The hole was drilled from Mill Street in Negaunee at coordinates South 1238, West 7518 at a declination of 69° 30'. The bearing of the hole was N 69° W.

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

8. UNDERGROUND:

a. General:

Production for the year was 1,296,499 tons. This was an increase of 8,455 tons over 1956. Of this tonnage, 13% or 168,019 tons came from 6th Level; 24% or 308,084 tons from 7th Level; 62% or 811,932 tons from 8th Level and 1% or 8,464 tons from 10th Level. The tonnage from 10th Level was obtained from advancing the cross-cuts for exploration purposes.

In an attempt to lower repair costs and improve mining costs, yieldable arch mine supports were used throughout the year in mining areas. The principle of the yieldable arch is that when the ground gets heavy, the legs of the sets gradually telescope. As the sets gradually get smaller, the broken ground around the sets pack and tends to become self-supporting. A considerable amount of experimenting in the spacing of the sets was necessary before the yieldable arch support performed satisfactorily.

This year chain conveyors were used to replace scrapers in secondary scraping drifts and proved to be very successful. The best results were obtained with the conveyor in a 10' high narrow slusher drift which was driven in a mining area above the 7th Level conveyor belt. The ore above the drift was undercut and mining proceeded very rapidly. The ore from the mills ran directly on to the chain conveyor, which in turn discharged directly on to the 7th Level belt. The area was mined very rapidly as the chain conveyor handled the ore much faster than a scraper. The accelerated mining of this area cut labor and repair costs appreciably.

6th Level:

The sub-level stope system was used in mining the stopes on this level. During the year, 168,019 tons of hi-sulphur ore were mined from this level. Because of the extreme hardness and the lack of well defined fracture systems, the block caving system of mining is not adaptable to the high-sulphur orebody.

Mining in the 6th Level crusher-chain conveyor area was started during April and has progressed very satisfactorily. A study of the area indicates that the productivity of a slusher drift has increased greatly with the installation of the crusher and conveyor.

Area Above 6200 Cross-cut:

Block #61-A Pillar: A small pillar of ore between two mined-out stopes and above the 6100 cross-cut was mined from a timbered slusher drift. From the area, 6,000 tons were mined.

Area Between 6200 and 6300 Cross-cuts:

Block #62-B Pillar: During the early part of the year, 10,800 tons were mined from a timbered slusher drift in a pillar located between two mined out areas.

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

8. UNDERGROUND: (Cont'd.)

6th Level: (Cont'd.)

Block #63-B: Development of the 300,000 ton hi-sulphur block which was started two years ago was completed in February. At the end of the year, 108,600 tons were recovered. The ore from this area is conveyed with a chain conveyor to a crusher above the main line. Cost savings show this system to be the best mining combination yet tried in the hi-sulphur orebody.

Area Between 6300 and 6400 Cross-cuts:

Block #63-A: Mining in this area was completed early in the year after 7,200 tons were produced. This block was brought into production in 1956.

Block #64-B: Development work on the slusher drift elevation was started during the year in this 300,000 ton hi-sulphur block; however, work in this area was stopped when the demand for hi-sulphur ore softened. The block is located along the footwall and 50' above the level.

7th Level:

The majority of the mining on this level was done along the footwall and above the 1,225' mining conveyor. All of the 308,084 tons produced on this level was dropped to the 8th Level crusher-trench by means of an ore pass. After crushing, it was conveyed to the shaft by a conveyor belt. The block-cave system of mining was used in all the standard ore blocks on the 7th Level.

Area Between 7000 and 7100 Cross-cuts:

Block #71-C: Block caving was completed in July after 107,400 tons were mined during the year.

Block #71-C North: A single timbered slusher drift was driven at the -775 sub elevation and along the footwall below the 6th Level in this small 11,200-ton area.

Block #71-C Pillar: A high narrow slusher drift was driven and a chain conveyor installed during the latter part of the year. A total of 22,800 tons were recovered from the area.

Area Between 7100 and 7200 Cross-cuts:

Block #72-A Pillar: A small pillar between two mined-out areas was undercut and caved. A total of 42,600 tons were mined from the area.

Area Between 7200 and 7300 Cross-cuts:

Block #73-C: Block caving continued in this 285,000 ton standard ore body with 121,800 tons having been mined this year.

Area Between 7300 and 7400 Cross-cuts:

Block #74-C: Development work at the -875 sub elevation was started at the end of the year in this standard ore body located along the footwall and on the north side of Dike #22.

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

8. UNDERGROUND: (Cont'd.)

7th Level: (Cont'd.)

Area above the 7500 Cross-cut:

Block #75-B: Mining in this area was completed after 17,400 tons were recovered from a timbered slusher drift located in a small pillar 50' above the level.

8th Level:

All of the 8th Level standard ore is adaptable to the block caving system of mining. Production for the year totalled 811,932 tons from this level.

The 8th Level crusher-conveyor system completed in 1955 continued to operate very satisfactorily.

Area above 8000 Cross-cut:

Block #80-A: Development of three slusher drifts, which were driven from a chain conveyor cross-haul drift, were completed in August. To date, 12,600 tons have been mined.

Area Between 8400 and 8500 Cross-cuts:

Block #84-A North: 3,600 tons were recovered in this small orebody located 50' below the 7th Level.

Block #84-B: Block caving produced 13,200 tons of standard ore from this block located along the north side of the Negaunee Fault zone.

Block #84-C: This area, consisting of three slusher drifts, was developed and produced 64,800 tons during the year.

Block #85-B East: Three timber drifts were driven and undercut in this area located 150' above the 8th Level. Production totalled 16,200 tons.

Block #85-B North: Block caving continued in this 30,000 ton standard orebody. To date, 20,400 tons have been mined.

Block #85-E East: Three slusher drifts were developed and undercut this year. Mining was completed in June after 90,600 tons were recovered.

Block #85-E West: Mining from this area totalled 36,000 tons. This standard ore body is located 75' above the 8th Level.

Area Between 8500 and 8600 Cross-cuts:

Block #86-B: Production totalled 54,600 tons in this standard orebody that lies along the footwall and Dike #22.

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

8. UNDERGROUND: (Cont'd.)

8th Level: (Cont'd.)

Area Between 8600 and 8700 Cross-cuts:

Block #87-A: Block caving was completed in August after 140,400 tons were mined this year.

Block #87-B: This 195,000 ton block, located along the south side of Dike #22, was undercut during November. To date, 6,000 tons have been mined.

Block #87-D: Production totalled 12,000 tons from two timbered slusher drifts located at the south end of the 8700 Cross-cut.

Area Between 8700 and 8800 Cross-cuts:

Block #88-A: Mining was completed during October after 67,800 tons had been produced.

Block #88-C: Eight slusher drifts were developed in this 325,000 ton ore body that lies along the footwall and above the 8800 Cross-cut. To date, 131,400 tons have been recovered from this area.

Area Between 8800 and 8900 Cross-cuts:

Block #89-A: Development of four slusher drifts at top timber elevation was completed at the end of the year in this 185,000 ton standard orebody.

Block #89-B: Block caving at top timber elevation accounted for 70,200 tons of ore during the year from this block.

Block #89-D: A total of 43,200 tons of ore were mined from this block during the year.

9th Level:

Main level development work for the year consisted of extending eight cross-cut headings to the Negaunee Fault zone contact and advancing the footwall heading on the west side of the Cambria-Jackson Fault. A total of 2,083' of drift was driven during the year, all of which was supported with steel.

Development of the 9th Level mining conveyor was started in February and at the end of the year the north and east belts were ready for operation. Additional drifting excavation is required before the 1,280' west conveyor belt will be in operation. The east and west belts, which are driven parallel to the strike and in the footwall argillite, will convey the ore from the block cave areas to the short north belt. At the end of the north belt, the ore is discharged into a 200' ore pass raise to the centrally located 10th Level crusher storage trench. The 10th Level set-up is similar to the 8th Level, in that the ore is crushed and conveyed to the storage trench at shaft.

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

8. UNDERGROUND: (Cont'd.)

9th Level: (Cont'd.)

The driving of a 200' ventilation raise between the 9th Level and the 8000 cross-cut on the 8th Level with a raise cage has proven to be very successful. A 4" hole is drilled between the two levels. An electric hoist is installed at the top of this hole and a hoisting rope is dropped through the hole to the level below and connected to the cage. By this means, the miners are hoisted to the working face. The round is then drilled from the top of the cage. After drilling and charging the holes, the miners are lowered to the level and the round is blasted by means of an electric cable.

10th Level:

Main level development work consisted of advancing the 10400 cross-cut for diamond drill purposes and continuing the footwall heading towards the Mather Mine "A" Shaft's incline. A total of 3,491' of main level drift was driven during the year. The footwall heading is 1,195' west of the Mather "A" - "B" boundary line.

Construction of the 10th Level crusher-conveyor system, which continued throughout the year, will be completed during 1958. All of the 9th and 10th Level standard ore will be crushed and conveyed 1,900' to the 10th Level shaft trench by this system.

Development of the 10th Level east storage trench at the shaft was completed at the end of the year.

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

8. UNDERGROUND: (Cont'd.)

b. Diamond Drilling:

A total of 14,359' of diamond drilling was done in 1957, as compared to 10,777' in 1956 and 6,034' in 1955. The major portion of the drilling was carried out from the 9th Level, the remainder being distributed, in order of decreasing amounts, on 8th, 10th, 5th, and 6th Levels. The main objectives in the drilling program were:

1. Detailing 5th, 8th, and 9th Level ore.
2. Outlining 9th and 10th Level ore east of the Cambria Fault.
3. Drilling for 9th, 10th, 11th, and 12th Level ore west of the Cambria Fault.

5th Level:

Three holes were drilled to detail the 5th Level ore in the 8200-W area. The ore outline was found to be as expected and similar to that found east and west of the area.

6th Level:

Two holes were drilled to determine the western extremity of the 6th Level orebody. The ore was found to pinch out between the 8600-W and 8650-W sections.

7th Level:

One hole was drilled from 6th Level to outline the 7th Level ore on the 8550-W section. The outline was as expected; however, the ore grade was found to be mostly second class.

8th Level:

Most of the drilling was done to outline ore at the west end of the 8700, 8800, and 8900 cross-cuts. The ore outlines were much as expected. In drilling from the 8997 T.T., an upward extension of the 9th Level ore south of the Negaunee Fault was found. This ore reached up to the diorite sill above 8th Level and was about 150' thick horizontally. The lateral extent of this ore above 8th Level elevation is not known, but it is estimated at 150'.

9th Level:

The drilling on this level is divided into two phases: the first is the outlining of the ore from the shaft pillar to the Cambria Fault. It was found that this orebody ranges from 200 to 300 feet in thickness, is 200' high on each end, and dips down in the center portion to a height of only 40'.

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

8. UNDERGROUND: (Cont'd.)

b. Diamond Drilling: (Cont'd.)

The second phase of the 9th Level drilling was to outline the ore on the Negaunee Fault between the Cambria Fault and the N-S Dike. This drilling disclosed a small orebody at the junction of the Cambria and Negaunee Faults which consists of a rather low-grade ore. This orebody thins out as it progresses westward and then increases in thickness again as it approaches the N-S Dike. The grade of this ore becomes higher as it progresses westward.

10th Level:

The 10th Level drilling program consisted of three phases: the first phase was a small program to outline some of the 10th Level ore east of the Cambria Fault. It was found that an intrusive I-fm. complex was lying between the Fault-footwall and the orebody. This complex was 100' thick, about 500' wide, and extended from 8th to 10th Level on the 8800-W section.

The second phase was the drilling for a downward extension of the 9th Level ore to 10th Level and the location of the argillite footwall in the area west of the Cambria Fault. It was found that the footwall contact with the Negaunee Fault was just below 9th Level, 200' higher than the contact west of the Cambria Fault. A downward extension of the 9th Level ore about 100' thick is located on this footwall.

The third phase of the 10th Level drilling was for Mather Mine "A" Shaft ore below 10th Level, south of the Negaunee (E-W) Fault. Two of these holes entered intrusive material at about -2000', but no definite footwall or mineable ore was found.

Ore Reserves:

The net ore reserves reported to the Tax Commission on December 31, 1957, were 12,961,580 tons, an increase of 299,488 tons from the previous year. The reserves were increased because of ore found during the extensive diamond drill program of 1957.

Subsidence:

As in 1956, a considerable amount of time was spent on subsidence studies in an attempt to trace the progress of the cave at Mather Mine "B" Shaft. The cave, after advancing above the 4th Level, seems to have slowed down. A new diamond drill hole, #168, was drilled directly over the cave area to a depth of 1,186' without encountering any broken ground. Only a partial loss of circulation was encountered, which indicates that the cave proper is more than 1,200' from surface.

Geophones operated in all three surface holes (#153, #167, and #168) with a small amount of activity recorded in each. The seismic time interval shots between holes #153 and #167 indicate no fracturing above the 1000' depth.



MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

8. UNDERGROUND: (Cont'd.)b. Diamond Drilling: (Cont'd.)

The following table shows the drilling for the year.

<u>Holes Drilled From Cambria 8th Level.</u>	<u>From</u>	<u>Ore Drilled</u>	<u>Depth</u>
Hole Number: 238	75	60	157
239	0	120	148
240	0	0	126
241	0	0	130
242	0	32	49
243	0	0	87

Holes Drilled From 5th Level.

Hole Number: 383	0	50	100
385	0	102	117
386	0	63	70
388	0	92	140
427	0	158	194
430	0	156	193

Holes Drilled From 6th Level.

Hole Number: 426	0	51	141
429	0	0	115
431	0	83	170

Holes Drilled From 8th Level.

Hole Number: 372	0	94	134
373	0	55	130
374	0	45	101
382	0	130	170
398	0	88	135
401	0	158	215
407	0	105	130
408	0	37	127
412	0	40	145
413	0	20	80

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

8. UNDERGROUND: (Cont'd.)b. Diamond Drilling: (Cont'd.)

<u>Holes Drilled From 9th Level.</u>	<u>From</u>	<u>Ore Drilled</u>	<u>Depth</u>
Hole Number: 371	0	104	251
381	0	10	305
384	0	93	275
387	0	74	507
389	0	124	241
390	0	290	310
391	0	251	284
392	0	81	464
393	0	180	253
405	0	149	303
411	0	175	306
415	0	161	251
416	0	203	264
421	0	30	176
422	0	115	205
424	0	53	115
425	0	54	225
428	0	172	374
433	0	100	188
435	0	109	223
436	0	260	340
437	0	5	100
438	0	80	233
440	0	215	234
441	0	74	188
443	0	178	213
444	0	157	240
447	0	234	341
449	0	151	220
450	0	155	219
452	0	146	193
453	0	228	305

Holes Drilled From 10th Level.

Hole Number: 399	0	13	195
404	0	19	150
410	0	100	485
420	0	86	550
434	0	62	239
442	0	97	268
445	0	67	323
448	0	95	235
<u>451</u>	0	<u>139</u>	<u>340</u>
66		6,828'	14,360'

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

8. UNDERGROUND: (Cont'd.)

c. Timbering:

Statement of Ground Support Material Used Under Develop-  
ment and Mining Accounts

<u>Item</u>	<u>Amount</u>	<u>Cost Per Ton</u>
Cribbing	\$ 17,465.96	\$0.01347
Stull Timber	7,524.79	0.00580
Lagging	28,531.39	0.02200
Poles	10,862.95	0.00837
Steel	<u>235,595.14</u>	<u>0.18171</u>
Total 1957	\$299,980.23	\$0.23135
Total 1956	\$231,672.76	\$0.17984
Total 1955	\$142,941.88	\$0.11591
Total 1954	\$239,016.55	\$0.26281
Total 1953	\$211,907.78	\$0.19618

d. Explosives:

Explosives Used In Breaking 1,296,499 Tons Of Ore In  
Development and Mining Accounts

<u>Item</u>	<u>Amount</u>	<u>Cost Per Ton</u>
Gelamite (1 $\frac{1}{4}$ x 8)	\$ 37,940.78	\$0.02926
Gelatin 60%	55,591.40	0.04287
Gelatin 60% Extra	3,079.51	0.00237
Hercomite	<u>45,380.24</u>	<u>0.03500</u>
Total Powder	\$141,991.93	\$0.10950
Blasting Supplies	<u>101,916.28</u>	<u>0.07860</u>
Grand Total Powder & Blasting Supplies	\$243,908.21	\$0.18810
Pounds of Powder Per Ton of Ore		.52759
Tons of Ore Per Pound of Powder		1.89538
Cost Per Ton For Powder		\$0.10950
Cost Per Ton For Fuse, Caps, etc.		\$0.07860
Cost Per Ton For All Explosives		\$0.18810

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

8. UNDERGROUND: (Cont'd.)

e. Pumping:

The emergency pumping system was put into operation this year. With this system, a total of 2500 GPM can be pumped directly to surface. Any excess water can be diverted to the Mather Mine "A" Shaft via the 6th Level footwall drift.

All of the 9th and 10th Level water is pumped to the Negaunee storm sewer on the surface. The water from the 7th and 8th Levels is pumped to 6th Level and flows to the Mather "A" Shaft. The average flow of water on the 6th Level was 47 GPM; 7th Level 36.6 GPM; 8th Level 20 GPM; 9th Level 31.5 GPM, and 10th Level 42.5 GPM, for a total of 178 GPM. The quantity of water has decreased slightly from the 6th, 7th and 8th Levels. The flow has increased slightly on the 9th Level and remained about the same as last year from the 10th Level. Total gallonage remains practically the same as last year.

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

9. TAXES:

Mather Mine "B" Shaft, including stockpile, supplies and equipment as placed by State Tax Commission:

	1957			1956		
	<u>Valuation</u>	<u>Rate</u>	<u>Taxes</u>	<u>Valuation</u>	<u>Rate</u>	<u>Taxes</u>
Section 1, 47-27						
Real	\$7,540,000		\$316,680.00	\$6,975,000		\$289,462.50
Personal	2,155,000		90,510.00	1,330,000		55,195.00
Total	\$9,695,000	42.0000	\$407,190.00	\$8,305,000	41.5000	\$344,657.50
Collection Fee		.4200	4,071.90		.4150	3,446.57
Total Mather Mine "B" Shaft (Sec. 1 City of Negaunee)	\$9,695,000	42.4200	\$411,261.90	\$8,305,000	41.9150	\$348,104.07

	1957		
	<u>Taxes</u>	<u>Per Ton Produced</u>	<u>Per Ton Shipped</u>
Operating	\$411,261.90	\$0.317	\$0.329
Idle Expense	-	-	-
Total	\$411,261.90	\$0.317	\$0.329

	1956		
	<u>Taxes</u>	<u>Per Ton Produced</u>	<u>Per Ton Shipped</u>
Operating	\$313,244.07	\$0.243	\$0.256
Idle Expense	34,860.00	0.027	0.029
Total	\$348,104.07	\$0.270	\$0.285

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

10. ACCIDENTS AND PERSONAL INJURY:

There were twenty-nine compensable injuries during the year. The twenty-nine compensable injuries resulted in lost time of 6,863 days. One fatal accident occurred in 1957. There were also thirty-nine non-compensable injuries with a total of 119 days lost. The grand total days lost, including compensable and non-compensable injuries and one fatality, was 6,982 days. This resulted in a severity rate of 5.625 days lost per thousand man hours worked, and a frequency rate of 54.79 injuries per million man hours. The total hours worked were 1,241,170, as compared with 1,266,059 in 1956.

<u>Date</u>	<u>Name</u>	<u>Nature of Injury</u>	<u>Days Lost</u>
1- 2-57	Otis Horrocks	Sprained back.	8
1-31-57	Arven Takkanen	Fractured left foot.	134
2- 6-57	Samuel Sexton	Contusion right hand.	17
2-16-57	Ambrose Airaudi	Contusion right thumb.	67
3-26-57	Charles Delmont	Fractured right foot.	117
3-28-57	Eugene Anderson	Bruised left thigh.	31
4-10-57	Norman Hostetler	Bruised right hip and leg.	22
4-19-57	Peter Ombrello	Dirt in left eye.	7
4-29-57	Thomas Sharp	Fatality.	6,000
5-14-57	William Lehto	Bruised chin.	14
5-21-57	Joseph Gleason	Contusion chest.	8
5-22-57	Lawrence Linna	Bruised right leg.	8
6- 6-57	Vertin Dobbs	Bruised left thumb.	20
6-19-57	Leslie Kallionen	Contusion left hand.	12
6-20-57	William Koski	Bruised left ankle.	7
7-29-57	Peter Anderson	Fractured toe.	9
7-31-57	Andrew Maki	Fractured right forearm.	65
8- 3-57	Wilho Ruohomaki	Fractured left foot.	40
8-14-57	Rudolph Hakala	Fractured left thumb.	41
8-16-57	Samuel Svals	Contusion right hand.	8
8-17-57	Jerry Westman	Contusion right hand.	8
9-11-57	Mario Salvador	Strained back.	12
9-19-57	Emil Saari	Fractured right thumb.	51
10- 5-57	Peter Belpedio	Bruised right side.	25
10-14-57	Roland St. Andre	Puncture wound right foot.	9
10-22-57	Ralph Nadeau	Contusion right hand.	15
11-14-57	Waino Warra	Strained back.	30
11-14-57	Arne Laitala	Fractured left arm.	70
12- 3-57	Tauno Koski	Burned hands.	8
			6,863

MATHER MINE "B" SHAFT  
ANNUAL REPORT  
YEAR 1957

11. POWER:

	<u>CONSUMPTION</u> K.W. HOURS	<u>AVERAGE</u> <u>MAX. DEMAND</u>	<u>AVERAGE</u> <u>DEM. FACTOR</u>	<u>COST OF</u> <u>CURRENT</u>	<u>AVERAGE PRICE</u> <u>PER K.W. HOUR</u>
1957 -	19,263,481	4,219 K.W.	53.1%	\$214,657.24	\$0.01114
1956 -	17,699,459	3,532 K.W.	57.8%	\$157,953.08	\$0.00892
1955 -	15,193,755	3,300 K.W.	53.1%	\$140,408.83	\$0.00924
1954 -	12,486,451	3,020 K.W.	47.6%	\$116,430.27	\$0.00932
1953 -	13,519,000	2,780 K.W.	55.5%	\$217,415.82	\$0.01608

22  
✓ 203

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

General

The original design and construction of the Eagle Mills Pelletizing Plant was on a turn key basis. The plant upon completion was to produce an average tonnage of 2,000 long tons of pellets per day.

The many mechanical difficulties necessitating equipment and design changes plaguing the 1956 season continued through 1957. However, the last few months of 1957 indicated a definite up-swing in production as each revision and addition was completed.

The production rates and costs for 1957 were disappointing in the light of Cleveland-Cliffs past experience in getting designed production from such plants as the Ohio, Humboldt, and Republic Mines in a minimum length of time. However, the newness of the process and the many variables that effected the success of pelletizing represented quite a problem in attempting to obtain production tonnages that would approximate designed production figures.

The greater part of the first three months were spent in making flow sheet changes and adding new equipment.

The outlook for increased tonnages and reasonable cost figures appears promising for the year 1958.



PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

I. PRODUCTION, SHIPMENT, AND INVENTORIES

A. Operating Schedule

The plant was in operation at the beginning of the year, but shut down early in January for scheduled repairs and revisions. The plant resumed operation on March 4th after an eight week downtime. Operating was on a 3 shifts per day, 5 days per week basis until April 1st when a 3 shift 7 day per week basis was initiated with one or more scheduled repair shifts per week. The plant operated on this basis for the remainder of the year. The entire schedule is shown in Table No. 1 below.

TABLE NO. 1

<u>Month</u>	<u>Days Operated</u>	<u>Days/Week</u>	<u>Total Shifts</u>	<u>Total Hours</u>
January	3	5	9	72
February	-	-	-	-
March	20	5	60	480
April	30	7	86	688
May	31	7	88	704
June	30	7	79	632
July	30	7	73	584
August	31	7	80	640
September	20-2/3	7	62	496
October	28-2/3	7	85	680
November	21-2/3	7	65	520
December	28	7	84	672
Totals			771	6168

B. Production and Production Rates

The production and production rates for 1957 were as shown in Table No. 2 below.

TABLE NO. 2

<u>Month</u>	<u>Concentrate Regrinding Section</u>			<u>Pellet Firing Section</u>		
	<u>Tonnage</u>	<u>LTPH</u>		<u>Tonnage</u>	<u>LTPH</u>	
		<u>Gross</u>	<u>Net</u>		<u>Gross</u>	<u>Net</u>
January	3,875	73.8	73.8	2,620	36.4	44.2
February	-	-	-	-	-	-
March	17,135	48.2	49.0	9,803	20.4	28.3
April	34,142	52.0	52.8	23,316	33.9	45.2
May	35,368	62.9	63.6	22,786	32.4	44.4
June	35,815	66.77	66.77	24,105	38.14	52.44
July	30,386	68.07	70.07	17,796	30.47	45.09
August	36,946	69.52	70.79	27,753	43.36	53.42
September	31,067	69.05	69.34	21,738	43.83	53.25
October	44,126	79.82	79.95	33,511	49.28	62.32
November	38,389	83.48	84.45	25,576	49.19	62.01
December	50,439	82.69	84.08	34,130	50.79	59.87
Totals	365,243			248,485		

A more detailed description of production rates of the various sections may be found in Tables Nos. 19 to 21.

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

C. Production Costs

The cost of producing the 248,485 long tons of pellets averaged 7.34 dollars per ton. A brief description of the operating costs is shown below:

TABLE NO. 3

Raw Materials - Unloading and Storage	0.175
Material Preparation	3.211
Pellet Firing	1.902
Product Screening & Loading	.779
Water Supply	.040
Control & Analysis	.214
Other Direct Plant Expense	.693
Allocated Expense	.326
 Total	 7.340

A detailed monthly cost analysis may be found in Table No. 15.

D. Tonnage and Analysis of Pellets Produced and Shipped

During the shipping season, 226,245 long tons of pellets were shipped to partners. The chemical analysis of the pellets produced and shipped is presented below

TABLE NO. 4

Pellets Produced:

	<u>Fe.</u>	<u>Phos.</u>	<u>Silica</u>	<u>Sulph.</u>	<u>Moisture</u>
January	63.89	.041	7.21	.005	
February					
March	64.87	.038	7.47	.012	
April	64.06	.035	8.47	.006	
May	66.94	.032	8.77	.005	
June	63.81	.030	8.65	.005	
July	63.68	.034	8.84	.006	
August	63.79	.034	8.77	.006	
September	64.01	.038	9.06	.007	
October	63.28	.032	9.18	.005	
November	63.86	.037	8.43	.005	
December	63.84	.035	9.17	.007	
 Yearly Average	 63.84	 .034	 8.76	 .006	

TABLE NO. 5

Pellets Shipped:

Pocket	63.81	.034	8.86	.006
Stockpile	63.64	.036	8.48	.006

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

E. Estimated Production and Analysis

The estimated tonnage and chemical analysis of pellets for 1958 is as follows:

TABLE NO. 6

Estimated Tonnage	500,000 Long Tons				
Estimated Analysis	<u>Fe.</u>	<u>Phos.</u>	<u>Silica</u>	<u>Sulph.</u>	<u>Moisture</u>
Dry	62.65	.028	9.11	.013	
Natural	61.71	.028	8.97	.013	1.50

The pellet analysis is based on Republic's 1957 analysis.

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

II. LABOR AND WAGES

A. Report of Men Hired, Transferred, and Separated

TABLE NO. 7

	<u>First of</u> <u>Month</u>	<u>Hires</u>	<u>Trans. From</u> <u>Other Mines</u>	<u>Separations</u>	<u>End of</u> <u>Month</u>
January	66		1	7	60
February	60		1	2	59
March	59	13	1	1	72
April	72	8		2	78
May	78	10		5	83
June	83	1	1	3	82
July	82			1	81
August	81			3	78
September	78		2	2	78
October	78		3	1	80
November	80		9		89
December	89		11	1	99

B. Annual Statement of Labor

TABLE NO. 8

	<u>Stat.</u> <u>Men</u>	<u>Hours</u>	<u>Amount</u>	<u>Average</u> <u>Rate</u>
<u>Hourly Employees</u>				
Straight Time - Classified	81½	169,937¾	397,025.41	2.336
Overtime - Classified		(23,760)	28,643.14	1.206
Shift Differential - Aftn.		(42,876¼)	2,696.72	.063
- Night		(29,126½)	2,809.25	.096
Holiday Allowance		( 2,462)	5,818.74	2.363
Holiday Worked - Prem. Time Only		( 1,755)	4,290.48	2.445
Sunday Premium Pay		(15,524)	5,928.69	.382
Sub Total	81½	169,937¾	447,212.43	2.632
Vacation Pay			9,129.34	
Total Hourly Employees	81½	169,927¾	456,341.77	2.685
<u>Salaried Employees</u>				
Mine Payroll - Straight Time	3	6,555	22,473.00	3.428
Total Mine Payroll	84½	176,492¾	478,814.77	2.713
<u>General Payroll</u>				
Salaries - Straight Time	4¼	9,003½	23,970.69	2.662
- Overtime		( 839½)	1,009.49	1.202
Labor From Other Mines	22½	46,998¾	148,909.02	3.168
Total Labor	111¼	232,495	652,703.97	2.807
<u>Distributed as Follows:</u>				
Operating Plant	91½	190,806¼	533,443.89	2.800
Uncompleted Construction	19½	41,111¾	117,534.23	2.859
Other Mines	-	20	57.40	2.870
Other Accounts	¼	557	1,668.45	2.995
Total A s Above	111¼	232,495	652,703.97	2.807

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

C. Labor Breakdown

At the end of 1957 the crew was 96 hourly rate and 3 salaried.

TABLE NO. 9

	<u>Number of Men</u>
Pelletizing Plant	
Plant Foremen	2
Maintenance Foremen	1
Shift Leaders	4
Raw Materials Unloading and Storage	
Car Dumpmen	2
Car Dumpmen Helpers	3
Material Preparation	
Pulverizer Operators	3
Ball Mill Operators	4
Disc Operators	8
Feedermen	4
Ball Mill - Pulverizer Helpers	4
Pellet Firing	
Hardening Furnace Operators	4
Hardening Furnace Assistants	4
Product Screening and Loading	
Pocketmen	4
Plant Laboratory and Sampling	
Plant Analyst	1
Plant Sampler	1
Truck & Tractor	
Service Truck	1
Tractor	1
Janitors	2
Plant Laborers	12
Plant Maintenance	
Electrician Leader	1
Electricians	6
Assistant Mill Foreman	1
Mechanical Leaders	1
Plant Repairmen	6
Welder Standards	5
Welder Starters	4
Sheet Metal Worker	1
Sheet Metal Worker Helpers	3
Plant Repairman Helpers	5
Grease man	1
Total	99

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

III. PLANT OPERATION

A. Introduction

During January the Pelletizing Plant was operated for only a few days and during February operation was suspended completely. Pellet production reached a high of 33,511 LT in October. The production rate increased to 62.3 LTPH in October and November. Operating time increased to a high of 84.8% in December. Total pellet production for the year was 248,485 long tons.

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

B. Concentrate Balance with Pellet Production

TABLE NO. 10

Republic Concentrates Shipped	315,919 LT
Eagle Mills Pellets Produced	<u>248,485</u>
Material Unaccounted For	67,434 LT
<u>Unaccounted for Material</u>	
Moisture Differences	
159,522 tons Coarse Concentrate @ 6% Water	9,571
156,397 tons Reground Concentrate @ 8% Water	12,512
Concentrate Intransit	10,570
Concentrate in Storage at Eagle Mills	475
Intransit Losses - Republic to Eagle Mills	6,318
Roto-Clone Dust Losses - to Atmosphere	2,485
Oxygen Loss - Reduction of Hematite to Magnetite	4,970
Other Losses (including loss in thickener overflow, spillage, etc)	<u>20,533</u>
Total	67,434 LT
<u>Actual Lost Material</u>	
Intransit Losses - Republic to Eagle Mills	6,318 LT
Roto-Clone Dust Losses - To Atmosphere	2,485
Other Losses (including loss in thickener overflow, spillage, etc)	<u>20,533</u>
Total	29,336 LT
<u>Possible Recoverable Material</u>	
Other Losses (including loss in thickener overflow, spillage, etc)	20,533 LT

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

C. Monthly Hourly Operating Rates

The operating rates of major pieces of equipment is presented below. This data is on a net time basis.

TABLE NO. 11

	Ball Mills & Filters <u>LTPH</u>	Pulverizer Process <u>Coal</u>	Average No. Discs <u>Operating</u>	Grate Machine <u>LTPH</u>
January	73.8	-	3.04	44.2
February	-	-	-	-
March	49.0	-	2.88	28.3
April	52.8	7.20	3.77	45.2
May	63.6	6.30	3.67	44.4
June	66.8	5.46	3.79	52.4
July	70.1	13.12	3.81	45.1
August	70.8	7.81	3.88	53.4
September	69.3	4.92	3.97	53.3
October	80.0	6.72	3.95	62.3
November	84.5	7.34	3.98	62.3
December	84.1	8.60	3.94	59.9

A complete description of the operating rates of these pieces of equipment may be found in tables 19 through 21.

D. Major Delay Time

The operating time varied from a low of 67% to a high of 85%. A specific piece of equipment was not charged with delay time unless the production of the plant was halted because of the piece of equipment. Some of the major delays are listed below.

TABLE NO. 12

Piece of Equipment  
No. 1 fan bearing  
Sump pump sanded  
No. 26 conveyor belt  
Simplicity screen  
No. 2 fan repairs  
Simplicity vibrating conveyor  
Grate discharge grizzly repairs  
Grate discharge grizzly plugged  
Derrick screen repairs  
No. 24 conveyor belt  
Clinker breaker repairs  
Grate machine feeder repairs  
No. 23 conveyor



PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

E. Fuel and Raw Materials Consumption

The raw materials consumption during 1957 is presented below. These are divided into total consumption and consumption per ton of pellets produced.

TABLE NO. 13

<u>Raw Material</u>	<u>Amount Used</u>	<u>Amount/Ton of Pellets</u>
Concentrate	306,204 LT	1.23 LT
Bentonite	1,587 LT	14.31 lbs.
Limestone	87 LT	-
Process Coal	21,995 LT	198.28 lbs.
Ignition Coal	6,323 LT	57.0 lbs.
Propane	815,439 Gal.	3.28 Gal.

A monthly distribution of the heat required for pelletizing is presented below.

TABLE NO. 14

	<u>Consumption - Million BTU/LT</u>			<u>Total</u>
	<u>Propane</u>	<u>Ignition Coal</u>	<u>Process Coal</u>	
January	Data Not Available	On Monthly Basis		
February	-	-	-	-
March	Data Not Available	On Monthly Basis		
April	.259	.562	2.20	3.021
May	.257	.802	2.36	3.419
June	.225	.553	1.78	2.558
July	.171	1.14	3.69	5.001
August	.163	.811	2.453	3.427
September	.292	.951	2.705	3.948
October	.212	.659	2.580	3.451
November	.147	.925	1.829	2.901
December	.197	.913	3.134	4.244

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

IV. REPAIRS AND CHANGES

A. Pellet Firing

An improved clinker breaker of a mechanical type was installed to break clinkers at the discharge end of the grate machine.

Windbox controls were installed at each feed point to assist the operator in controlling air to the windboxes in the burning zone.

An auxiliary fan was installed at the discharge end of the grate machine to remove dust from that portion of the plant building.

Provisions were made so that pulverized coal could be added to the reroll ring on each of the 4 flying saucers.

No. 23 conveyor belt was replaced with a Carrier type vibrating conveyor. This unit conveys hearth layer material over to No. 24 conveyor.

A new water cooled drive assembly was installed onto the Simplicity double deck screen at the discharge end of the grate machine.

The air drives on the four oscillating grate feeders were replaced with variable speed mechanical drives.

The grate machine seal bars were replaced with Firmex steel. A revised type of grate machine seal shields were installed to minimize spill along the grate machine. The grate was hooded over near the discharge end along the area originally designed for downdraft cooling.

The 4 type N-40 Rotoclones were fully relined with stainless steel liners. New hoods for the 4 wet type dust collectors were fabricated out of stainless steel by the Walker-Jamar Company of Duluth, Minnesota.

A steady head tank was erected to make uniform water pressures available to the ball mills for optimum grinding conditions.

As a result of being unable to stabilize the Simplicity shaker conveyor onto the 6 inch concrete floor slab it was necessary to pour a new steel reinforced concrete base.

B. Material Preparation

Properly sized pumps, 8" Wilfley, were installed at the ball mill discharge to pump directly to the filters.

A used 40-S Dorr thickener was erected just east of the plant building to recover the fines from the inside thickener overflow water and the plant discharge water.

Two settling basins were built to reclaim fines plus a reuse water pumping installation.

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

IV. REPAIRS AND CHANGES (CONT'D)

B. Material Preparation (Cont'd)

A new Allis-Chalmers 10½ x 14 foot ball mill was added to the wet section. To insure proper lubrication an automatic spray lubrication was installed to lubricate the pinions on the Hardinge ball mill, the Allis-Chalmers 10½ x 14 foot ball mill, and the Allis-Chalmers 6 x 10 foot ball mill.

C. General

A new type hot material belt was tried on the conveyors carrying hot product to the pocket and hot pellets to the hearth layer bin. The life of these Wissco belts were quite short resulting in excessive conveying costs.

A ditch approximately 12 feet deep and 450 feet long was dug to facilitate the flow of excess water from the building sanitary drain field.

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

V. General Surface

A. New Equipment Received

A new Bucyrus Erie Model 54-B electric shovel was erected and placed in operation in May.

Delivery was taken on a new International Harvester Model TD-18 tractor in January.

B. Water Supply

Settling basins to facilitate the recovery of thickener overflow and ditch losses were built to the east of the plant building proper. Necessary pumping equipment was installed for introducing the used water back into the plant.

C. Roads

A road was constructed between the Eagle Mills Pelletizing Plant and the Ore Improvement Plant.

D. Buildings

A thaw shed equipped with 2 Olson Heaters and designed to hold 20 railroad cars of concentrate was completed and placed into operation late in the spring.

E. Outside Lighting

Poles were erected and lights installed to give proper lighting over the parking area.

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

VI. COST OF PRODUCTION

TABLE NO. 15

Processing Cost	Monthly Operating Costs												Total Year
	January	February	March	April	May	June	July	August	September	October	November	December	
<b>Raw Mat'l Unload &amp; Storage</b>													
Operating Labor			.138	.070	.076	.058	.075	.055	.073	.051	.074	.089	.071
Power	.251					.008	.041	.012	.018	.014	.013	.013	.012
Operating Supplies	.728		.098	.019	.073	.063	.019	.009	.015	.017	.061	.116	.055
Maintenance Labor			.006	.022	.016	.014	.011	.015	.022	.023	.045	.038	.023
Maintenance Supplies			.002	.006	.008	.007	.005	.006	.033	.010	.008	.039	.013
<b>Total Month</b>	<b>.986</b>		<b>.244</b>	<b>.117</b>	<b>.173</b>	<b>.150</b>	<b>.151</b>	<b>.097</b>	<b>.161</b>	<b>.115</b>	<b>.201</b>	<b>.295</b>	<b>.175</b>
<b>Material Preparation</b>													
Operating Labor	.532		1.093	.522	.540	.529	.732	.486	.612	.443	.475	.410	.524
Power	.148		.194	.217	.277	.189	1.001	.263	.412	.304	.293	.286	.321
Operating Supplies	2.235		2.101	1.640	1.662	1.413	2.414	1.316	1.944	1.393	1.685	2.530	1.748
Maintenance Labor	.147		.194	.380	.318	.280	.433	.194	.320	.215	.342	.239	.279
Maintenance Supplies	.197		.130	.179	.307	.345	.374	.402	.420	.360	.234	.525	.340
<b>Total Month</b>	<b>3.259</b>		<b>3.712</b>	<b>2.938</b>	<b>3.104</b>	<b>2.756</b>	<b>4.954</b>	<b>2.661</b>	<b>3.708</b>	<b>2.715</b>	<b>3.029</b>	<b>3.990</b>	<b>3.211</b>
<b>Pellet Firing</b>													
Operating Labor	.337		.410	.187	.222	.186	.268	.180	.228	.164	.178	.152	.196
Power	.163		.240	.214	.272	.184	1.006	.256	.401	.296	.287	.278	.317
Operating Supplies	.622		.621	.311	.837	.440	.768	.726	.653	.707	.788	1.588	.768
Maintenance Labor	.115		.471	.128	.199	.274	.345	.370	.444	.240	.356	.212	.280
Maintenance Supplies	.146		.374	.066	.158	.297	.186	.612	.678	.160	.493	.450	.342
<b>Total Month</b>	<b>1.383</b>		<b>2.116</b>	<b>.906</b>	<b>1.688</b>	<b>1.381</b>	<b>2.573</b>	<b>2.144</b>	<b>2.404</b>	<b>1.567</b>	<b>2.102</b>	<b>2.680</b>	<b>1.902</b>
<b>Product Screening &amp; Loading</b>													
Operating Labor	1.074		.213	.079	.074	.059	.085	.055	.093	.079	.092	.085	.099
Power	.005		.007	.018	.009	.006	.031	.009	.013	.010	.010	.009	.011
Operating Supplies	.778		.283	.392	.194	.270	.165	.081	.127	.028	.027	.717	.244
Maintenance Labor	.048		.116	.077	.148	.173	.322	.115	.211	.154	.466	.181	.191
Maintenance Supplies	.104		.031	.100	.115	.138	.462	.226	.138	.146	.460	.434	.233
<b>Total Month</b>	<b>2.009</b>		<b>.650</b>	<b>.666</b>	<b>.540</b>	<b>.646</b>	<b>1.065</b>	<b>.486</b>	<b>.582</b>	<b>.417</b>	<b>1.055</b>	<b>1.426</b>	<b>.779</b>
<b>Water Supply</b>													
Operating Labor			.001										
Power	.005		.006	.007	.008	.006	.029	.007	.012	.010	.008	.009	.009
Operating Supplies	.004			.001	.001		.001		.004	.001	.011	.001	.002
Maintenance Labor	.006		.015	.009	.023	.013	.016	.007	.030	.019	.040	.023	.019
Maintenance Supplies	.002		.005		.028	.003	.008	.019	.017	.003	.004	.006	.010
<b>Total Month</b>	<b>.017</b>		<b>.027</b>	<b>.017</b>	<b>.060</b>	<b>.022</b>	<b>.054</b>	<b>.033</b>	<b>.063</b>	<b>.033</b>	<b>.063</b>	<b>.039</b>	<b>.040</b>

CHECK OUT WITH

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

TABLE NO. 15 (Contd)

Processing Cost	Monthly Operating Costs												Total Year
	January	February	March	April	May	June	July	August	September	October	November	December	
Control and Analysis													
Operating Labor	.750		.381	.153	.155	.147	.208	.131	.140	.089	.116	.097	.155
Power			.001		.001		.003		.001	.001		.001	.001
Operating Supplies	.221		.096	.037	.045	.065	.048	.052	.046	.062	.041	.043	.055
Maintenance Labor			.003	.006	.005				.004				.001
Maintenance Supplies			.001	.002				.002	.021				.002
Total Month	.971		.482	.198	.206	.212	.259	.185	.212	.152	.157	.141	.214
Other Direct Plant Expense													
Operating Labor	2.012		.623	.304	.342	.296	.436	.230	.361	.209	.323	.246	.335
Power	1.415		.008	.008	.009	.008	.034	.010	.015	.010	.010	.169	.047
Operating Supplies	.956		.787	.191	.193	.186	.189	.169	.166	.113	.191	.289	.236
Maintenance Labor	.020		.015	.053	.047	.020	.034	.032	.050	.063	.058	.055	.044
Maintenance Supplies	.066		.034	.017	.029	.031	.019	.029	.026	.025	.053	.054	.031
Total Month	4.469		1.467	.573	.620	.525	.712	.470	.618	.420	.635	.813	.693
Allocated Expense													
Operating Labor	1.565		.119	.055	.088	.057	.112	.075	.095	.060	.086	.193	.119
Operating Supplies	.746		.160	.094	.181	.098	.285	.104	.144	.082	.120	.610	.207
Total Month	2.311		.279	.149	.269	.155	.397	.179	.239	.142	.206	.803	.326
Total Processing Cost													
Operating Labor	6.521		2.978	1.370	1.497	1.332	1.916	1.212	1.602	1.095	1.344	1.272	1.499
Power	1.743		.456	.464	.576	.385	2.145	.557	.872	.645	.621	.765	.718
Operating Supplies	6.290		4.146	2.685	3.186	2.535	3.889	2.457	3.099	2.403	2.924	5.894	3.315
Maintenance Labor	.336		.820	.675	.756	.774	1.161	.733	1.081	.714	1.307	.748	.837
Maintenance Supplies	.515		.577	.370	.645	.821	1.054	1.296	1.333	.704	1.252	1.508	.971
Total Month	15.405		8.977	5.564	6.660	5,847	10.165	6.255	7.987	5.561	7.448	10.187	7.340

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

VII. STATEMENT OF TAXES

TABLE NO. 16

<u>Negaunee Township</u>	<u>Valuation</u>	<u>Taxes</u>
S $\frac{1}{2}$ of NW $\frac{1}{4}$ & NE $\frac{1}{4}$ of SW $\frac{1}{4}$ Sec. 36, 48-26 Eagle Mills Pelletizing Plant	1,090,000.00	27,522.50
Tax Rates		25.25

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

VIII. ACCIDENTS AND PERSONAL INJURY

Following is the statistics completed by the Safety Department for the Pelletizing Plant during 1957.

TABLE NO. 17

1. Number of Man Hours Worked	176,493
2. Position Rating - Miscellaneous Group	5
3. Accidents	
Compensable Injuries (16 Compensable Days)	1
Non Compensable Injuries (14 Days)	<u>5</u>
Total (30 Days)	6
Average Days Lost Per Injury	5
4. Frequency (Number of accidents per million man hours worked)	34.00
5. Severity (Number of days lost per million man hours worked)	170



PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

IX. PROPOSED NEW EQUIPMENT AND CONSTRUCTION

A. Equipment

1. Type N-40 Rotoclone.
2. Service truck with snow plow attachment.
3. 22 ton pocket - stocking truck.
4. Hydro-crane equipped with magnet.
5. Disc type filter.
6. Compressor.
7. Rubber tired dozer for stockpile.
8. Shaker conveyors.
9. Screw conveyors.
10. Two 6 inch pumps.
11. Pan type conveyors to replace #26 and #24.
12. Added transformer capacity.
13. Dust collection equipment to recover coal dust losses.

B. Construction

1. Additional thaw shed space.
2. Gallery to cover #26 conveyor.
3. Gallery for man walkway from plant to outside thickener.
4. Cold storage warehouse space.
5. Increased sump capacity at discharge end of grate machine.
6. Heated oil storage space independent of plant building proper.
7. Grinding ball storage and handling facilities inside plant building.
8. Install conveyor to carry ignition coal across the top of the building to eliminate truck haulage.

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

X. MONTHLY OPERATING TABLES

TABLE NO. 18 - Raw Materials Consumption - Monthly Operating Data

<u>Month</u>	<u>Concentrates</u>	<u>Process Coal</u>	<u>Tonnages</u>			<u>Gallons Propane</u>	<u>Net Tons Grinding Balls</u>
			<u>Ignition Coal</u>	<u>Limestone</u>	<u>Bentonite</u>		
January	3,875	162	23	75	16	46,900	2.00
February							
March	14,081	1,104	97	22	101	85,846	21.00
April	28,985	2,091	449	0	167	66,138	34.25
May	29,585	2,111	601	0	107	62,376	48.50
June	27,150	1,470	438	0	77	57,687	50.20
July	24,585	2,237	663	0	147	42,828	34.00
August	31,451	2,399	763	0	170	77,065	35.50
September	29,151	2,075	701	0	110	70,331	76.50
October	44,126	3,053	743	0	264	79,206	78.00
November	27,870	1,652	801	0	158	97,681	61.50
December	45,345	3,777	1,056	0	283	129,381	143.00
Totals	306,204	21,995	6,323	87	1,587	815,439	584.45

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

TABLE NO. 19

Material Preparation  
Regrind Section - Monthly Operating Data

	<u>Ball Mills and Filters</u>				<u>Regrinding Rate LTPH</u>	
	<u>Tonnage Processed</u>	<u>Hours Operating</u>	<u>Delays</u>	<u>Percent Operation</u>	<u>Gross Time Basis</u>	<u>Net Time Basis</u>
January	3,875	52.5	0	100.0	73.8	73.8 ✓
February	-	-	-	-	-	-
March	17,135	350.1	6.1	98.3	48.2	49.0
April	34,142	646.7	10.5	98.4	52.0	52.8
May	35,368	556.4	5.8	99.0	62.9	63.6
June	35,815	536.4	0	100.0	66.8	66.8
July	30,386	443.6	2.8	99.4	68.1	70.1
August	36,946	521.9	9.5	98.2	69.5	70.8
September	31,067	448.1	1.9	99.6	69.1	69.3
October	44,126	555.5	3.7	99.3	79.6	80.0
November	38,389	454.7	5.2	98.9	83.5	84.5
December	50,439	599.9	10.1	98.4	82.7	84.1
Total & Avgs.	365,243				70.0	70.7

	<u>Power Consumption</u>				<u>Steel Consumption</u> Lbs./LT	<u>Structure - % -325 m</u>			
	<u>KWH/LT</u>		<u>KWH/LT % -325 m</u>			<u>Mill Feed</u>		<u>Mill Discharge</u>	
	<u>#1 Ball Mill</u>	<u>#2 Ball Mill</u>	<u>#1 Ball Mill</u>	<u>#2 Ball Mill</u>		<u>Concentrate</u>	<u>Returns</u>	<u>#1 Ball Mill</u>	<u>#2 Ball Mill</u>
January	Data Not Available on Monthly Basis								
February	-								
March	Data Not Available on Monthly Basis								
April	6.78		73.30		1.55	57.61	57.12	66.86	
May	9.36		66.90		1.94	58.90	60.29	72.88	
June	6.55		50.00		2.16	55.64	60.30	68.76	
July	6.42		54.74		1.84	55.56	54.65	67.29	
August	6.25		42.73		1.92	53.16	53.85	67.79	
September	12.17	15.63	64.65	63.58	3.82	54.12	56.15	73.42	78.70
October	13.00	14.24	80.28	70.11	3.76	58.39	58.50	74.58	78.70
November	20.6	20.0	89.90	68.20	3.86	45.51	43.50	68.41	74.41
December	16.2	12.0	93.50	53.40	4.47	52.02	47.25	69.30	74.51

	<u>Pulverizer</u>		<u>Structure % -200 m</u> <u>Discharge</u>	<u>Power Consumption</u> <u>KWH/LT</u>	<u>Heat Consumption</u> <u>BTU/LT</u>
	<u>Tonnage Processed</u> <u>Process Coal</u>	<u>Pulverizing Rate - LTPH</u>			
January	Data Not Available on Monthly Basis				
February	-				
March	Date Not Available on Monthly Basis				
April	2,091	7.20 ✓	72.09	21.2	452,000
May	1,847	6.30	72.19	27.3	685,000
June	1,470	5.46	70.54	27.1	827,000
July	2,237	13.12	67.67	12.70	186,000
August	2,399	7.81	63.83	24.18	347,000
September	2,075	4.92	67.50	23.32	298,800
October	2,446	6.72	70.50	21.10	324,899
November	1,957	7.34	63.30	19.16	286,392
December	3,107	8.60	52.80	15.93	333,569

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

TABLE NO. 20

Material Preparation  
Balling Section - Monthly Operating Data

	<u>Tonnage</u> <u>Processed LT</u>	<u>Processing Rate</u>		<u>A Disc</u>	<u>Percent Operating Hours - Net Time Basis</u>			
		<u>LT/Disc-Hour</u>	<u>Average No. of Discs</u> <u>Optg. - Net Time Basis</u>		<u>B Disc</u>	<u>C Disc</u>	<u>D Disc</u>	
January			3.04 ✓	100.0	91.9	75.6	36.9	
February			-	-	-	-	-	
March			2.88	100.0	95.4	65.2	18.6	
April	34,142	17.50	3.77	100.0	96.7	96.1	84.5	
May	35,368	18.74	3.67	100.0	95.2	87.3	85.0	
June	35,815	19.48	3.79	100.0	95.1	93.5	90.5	
July	30,368	20.19	3.81	100.0	97.19	92.94	90.84	
August	36,946	18.35	3.88	100.0	97.13	97.59	92.97	
September	31,069	19.19	3.97	-	-	-	-	
October	46,720	21.98	3.95	100.0	99.59	99.33	98.89	
November	34,704	20.75	3.98	100.0	99.57	99.36	98.92	
December	45,597	20.30	3.94	100.0	99.38	99.37	98.18	

PELLETIZING PLANT  
ANNUAL REPORT  
YEAR 1957

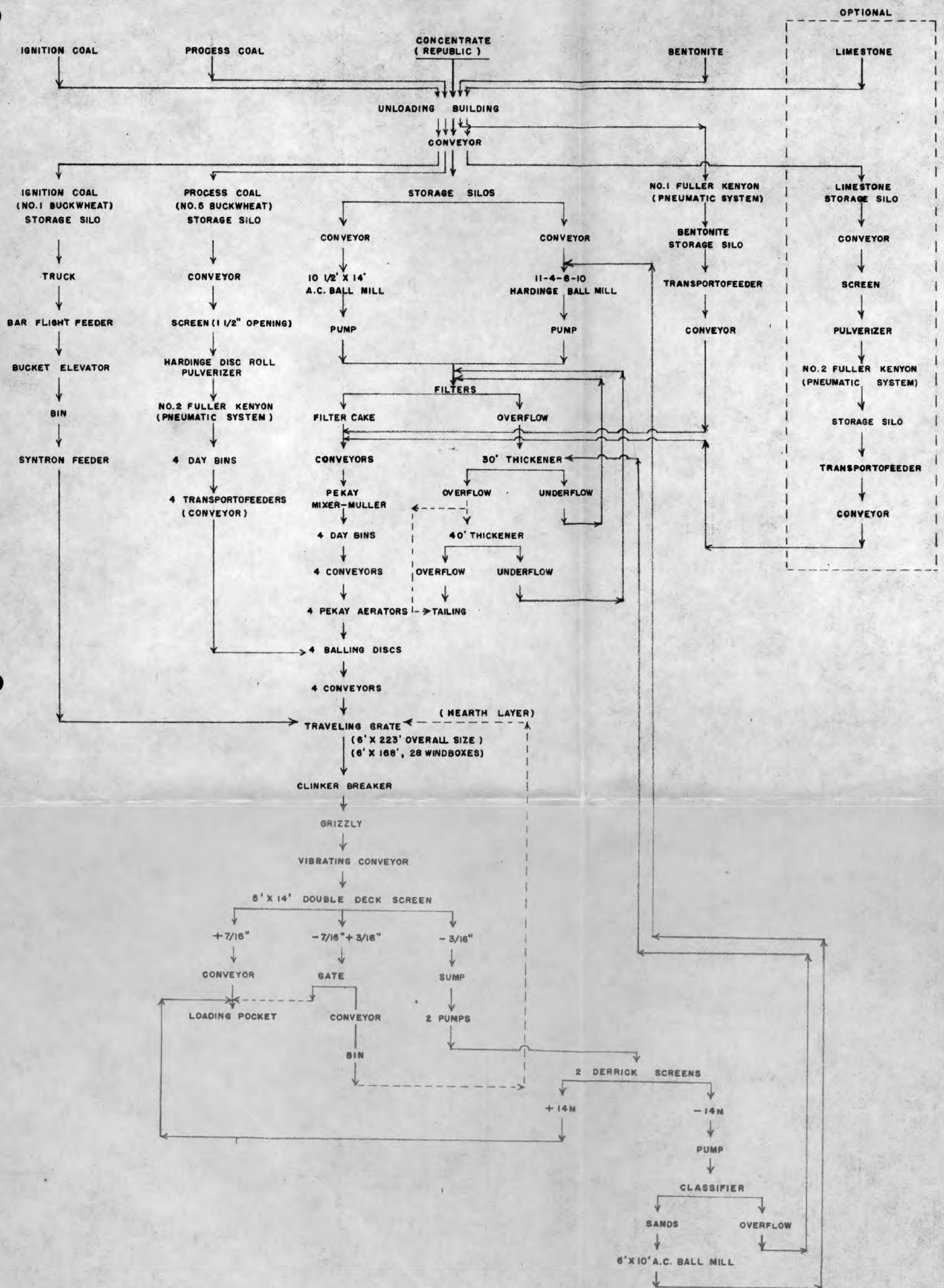
TABLE NO. 21

Pellet Firing - Monthly Operating Data

	Pellets Produced	Hours Operating	Delays	Percent Operating	Pelletizing Rate - Net Time Basis			Fuel Consumption MBTU/LT
					LTPH	LT/Sq. Ft./Day	Over Firing Zone	
January	2,620	59.3	12.7	82.4	44.2	Data Not Available on Monthly Basis		
February	-	-	-	-	-	Data Not Available on Monthly Basis		
March	9,803	346.7	133.3	72.2	28.3	Data Not Available on Monthly Basis		
April	23,316	516.2	171.8	75.0	45.2	-	-	3.021
May	22,786	513.4	190.6	72.9	44.4	2.12	1.29	3.419
June	24,105	459.7	172.3	72.7	52.4	2.50	1.52	2.558
July	17,796	394.7	189.3	67.6	45.1	2.15	1.31	5.001
August	27,753	519.3	120.3	81.2	53.4	2.54	1.55	3.427
September	21,738	408.3	87.8	82.3	53.3	2.54	1.55	3.948
October	33,511	537.8	142.3	79.1	62.3	2.97	1.81	3.451
November	25,576	412.5	107.5	79.3	62.3	2.27	1.22	2.901
December	34,130	570.0	101.9	84.8	59.9	2.85	1.53	4.244

# EAGLE MILLS PELLETIZING PLANT - FLOWSHEET

APRIL 9, 1958



ORE IMPROVEMENT PLANT  
ANNUAL REPORT  
YEAR 1957

1. INTRODUCTION

The Ore Improvement Plant was turned over to the Operating Department by the Project Engineering Section on July 8, 1957. Numerous changes and modifications were indicated by the first day's operation and the screening, crushing and heavy density sections of the plant were finally placed in operation on August 1st. The designed capacity of 6000 tons per day for the crushing and screening section, operating under most favorable conditions, was exceeded by 20% at intervals during the operating season.

The rotary kiln section was placed in operation by mid-September and operated continuously through November 6th when the season ended. A high of 5000 tons per day was handled through the kiln which had a designed capacity of 6000 tons per day. The unit was underpowered and will have to be repowered during the winter season if designed capacity and product control are to be realized.

With the exception of two electricians standard; one electrician apprentice; one underground sub-supervisor (production); and one diamond drill helper, all employees were new hires through the company employment service. After some "pruning" a fine force of men were assembled and operated most satisfactorily during the operating season.

A winterization program began on November 7th with a skeleton force and was completed on December 20th.

ORE IMPROVEMENT PLANT  
ANNUAL REPORT  
YEAR 1957

2. PLANT PROCESSES:

a. Distribution and Analyses of Feed:

	<u>Tons</u>	<u>%age</u>	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Sul.</u>	<u>Moist.</u>
Athens-B. H.	100,220	17.64	57.37	.118	9.97	.015	12.12
Maas	39,235	6.91	56.61	.091	9.73	.306	12.45
Lloyd	1,445	0.25	49.30	.107	21.95	.017	8.50
Mather "A"	238,815	42.03	57.78	.098	9.63	.033	9.73
Mather "B"	<u>188,476</u>	<u>33.17</u>	<u>58.54</u>	<u>.092</u>	<u>9.55</u>	<u>.052</u>	<u>9.12</u>
Total	568,191	100.00	57.86	.099	9.70	.055	10.13
Natural Mine Analysis			52.00	.089	8.72	.049	
Natural Plant Analysis			50.58	.089	8.83	.049	

b. Dryer Balance:

Average Moisture - Feed - 11.9

Average Moisture - Product - 6.18

	<u>Natural Tons</u>	<u>Percent Recovery</u>	<u>Percent Moisture</u>	<u>Dry Tons</u>
Product	160,368	90.52	6.18	150,507
Moisture Loss	11,222		100.00	
Dust Loss	<u>5,575</u>			<u>5,575</u>
Total	177,165		11.90	156,082

Heavy Media Section

	<u>Tons</u>
Total +1/2"	145,293
Less Proportion of Dust and Moisture Loss	<u>2,707</u>
Heavy Media Feed	142,586

c. Primary Section (Unloading Pockets 1 and 2)

	<u>Tons</u>	<u>Split</u>
Tons Unloaded	568,191	100.00
Tons -1/2" (Includes Dust and Moist. Loss)	422,898	74.43
Tons +1/2"	145,293	25.57



ORE IMPROVEMENT PLANT  
ANNUAL REPORT  
YEAR 1957

2. PLANT PROCESSES (CONT'D.)

d. Production Figures

Type		Tons	Iron	Sil.	Phos.	Sul.	Moist.
Group I	Dry	-	57.82	9.55	.098	.058	-
Group I	Nat.	408,808	52.90	8.74	.090	.053	8.50
Group II	Dry	-	58.58	9.79	.091	.071	-
Group II	Nat.	82,045	53.95	9.02	.084	.065	7.91
Total Product	Dry	-	57.95	9.59	.097	.060	-
Total Product	Nat.	490,853	53.08	8.78	.089	.055	8.40

Average Improvement Fe Nat. - 2.50 Units.

In Stockpile	Dry	-	57.01	10.58	.099	.056	7.51
In Stockpile	Nat.	76,416	52.73	9.78	.092	.052	

e. Metallurgical Balances

<u>Product - Natural</u>	<u>Tons</u>	<u>% Wt. Crude</u>	<u>Cuml. % Wt. Crude</u>	<u>% Fe</u>	<u>% SiO<sub>2</sub></u>	<u>% Moist.</u>
-1/2" Crude	408,808	71.95	71.95	52.90	8.74	8.50
H. M. Concentrate	82,045	14.44	86.39	53.95	9.02	7.91
* +1/2" Tailings	60,541	10.65	97.04	39.12	-	8.42
Dryer Dust Loss	5,575	.98	98.02	56.47	-	0.00
Dryer Moisture Loss	<u>11,222</u>	<u>1.98</u>	<u>100.00</u>	-	-	<u>100.00</u>

Total Feed	568,191	100.00	-	50.58	-	10.13
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Mine Analysis Feed 52.00

Product - Dry

-1/2" Crude	374,059	73.25	73.25	57.82	9.55	-
H. M. Concentrate	75,555	14.80	88.05	58.58	9.79	-
* +1/2" Tailings	55,444	10.86	98.91	42.72	-	-
Dryer Dust Loss	<u>5,575</u>	<u>1.09</u>	<u>100.00</u>	<u>56.47</u>	-	-

Total Feed	510,633	100.00	-	56.28	-	-
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Mine Analysis Feed 57.86

\* Includes H. M. Rejects and Thickener Underflow

ORE IMPROVEMENT PLANT  
ANNUAL REPORT  
YEAR 1957

2. PLANT PROCESSES (CONT'D.)f. Metallurgical Balance, Heavy Media Section

<u>Product</u>	<u>Tons</u>	<u>% Wt.</u>	<u>% Wt. H. M. Feed</u>	<u>% Fe</u>	<u>% SiO<sub>2</sub></u>	<u>% Phos.</u>	<u>% Sul.</u>
Feed	142,586		100.00				
Sink	64,602	55.12	45.30	58.75	9.66		
Float	52,609	44.88	36.89	40.58			
H. M. Drum Feed	117,201	100.00	82.20	50.60			
Class. Sands	17,443	68.71	12.23	57.27	10.66		
Class. Overflow	7,942	31.29	5.57	56.85			
Class. Feed	25,385	100.00	17.80	57.14			
Total	142,586		100.00	51.76			
Sink	64,602	78.74	45.30	58.75	9.66		
Class. Sands	17,443	21.26	12.23	57.27	10.66		
Total Concentrate (Plant Analyses)	82,045	100.00	57.53	58.44	9.87		
Total Concentrate (Shipping Dept.)	82,045			58.58	9.79	.091	.071

g. Ferrosilicon Consumption

	<u>Tons H.M. Feed</u>	<u>Lbs. FeSi Dumped</u>	<u>FeSi Loss Lbs/Ton H.M. Feed</u>	<u>Tons H.M. Concentrate</u>	<u>FeSi Lbs/Ton of H.M. Concentrate</u>	<u>% Recovery</u>
1957 Totals	117,201	121,585	1.04	64,602	1.88	57.53

h. Process Oil Consumption

	<u>Tons Dryer Feed</u>	<u>Process Oil Used</u>	<u>Gals. Oil/ Ton Feed</u>	<u>Tons Dryer Product</u>	<u>Gals. Oil/ Ton Product</u>	<u>Cost/Ton Product for Oil</u>
1957 Totals	177,165	292,185	1.65	160,368	1.82	.173

ORE IMPROVEMENT PLANT  
ANNUAL REPORT  
YEAR 1957

2. PLANT PROCESSES (CONT'D.)

i. Final Distribution of Ores to the Plant

	<u>Mather A</u>	<u>Mather B</u>	<u>Bunker Hill</u>	<u>Athens</u>	<u>Maas</u>	<u>Lloyd</u>	<u>Total</u>
Tons Unloaded	238,815	188,476	94,763	5,457	39,235	1,445	568,191
Tons Recovered	208,280	163,935	80,056	4,569	33,148	865	490,853
Loss	30,535	24,541	14,707	888	6,087	580	77,338
Percent Recovery	87.2	87.0	84.5	83.7	84.5	59.9	86.4
Tons Shipped	174,969	145,487	60,836	3,244	29,036	865	414,437
Tons on Stock	33,311	18,448	19,220	1,325	4,112	-	76,416

ORE IMPROVEMENT PLANT  
ANNUAL REPORT  
YEAR 1957

3. COST OF OPERATIONS

a. Comments

Because of the small tonnage processed as a result of the much delayed start of operations together with the high plant depreciation rate and other contributing factors, the cost per ton of product as shown in section 3-b, below, is not realistic and a more average month (October) has been included in this report for comparative purposes. Actually the October figures are also somewhat inflated since the entire "Winter and Idle" account for the 1957 season was carried in that month.

b. Yearly Cost - 1957 Season

<u>Account</u>	<u>Amount</u>	<u>Per Ton of Product</u>
Unloading	73,255.65	.149
Drying	45,089.18	.092
Screening and Crushing	48,288.18	.098
Heavy Media	31,825.45	.065
Stocking Expense	8,664.38	.018
Other Direct Plant Expense	93,692.86	.191
Allocated Expense	<u>50,434.16</u>	<u>.102</u>
Cost of Production	351,249.86	.715
Freight - Mines to Plant	39,770.36	.081
Advalorem Taxes	2,777.50	.006
Depreciation	182,949.02	.373
Shipping Expense	<u>21,743.64</u>	<u>.044</u>
Total Cost at Plant	598,490.38	1.219

c. Cost - Average Month (October)

<u>Account</u>	<u>Amount</u>	<u>Per Ton of Product</u>
Unloading	21,473.43	.109
Drying	18,883.71	.095
Screening and Crushing	10,202.43	.052
Heavy Media	7,330.03	.037
Stocking Expense	6,982.81	.035
Other Direct Plant Expense	23,567.44	.119
Allocated Expense	6,165.12	.031
Winter and Idle Expense	<u>17,200.00</u>	<u>.087</u>
Cost of Production	111,804.97	.565
Freight - Mines to Plant	19,390.12	.098
Advalorem Taxes	2,777.50	.014
Depreciation	24,345.90	.123
Shipping Expense	<u>4,917.61</u>	<u>.025</u>
Total Cost at Plant	163,236.10	.825

ORE IMPROVEMENT PLANT  
ANNUAL REPORT  
YEAR 1957

4. HOURLY OPERATING RATES - 1957 SEASON

	<u>Tons</u>	<u>Gross Hours Operation</u>	<u>Net Hours Operation</u>	<u>LTPH Gross</u>	<u>LTPH Net</u>
Unloading Pocket to Crushing Plant	391,026	1904.00	1436.00	205.37	272.30
Unloading Pocket to Dryer	177,165	1200.00	960.58	147.64	183.44
Surge Pile 3 to Crushing Plant	27,864	297.68	280.13	93.60	99.47
Group I	408,808	2133.92	1627.92	191.58	251.12
Heavy Media Feed	141,972	851.10	675.56	166.81	210.15
Group II	82,045	851.10	675.56	96.40	121.45
Dryer Operating Time		80.05%			
Crusher Operating Time		75.93%			
Mill Operating Time		79.37%			

5. PLANT DELAYS

a. Dryer Section

<u>Source of Delay</u>	<u>Total Delay Hours</u>	<u>% of Total Delay Hours</u>	<u>% of 1200 Working Hours</u>
Unloading Pocket and Grizzly	53.12	22.19	4.43
Unloading Pocket Feeder	21.43	8.95	1.79
Dryer Feeder Chute and Transfers	18.57	7.76	1.55
Dryer Burner and Control	10.59	4.42	.88
Dryer Motor	19.50	8.14	1.62
Conveyor No. 1	21.05	8.79	1.75
Conveyor No. 1A	1.50	.63	.13
Conveyor No. 2	7.33	3.07	.61
Conveyor No. 2A	1.00	.42	.08
Conveyor No. 2C	11.99	5.01	1.00
Conveyor No. 3	7.62	3.18	.63
Conveyor No. 17	4.09	1.71	.34
Wet Ore, Chunks and Scrap	3.08	1.27	.26
Simplicity Screen	2.75	1.15	.23
Spill or Plug-up - Dryer Discharge	21.62	9.03	1.80
Sampling (State Men)	.50	.21	.04
No Railroad Cars	1.17	.49	.10
Dryer Discharge	1.75	.73	.15
Drum Overload	5.43	2.27	.45
Car Shaker	7.84	3.28	.65
Dust Collector	1.59	.66	.13
Electrical	5.74	2.40	.48
Power Failure	4.41	1.84	.37
Air Compressor	.50	.21	.04
Lubrication	5.25	2.19	.44
Total	239.42	100.00	19.95

ORE IMPROVEMENT PLANT

ANNUAL REPORT

YEAR 1957

5. PLANT DELAYS (CONT'D.)

b. Crusher Section

<u>Source of Delay</u>	<u>Total Delay Hours</u>	<u>% of Total Delay Hours</u>	<u>% of 2,017.68 Working Hours</u>
Loading Pocket	10.36	2.13	.51
Car Shaker	1.48	.30	.07
Unloading Pocket Plugged	174.29	35.89	8.64
Unloading Pocket Feeder	6.83	1.40	.34
No Railroad Cars	25.59	5.27	1.27
Bad Brakes, Railroad Cars	2.96	.61	.15
Doors Jammed, Railroad Cars	.79	.16	.04
Conveyor No. 2	33.83	6.98	1.68
Conveyor No. 2A	22.51	4.64	1.12
Conveyor No. 2B	5.54	1.14	.27
Conveyor No. 4	17.70	3.65	.88
Conveyor No. 5	21.97	4.52	1.09
Conveyor No. 6	2.35	.48	.12
Conveyor No. 7	10.59	2.18	.53
Conveyor No. 8	14.76	3.04	.73
Conveyor No. 9	1.19	.24	.06
Conveyor No. 10	1.68	.35	.08
Conveyor No. 11	7.06	1.46	.35
Conveyor No. 17	4.44	.92	.22
Symons Crusher	36.24	7.46	1.80
Crusher Chute	2.96	.61	.15
6 x 20 Simplicity Screen	14.55	3.00	.72
6 x 20 Hewitt-Robbins Screen	9.54	1.96	.47
Screen Chutes	34.51	7.11	1.71
Tumble Drum	5.30	1.09	.26
Surge No. 3 Feeder	1.98	.41	.10
Electrical	.68	.14	.03
Transfer Chute, Conveyor 5 to 4	10.79	2.22	.53
Chunks	1.58	.32	.08
Power Failure	.20	.04	.01
No. 2 Feeder	.34	.07	.02
Changeover	1.00	.21	.04
<b>Total</b>	<b>485.59</b>	<b>100.00</b>	<b>24.07</b>

ORE IMPROVEMENT PLANT  
ANNUAL REPORT  
YEAR 1957

5. PLANT DELAYS (CONT'D.)

c. Heavy Media Section

<u>Source of Delay</u>	<u>Total Delay Hours</u>	<u>% of Total Delay Hours</u>	<u>% of 851.10 Working Hours</u>
Startup	18.54	10.57	2.18
Shutdown	2.50	1.42	.29
Building Up Gravity	15.17	8.64	1.78
Conveyor No. 12	1.00	.57	.12
Conveyor No. 13	7.17	4.08	.84
Conveyor No. 14	.25	.14	.03
Conveyor No. 15	4.10	2.34	.48
Conveyor No. 16	10.00	5.71	1.18
Wash Pump	.50	.28	.06
Media Pump	5.96	3.40	.70
Media Sump	1.50	.85	.18
Media Lines Plugged	18.58	10.59	2.18
No Railroad Cars	3.41	1.94	.40
Spill	3.85	2.19	.45
Preparation Screen	32.50	8.52	3.83
Chutes	3.25	1.85	.38
Surge Pile Feeder	4.08	2.32	.48
Hardinge Drum	3.34	1.90	.39
Hardinge Discharge Chute	1.75	1.00	.21
Recirculating Pump	1.25	.71	.15
Euclid Breakdown	1.84	1.05	.22
Densifier	2.50	1.42	.29
Charging Pump	8.50	4.84	1.00
Lubrication System	7.42	4.23	.87
Power Failure	1.00	.57	.12
Magnetic Separators	1.00	.57	.12
Air Compressor	.83	.47	.10
Excessive Fines	3.00	1.71	.35
Wash and Drain Screens	3.50	1.99	.41
Nozzle and Sprays	2.00	1.14	.22
No Feed	3.75	2.14	.44
Water Supply	1.50	.85	.18
<b>Total</b>	<b>175.54</b>	<b>100.00</b>	<b>20.63</b>

ORE IMPROVEMENT PLANT  
ANNUAL REPORT  
YEAR 1957

6. LABOR AND WAGES

a. Comments

Employees of the Ore Improvement Plant did not affiliate with the AFL - CIO Steelworkers during the 1957 season. The job descriptions and classifications presently in force between Cleveland-Cliffs and the Steelworker's union at all other properties were used as standard at the plant. The same \$.07 per hour general increase; the \$.002 per job increment; and the \$.04 per hour cost of living adjustment granted the Steelworker's union effective July 1st was extended to plant employees.

There were no grievances submitted as such. Differences were settled in conference between the employee himself, his supervisor, and the mill foreman or the plant superintendent. Relations were basically very friendly and the efforts exerted by all personnel were commendable.

All plant personnel were tested under the new aptitude testing program instituted by the Industrial Relations Department with some very interesting results being noted. Based on test results and later observations as to a man's ability and effort on the job, it would appear that men in the top one-quarter of the group (based on national standards) generally might better not be considered for employment where work is very basic and repetitious.

b. Report of Vacations Paid

No vacations were paid during the 1957 season since the plant operation began on July 8, 1957.

c. Statement of Production and Wages

Product - Concentrates	490,853
Number of Days Operated	99
Average Daily Product - Tons	4,958
Average No. of Men Employed	81 $\frac{1}{2}$
Product Per Man Per Day	64.52
Average Wages Per Man Per Day	21.44
Total Amount Paid for Labor During Operating Season	172981.99
Labor Cost Per Ton	0.352



ORE IMPROVEMENT PLANT  
ANNUAL REPORT  
YEAR 1957

6. LABOR AND WAGES (CONT'D.)d. Annual Statement of Labor

<u>Mine Payroll</u>	<u>Stat. Men</u>	<u>Hours</u>	<u>Amount</u>	<u>Avg. Rate</u>
Straight Time	51 $\frac{1}{4}$	75,038	175,327.61	2.337
Overtime		15,982 $\frac{1}{4}$	18,983.55	1.188
Afternoon Differential		15,484 $\frac{1}{4}$	1,023.80	.066
Night Differential		12,835 $\frac{1}{4}$	1,268.64	.099
Holiday Allowance		720	1,754.81	2.437
Holiday Worked - Premium Time		8	26.40	3.300
Sub Total	51 $\frac{1}{4}$	75,038	198,384.81	2.644
Vacation Pay Accrual			8,250.00	
Sunday Premium		5,793	2,699.02	.466
Total Hourly Employees	51 $\frac{1}{4}$	75,038	209,333.83	2.790
Average Job Class				7.800
<u>Salaried Employees</u>				
<u>General Payroll</u>				
Salaried - Straight Time	2 $\frac{1}{2}$	3,647 $\frac{1}{2}$	12,687.12	3.478
Salaried - Overtime		187 $\frac{1}{2}$	233.94	1.248
Labor from Other Mines	10 $\frac{1}{4}$	14,905 $\frac{1}{2}$	48,836.45	3.276
Grand Total Labor	64	93,591	271,091.34	2.897
<u>Distributed as Follows:</u>				
Idle Expense	1	1,721 $\frac{3}{4}$	6,464.69	3.755
Operating Plant	40 $\frac{1}{2}$	59,135 $\frac{1}{2}$	166,517.30	2.816
Uncompleted Construction	17 $\frac{1}{4}$	26,076 $\frac{3}{4}$	79,568.53	3.051
Other Mines	1	1,299 $\frac{1}{2}$	3,655.56	2.813
Other Accounts	3 $\frac{3}{4}$	5,357 $\frac{1}{2}$	14,885.26	2.778
Grand Total as Above	64	93,591	271,091.34	2.897

ORE IMPROVEMENT PLANT  
ANNUAL REPORT  
YEAR 1957

7. ORE STRUCTURES - PRODUCT

a. Group I Structure

The structure listed below is approximate and represents a composite of several studies taken at various times during the operating season.

<u>Size</u>	<u>% Wt.</u>	<u>Cuml. % Wt.</u>	<u>% Fe</u>
+1/2"	10.34		53.79
+3/8"	9.35	19.69	56.32
+3M	14.61	34.30	56.99
+6M	23.40	57.70	58.39
-6M	42.30	100.00	58.89
Head	100.00		57.66

b. Group II Structure

The structure listed below is based on samples which were taken daily for royalty purposes; were analyzed monthly; and accumulated for the operating season.

<u>Size</u>	<u>% Wt.</u>	<u>Cuml. % Wt.</u>	<u>% Fe</u>	<u>% SiO<sub>2</sub></u>	<u>% Phos.</u>	<u>% Sul.</u>
+1-1/2"	4.08	4.08	59.81	6.91	.058	.037
+1"	20.01	24.09	58.14	9.91	.094	.202
+3/4"	23.78	47.87	58.70	9.18	.090	.155
+1/2"	11.52	59.39	59.86	8.59	.076	.092
+3/8"	5.80	65.19	59.63	8.34	.087	.102
+3M	3.92	69.11	59.04	9.48	.080	.085
+6M	6.04	75.15	57.04	11.47	.090	.079
+8M	3.59	78.74	56.98	10.91	.094	.075
+10M	2.71	81.45	57.44	10.52	.086	.062
+20M	5.45	86.90	58.04	9.64	.090	.065
+28M	2.54	89.44	58.58	9.07	.094	.058
+35M	1.54	90.98	58.68	8.60	.097	.058
+48M	1.82	92.80	58.37	9.00	.101	.058
+65M	1.54	94.34	58.82	8.42	.105	.048
+100M	1.21	95.45	59.69	7.48	.106	.043
-100M	4.45	100.00	60.27	7.44	.103	.024
Total	100.00		58.68	9.27	.089	.117

ORE IMPROVEMENT PLANT  
ANNUAL REPORT  
YEAR 1957

8. ACCIDENTS AND PERSONAL INJURY

a. Accident Statistics

No. of Hours of Labor	75,038
No. of Fatalities	0
No. of Compensable Injuries	6
No. of Non-Compensable Injuries	1
Days Lost - Compensable Injuries	373
Days Lost - Non-Compensable Injuries	4
Frequency Rate	93.29
Severity Rate	5,024
Average No. of Days Lost Per Injury	54
Position Rating (Independant Units)	8

b. Compensable Injuries

The accidents listed below might well be considered the result of the inexperience of the crew who were entirely new hires and totally inexperienced. As the season progressed and the crew gained experience the frequency and severity rates dropped sharply.

Accident No. 1 - Ronald A. Saari - August 3, 1957

Ronald A. Saari was one of three car riders, who were riding four cars down to Unloading Pocket No. 2, approximate distance 1,000 feet. The cars involved were very old and the car brakes were defective with the result that the cars ran away before the brakes could be tightened sufficiently to restrain their progress. Saari was braking two cars but when he saw another rider jump he thought that this was the proper thing to do and also jumped, striking a concrete pulley foundation and injuring both feet. This was Saari's first shift at the plant. Nature of injury: Multiple Fractures of Both Feet - No. of days lost - 110.

Accident No. 2 - John S. Heggaton - August 6, 1957

John S. Heggaton and other maintenance men were attempting to remove a defective impeller shaft from a car shaker. The foreman had just warned the crew not to attempt to lift the shafting by hand and had gone to get proper equipment for the job when Heggaton, in complete disregard of orders, attempted to remove the defective shaft by hand and dropped same on his foot. The subject shafting weighs approximately 550 pounds. Nature of injury: Fractured third metatarsal of right foot - No. of days lost - 40.

Accident No. 3 - James M. Bogetto - August 9, 1957

James M. Bogetto was unplugging a chute and when he reached in to free a chunk that was hung up, it broke loose striking him on his finger. He had been instructed to use a chute bar in every instance to free hangups in the chutes. Nature of injury: Fractured middle finger of right hand - No. of days lost - 40.

ORE IMPROVEMENT PLANT  
ANNUAL REPORT  
YEAR 1957

8. ACCIDENTS AND PERSONAL INJURY (CONT'D.)

b. Compensable Injuries (Cont'd.)

Accident No. 4 - Marvin B. Willette - September 17, 1957

While Marvin B. Willette was braking the cars he was riding, the brake handle slipped striking him on his right knee. This was his first shift at the plant. Nature of Injury: Contusion of right knee with torn cartilage - No. of days lost - 120 estimated.

Accident No. 5 - Richard Lahti - September 7, 1957

While Richard Lahti was drilling holes in concrete the drill rod broke and he fell against the concrete cutting the back of his hand. Nature of injury: Laceration of right hand with infection - No. of days lost - 13.

Accident No. 6 - James Kauppila - October 19, 1957

James Kauppila had been assisting the maintenance foreman in repairing and retraining a conveyor. When the belt was running properly the foreman told Kauppila to wait until the belt stopped before attempting to replace skirt boards. Kauppila neglected to follow instructions and while pressing downward on the skirting his hand slipped and was caught between the moving belt, the skirt rubber and a troughing idler. Nature of Injury: Fracture of right wrist - No. of days lost - 50.

9. TAXES

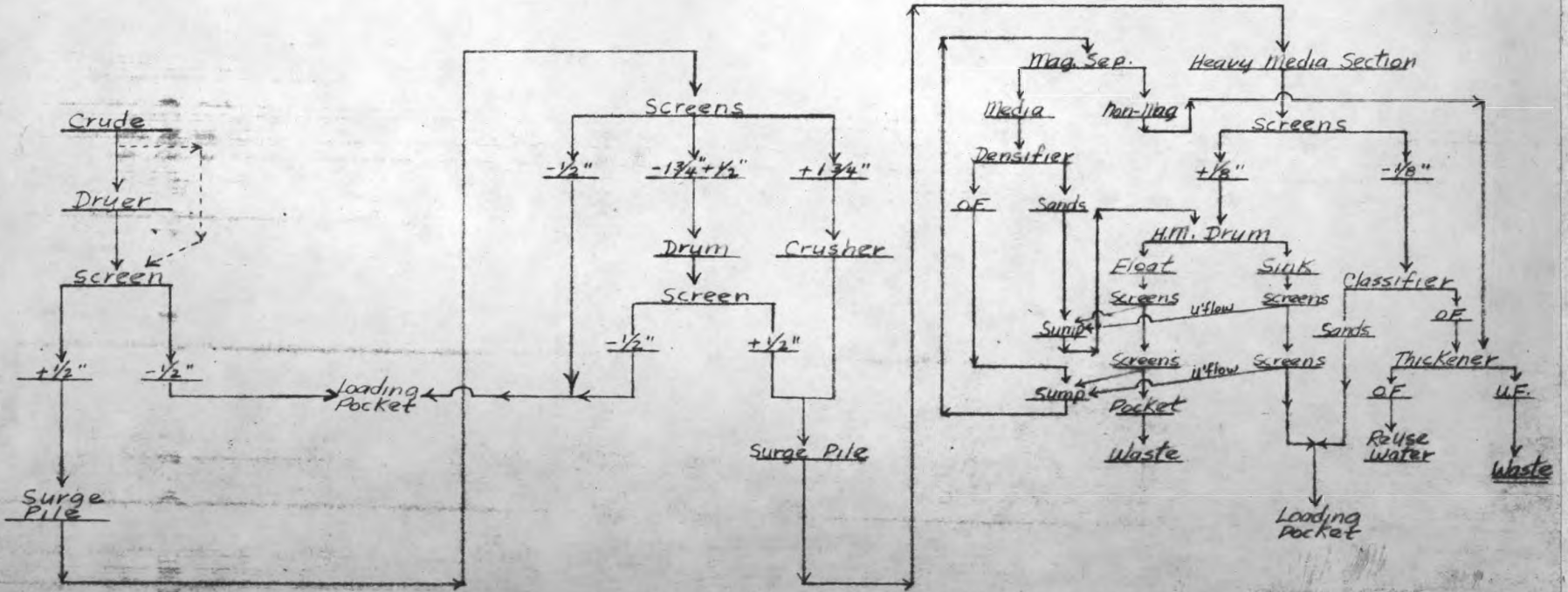
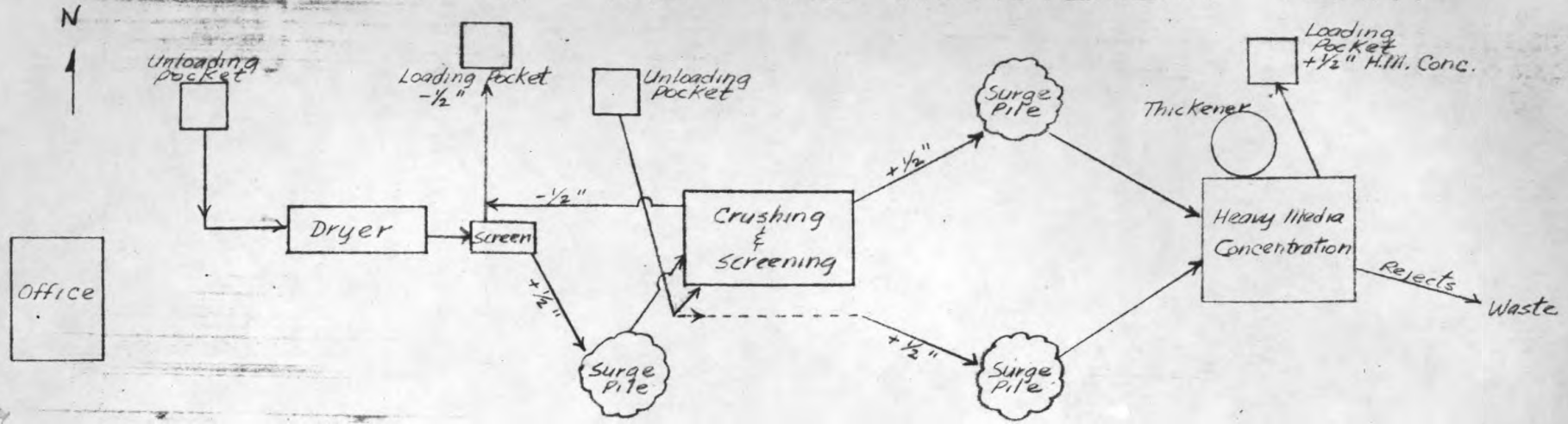
a. Comparative Statement of Taxes

NEGAUNEE TOWNSHIP	1957		1956	
	Valuation	Taxes	Valuation	Taxes
Ore Improvement Plant	\$ 110,000	\$ 2777.50	-	-

10. PROPOSED NEW EQUIPMENT AND CONSTRUCTION

- a. The addition of screening after crushing to improve heavy density feed.
- b. Repower the rotary kiln and provide variation in speed of rotation for volume and quality control.
- c. Place a dust scrubber on the exhaust stack of the rotary kiln.
- d. Install dust disposal system at discharge of kiln cyclone system.
- e. Repower all conveyors for efficient, continuous operation.
- f. Install larger process water and tailings pipe lines, and new pumps of increased capacity.
- g. Laboratory for chemical and physical analysis.
- h. New railroad unloading pocket.

# FLWSHEET OF THE ORE IMPROVEMENT PLANT





Office

Kiln Section

Crusher Section

Heavy Density Section

No. 3 Stackers

Nos. 1 & 2 Stackers

LOOKING NORTH

CLEVELAND-CLIFFS IRON COMPANY  
ORE IMPROVEMENT PLANT  
1957 SEASON

AGNEW MINE  
ANNUAL REPORT  
YEAR 1957

1. GENERAL

With the depletion of the economical underground ore by the end of February of 1956 and the subsequent salvage of equipment, there was no mining activity carried on at the Agnew during 1957 except for a small amount of open pit trespass ore produced and shipped by the M. A. Hanna Company under the terms of the Agnew-South Agnew cross mining agreement.

The cage and ore hoists were sold to Coker Construction Company. The buildings were sold to Dickovich Construction Company and are to be dismantled and removed from the property before May 1, 1958. The remaining items of value were either sold, transferred, or stored.

Notices of cancellation of the lease as of December 31, 1957, have been served on the various interested parties. The bridge over the Hull Rust approach tracks is in the process of being assigned to the M. A. Hanna Company. Hanna is also interested in obtaining an easement for an access road to the South Agnew Mine across the Agnew forty.

The M. A. Hanna Company produced 914 tons of crude ore and shipped 724 tons of concentrates under the Agnew-South Agnew cross mining agreement.

2. PRODUCTION-SHIPMENTS-INVENTORIES

a. <u>Production</u>	<u>Tons</u>
Crude Ore	914
Concentrates (Agnew-South Agnew)	724
Direct Ore	---
b. <u>Shipments</u>	
Agnew-South Agnew Concentrates (M. A. Hanna)	724
c. <u>Inventory</u>	None

Agnew Mine  
Annual Report  
Year 1957  
Page Two

d. Production by Months

	<u>June</u>	<u>Tons</u>
Crude Ore		914
Concentrates		724

3. ANALYSIS

a. Tonnage & Analysis of Ore Produced & Shipped

<u>Concentrates</u>	<u>Tons</u>	<u>Iron</u>	<u>Phos</u>	<u>Silica</u>	<u>Mang</u>	<u>Alum</u>	<u>Lime</u>	<u>Mag</u>	<u>Sulf</u>	<u>Ign</u> <u>Loss</u>	<u>Moist</u>
Agnew-South Agnew	724	55.64	.045	12.32	.88	.65	.10	.07	.009	5.93	10.00

4. ESTIMATE of ORE RESERVES

a. Developed Ore - Factors Used

	<u>Merch</u>
Cubic Feet Per Ton	14
Rock Deduction	0
Per Cent Recovery	100

b. Reserves as of December 31, 1957

Based on Estimated Production

<u>Open Pit</u> <u>NE-NE, 11-57-21</u>	<u>Reserve</u> <u>12-31-56</u>	<u>Mined</u> <u>1957</u>	<u>Balance</u> <u>after Mining</u>	<u>Reserve</u> <u>12-31-57</u>
Merch	24,423		24,423	24,423
Wash	2,632	724	1,908	1,908
	<u>27,055</u>	<u>724</u>	<u>26,331</u>	<u>26,331</u>



Agnew Mine  
Annual Report  
Year 1957  
Page Three

Open Pit Ore  
Hanna Trespass on Agnew  
Based on Joint Estimate by CCI and Hanna

<u>NE-NE, 11-57-21</u>	<u>Tons</u>	<u>Iron</u>	<u>Phos</u>	<u>Silica</u>	<u>Mang</u>	<u>Alum</u>
Merch	24,423	55.75	.050	11.00	.60	1.50
Wash	1,908	55.45	.052	11.88	.33	1.48
	26,331	55.73	.050	11.06	.58	1.50

12. TAXES

<u>Real Estate</u>	<u>1957</u>		<u>1956</u>		<u>Increase-Decrease</u>	
	<u>Assessed Value</u>	<u>Taxes</u>	<u>Assessed Value</u>	<u>Taxes</u>	<u>Assessed Value</u>	<u>Taxes</u>
Mineral	\$10,890	\$1,879.40	\$13,900	\$1,808.81	-\$3,010	<del>\$</del> 70.59
Lands, Bldgs, Machinery	2,584	445.96	2,584	336.25		<del>f</del> 109.71
<u>Personal Property</u>						
Equipment			200	26.02	- 200	- 26.02
	\$13,474	\$2,325.36	\$16,684	\$2,171.08	-\$3,210	<del>f</del> \$154.28
<u>Average Mill Rate</u>		172.58		130.13		<del>f</del> 42.45

Mill rate increase of 32.62 per cent offset reduction in mineral valuation by amount of line ore removed from tax rolls by production and elimination of all personal property.

ALWORTH LAND RESERVEANNUAL REPORTYEAR 19571. GENERAL

With the abandonment of the shaft and facilities early in 1956, no underground activities were conducted at the Alworth during 1957. However, by open pit methods, the Rhude-Gilbert Company shipped 90,737 tons of ore, and the Scranton produced 90,455 tons of ore from a trespass on the Alworth, for a total of 181,192 tons of ore produced and shipped during 1957.

As mentioned in the Agnew report, the underground cage hoists and auxiliary buildings were sold and notice of cancellation of the lease as of December 31, 1957, was served on the fee representatives.

2. PRODUCTION-SHIPMENTS-INVENTORIESa.b. Production & Shipments

<u>Alworth Open Pit</u>	<u>Production</u>	<u>Shipments</u>
<u>Rhude-Gilbert</u>		
Merch	80,887	80,887
Wash	9,850	9,850
<u>Scranton Trespass</u>		
Merch	11,906	11,906
Wash	78,549	78,549
	<u>181,192</u>	<u>181,192</u>

c. Inventories None

d. Production by Months

<u>Month</u>	<u>Open Pit</u>		<u>Total</u>
	<u>Direct</u>	<u>Concentrates</u>	
April	5,403		5,403
May	25,121	43,015	68,136
June	15,263	9,495	24,758
July	6,686	1,568	8,254
Aug	16,609	14,449	31,058
Sept	16,873	16,799	33,672
Oct	<u>6,838</u>	<u>3,073</u>	<u>9,911</u>
	92,793	88,399	181,192

Alworth Mine  
Annual Report  
Year 1957  
Page Two

3. ANALYSIS

a. Tonnage & Analysis of Ore Produced & Shipped

<u>Open Pit</u>	<u>Tons</u>	<u>Iron</u>	<u>Phos</u>	<u>Silica</u>	<u>Mang</u>	<u>Alum</u>	<u>Lime</u>	<u>Mag</u>	<u>Sulf</u>	<u>Ign Loss</u>	<u>Moist</u>
<u>Rhude-Gilbert</u>											
Direct	80,887	55.25	.104	10.62	1.26	2.90	.20	.15	.004	5.08	15.81
Wash	9,850	55.69	.071	12.36	1.08	1.89	.18	.15	.004	4.08	13.65
<u>Scranton Trespass</u>											
Direct	11,906	54.58	.055	13.77	.56	.89	.20	.16	.004	6.01	14.87
Wash	78,549	56.09	.051	12.74	.38	1.00	.19	.15	.004	5.06	12.74
	<u>181,192</u>	<u>55.59</u>	<u>.076</u>	<u>11.84</u>	<u>.82</u>	<u>1.89</u>	<u>.19</u>	<u>.15</u>	<u>.004</u>	<u>5.09</u>	<u>14.30</u>

4. ESTIMATE of ORE RESERVES

a. Developed Ore - Factors Used

<u>Material</u>	<u>Cubic Feet Per Ton</u>	<u>Rock Deduction</u>	<u>Per Cent Recovery</u>
Merch	14	0	100
Wash Concentrates	14	0	60
Retreat Concentrates	14	0	40

b. Estimate of Ore Reserves as of December 31, 1957

<u>Lease</u>	<u>Reserve 12-31-56</u>	<u>Mined 1957</u>	<u>Balance after Mining</u>	<u>Changed by Re-estimate</u>	<u>Reserve 12-31-57</u>
Alworth	208,112	181,192	26,919	167,831	194,750

Alworth Mine  
Annual Report  
Year 1957  
Page Three

c. Estimated Analysis of Ore Reserves

<u>Alworth Open Pit</u>	<u>Tons</u>	<u>Iron</u>	<u>Phos</u>	<u>Silica</u>	<u>Mang</u>	<u>Alum</u>
Bessemer Merch	104,574	55.81	.037	9.72	.31	.56
Non-Bessemer Merch	76,004	57.36	.101	8.15	1.15	2.53
Non-Bessemer Retreat Concts	14,172	57.00	.035	11.50	.65	.45
	194,750	56.50	.062	9.24	.66	1.32
<u>Merch</u>						
Bessemer	104,574	55.81	.037	9.72	.31	.56
Non-Bessemer	76,004	57.36	.101	8.15	1.15	2.53
	180,578	56.46	.064	9.06	.66	1.39

12. TAXES

<u>Real Estate</u>	<u>1957</u>		<u>1956</u>		<u>Increase-Decrease</u>	
	<u>Assessed Value</u>	<u>Taxes</u>	<u>Assessed Value</u>	<u>Taxes</u>	<u>Assessed Value</u>	<u>Taxes</u>
Mineral	\$160,411	\$39,918.28	\$82,110	\$14,303.56	/\$78,301	/\$25,614.72
Land	2,667	663.68	2,667	464.59	/	/ 199.09
Bldgs, Mach (Accts Rec)	5,288	1,315.92	5,288	921.17	/	/ 394.75
	\$168,366	\$41,897.88	\$90,065	\$15,689.32	/\$78,301	/\$26,208.56
<u>Average Mill Rate</u>		248.85		174.20	/	74.65

Note: The State Tax Commission reviewed property this year (1957). Computed mineral valuation on present worth basis more than doubling mineral valuation per ton rate. This, plus mill rate increase of 42.85 per cent, accounts for large increase of total taxes assessed against this property. They were allocated or rebilled as follows:

Alworth underground mineral and surface	\$ 2,589.78
Pickands Mather mineral	17,954.78
Rhude-Gilbert mineral and buildings	20,117.28
Oliver Iron Mining Division machinery, buildings	1,236.04
	<u>\$41,897.88</u>

17  
217

CANISTEO MINE

ANNUAL REPORT

YEAR 1956

1. GENERAL

Concentrating plant repairs--underway in the fall of 1956--continued from January 1, 1957, until the start of ore season on April 29.

91,886 tons of ore were loaded out of stockpile from April 16 to May 25, exhausting the 1956 stockpile.

Ore operations started on a 2-shift, 5-day schedule on April 29 and continued until September 27. 1,027,119 tons of crude ore (including 100,200 tons of screen rock) were mined. In addition, 68,163 tons of pit rock, lean ore, and cleanup were moved during mining.

Operating the same schedule as the pit, the concentrating plant received 926,919 tons of crude ore and produced 373,989 tons of concentrates.

The fine ore plant operated on a 3-shift, 5-day schedule, with the third shift operating on basin tailings. 60,261 tons of fine ore concentrates were produced which included 30,408 tons from current tailings and 29,853 tons from basin tailings.

2,444 tons of direct ore were shipped during the operating season.

After shutdown, ore was shipped from stockpile intermittently until November 14. 8,656 tons were shipped from stockpile, leaving 61,283 tons of concentrates in stock at the end of the 1957 season.

At the close of the ore season, pit operations were immediately shifted to truck stripping on a 15-shift schedule. 681,338 cubic yards of surface material were removed under E&A No. CC-932 by November 29. Crews and pit equipment were then transferred to the Sally where stripping was continued.

Necessary plant equipment repairs were started immediately after the end of ore season and continued until December 27 when all repair work was suspended.

Canisteo Mine  
Annual Report  
Year 1957  
Page Two

Installation of scrubber facilities—underway in the fall of 1956—continued intermittently throughout 1957. Because of the delay in delivery, the scrubber did not go into operation until September 9. Final construction work, including sheeting of the building extension, was completed on December 31.

The Henry Schultz Company drilled 13 structure drill holes in the Canisteo pit for a total of 1821 feet.

2. PRODUCTION-SHIPMENTS-INVENTORIES

a. Production by Grades

	<u>Crude</u>	<u>Retreat</u>	<u>Tailings Basin</u>	<u>Fines</u>	<u>Total</u>
Snyder		297,345			297,345
Bovey		554,027			554,027
Hemmens		75,547			75,547
Canisteo			107,091		107,091
		926,919	107,091		1,034,010

<u>Concentrates</u>	<u>Wash</u>	<u>Retreat</u>		<u>Tailings Basin</u>		<u>Overflow</u>		<u>Direct</u>	<u>Total</u>
	<u>Non-Bess</u>	<u>Bess</u>	<u>Non-Bess</u>	<u>Bess</u>	<u>Non-Bess</u>	<u>Bess</u>	<u>Non-Bess</u>	<u>Non-Bess</u>	
Snyder	2	38,438	90,697			2,579	8,284		140,000
Bovey	6	40,742	170,458			4,043	12,340		227,589
Hemmens		5,535	28,111			1,422	1,740	2,444	39,252
Canisteo				9,588	20,265				29,853
	8	84,715	289,266	9,588	20,265	8,044	22,364	2,444	436,694

b. Shipments by Grades

<u>Ore</u>	<u>Retreat</u>		<u>Overflow</u>		<u>Direct</u>	<u>Stockpiles</u>			<u>Tailings Basin</u>		<u>Total</u>
	<u>Bess</u>	<u>Non Bess</u>	<u>Bess</u>	<u>Non Bess</u>		<u>1957</u>		<u>1956</u>	<u>Bess</u>	<u>Non Bess</u>	
Snyder	32,879	40,125	2,579	8,284							83,867
Bovey	37,527	118,034	4,042	12,341							171,944
Hemmens	5,122	19,036	1,422	1,740	2,444						29,764
Canisteo						9,187	50,796	91,886	9,588	20,265	181,722
	75,528	177,195	8,043	22,365	2,444	9,187	50,796	91,886	9,588	20,265	467,297

Canisteo Mine  
Annual Report  
Year 1957  
Page Three

c. Stockpile Inventories

<u>Retreat Concentrates</u>	<u>Tons</u>
Snyder	38,067
Bovey	20,479
Hemmens	2,737
	<u>61,283</u>

d. Production by Months

<u>Month</u>	<u>Crude</u>			<u>Tailings Basin</u>	<u>Total</u>
	<u>Retreat</u>				
	<u>Snyder</u>	<u>Bovey</u>	<u>Hemmens</u>		
April		9,993			9,993
May		136,463	59,395	23,284	219,142
June		148,321		22,649	170,970
July		134,939		18,934	153,873
Aug	225,270	51,283		21,720	298,273
Sept	<u>72,075</u>	<u>73,028</u>	<u>16,152</u>	<u>20,504</u>	<u>181,759</u>
	<u>297,345</u>	<u>554,027</u>	<u>75,547</u>	<u>107,091</u>	<u>1,034,010</u>

Concentrates

<u>Month</u>	<u>Snyder</u>			<u>Bovey</u>			<u>Hemmens</u>			<u>Canisteo</u>	<u>Total</u>
	<u>Wash</u>	<u>Retreat</u>	<u>O'Flow</u>	<u>Wash</u>	<u>Retreat</u>	<u>O'Flow</u>	<u>Retreat</u>	<u>Direct</u>	<u>O'Flow</u>	<u>T.B.</u>	
April					3,682	100		1,204			4,986
May	2	273		6	54,996	4,564	26,308	1,240	2,558	5,372	95,319
June					50,742	4,148				5,089	59,979
July					53,288	3,513				5,849	62,650
Aug		99,069	8,255		19,898	1,996				7,153	136,371
Sept		<u>29,793</u>	<u>2,608</u>		<u>28,594</u>	<u>2,062</u>	<u>7,338</u>		<u>604</u>	<u>6,390</u>	<u>77,389</u>
	<u>2</u>	<u>129,135</u>	<u>10,863</u>	<u>6</u>	<u>211,200</u>	<u>16,383</u>	<u>33,646</u>	<u>2,444</u>	<u>3,162</u>	<u>29,853</u>	<u>436,694</u>

Canisteo Mine  
Annual Report  
Year 1957  
Page Four

### 3. ANALYSIS

#### a. Crude Ore

<u>Ore</u>	<u>Tons</u>	<u>Iron</u>	<u>Silica</u>
Snyder Retreat	297,345	46.96	26.97
Bovey Retreat	554,027	46.26	26.90
Hemmens Retreat	75,547	45.62	28.69
Canisteo Tailings Basin	<u>107,091</u>	<u>28.91</u>	<u>54.23</u>
	1,034,010	44.62	29.88

#### b. Tonnage & Analysis of Concentrates Produced

<u>Concentrates</u>	<u>Tons</u>	<u>Iron</u>	<u>Phos</u>	<u>Silica</u>	<u>Mang</u>	<u>Alum</u>	<u>Moisture</u>
<u>Snyder</u>							
Non-Bessemer Wash	2	57.61	.055	10.85	.42	.60	6.89
Bessemer Retreat	38,438	58.67	.048	10.26	.29	.56	6.69
Non-Bessemer Retreat	90,697	57.84	.060	11.21	.32	.63	7.18
Bessemer Overflow	2,579	56.98	.043	13.80	.32	.55	7.36
Non-Bessemer Overflow	8,284	56.92	.040	13.82	.30	.57	7.05
<u>Bovey</u>							
Non-Bessemer Wash	6	57.61	.055	10.85	.42	.60	6.89
Bessemer Retreat	40,742	57.92	.039	10.71	.39	.52	6.13
Non-Bessemer Retreat	170,458	57.02	.066	11.09	.48	.60	6.57
Bessemer Overflow	4,043	57.77	.032	12.32	.32	.53	6.53
Non-Bessemer Overflow	12,340	57.50	.044	12.22	.34	.54	6.96
<u>Hemmens</u>							
Bessemer Retreat	5,535	57.08	.043	11.70	.31	.80	6.79
Non-Bessemer Retreat	28,111	56.93	.042	10.04	1.00	.71	7.62
Bessemer Overflow	1,422	58.01	.025	12.78	.40	.66	7.45
Non-Bessemer Overflow	1,740	57.94	.027	12.08	.57	.67	7.77
Non-Bessemer Direct	2,444	49.57	.101	17.55	.38	.35	13.31
<u>Canisteo Tailings Basin</u>							
Bessemer Fines	9,588	57.51	.038	11.76	.37	.47	7.34
Non-Bessemer Fines	20,265	57.55	.040	11.61	.37	.47	7.36
	<u>436,694</u>	<u>57.52</u>	<u>.054</u>	<u>11.14</u>	<u>.42</u>	<u>.61</u>	<u>6.88</u>



Canisteo Mine  
Annual Report  
Year 1957  
Page Five

c. Tonnage & Analysis of Concentrates Shipped

<u>Concentrates</u>	<u>Tons</u>	<u>Iron</u>	<u>Phos</u>	<u>Silica</u>	<u>Mang</u>	<u>Alum</u>	<u>Lime</u>	<u>Mag</u>	<u>Sulf</u>	<u>Ign Loss</u>	<u>Moist.</u>
<u>Snyder</u>											
Bessemer Retreat	32,879	58.70	.048	10.13	.29	.55	.20	.14	.014	4.51	6.51
Non-Bessemer Retreat	40,125	57.59	.066	11.35	.30	.61	.20	.14	.014	4.76	7.17
Bessemer Overflow	2,579	56.98	.043	13.80	.32	.55	.20	.14	.014	3.27	7.36
Non-Bessemer Overflow	8,284	56.92	.040	13.82	.30	.57	.20	.14	.014	3.35	7.05
<u>Bovey</u>											
Bessemer Retreat	37,527	57.92	.039	10.71	.39	.53	.20	.14	.014	4.94	6.13
Non-Bessemer Retreat	118,034	57.02	.066	11.09	.48	.60	.20	.14	.014	5.59	6.57
Bessemer Overflow	4,042	57.77	.032	12.32	.32	.53	.20	.14	.014	3.66	6.53
Non-Bessemer Overflow	12,341	57.50	.044	12.22	.34	.54	.20	.14	.014	4.08	6.96
<u>Hemmens</u>											
Bessemer Retreat	5,122	57.08	.043	11.70	.31	.80	.12	.18	.027	5.02	6.79
Non-Bessemer Retreat	19,036	56.93	.042	10.04	1.00	.71	.12	.18	.027	5.99	7.62
Bessemer Overflow	1,422	58.01	.025	12.78	.40	.66	.12	.18	.027	2.66	7.45
Non-Bessemer Overflow	1,740	57.94	.027	12.08	.57	.67	.12	.18	.027	3.20	7.77
Non-Bessemer Direct	2,444	49.57	.101	17.55	.38	.35	.12	.18	.027	6.98	13.31
<u>Canisteo Stockpile</u>											
Bessemer-1957	9,187	58.48	.045	11.01	.29	.62	.12	.20	.014	3.90	7.73
Bessemer-Non 1957	50,796	57.61	.055	10.85	.42	.60	.12	.20	.014	5.12	6.89
Non-Bessemer-1956	91,886	56.70	.063	11.70	.42	.49	.12	.20	.014	5.66	7.03
<u>Canisteo Tailings Basin</u>											
Bessemer Fines	9,588	57.51	.038	11.76	.37	.47	.18	.20	.007	4.54	7.34
Non-Bessemer Fines	20,265	57.55	.040	11.61	.37	.47	.18	.20	.007	4.63	7.36
	467,297	57.30	.056	11.25	.43	.58	.17	.17	.014	5.14	6.89

Canisteo Mine  
Annual Report  
Year 1957  
Page Six

d. Mine Analysis of Ore in Stockpile

<u>Retreat Ore</u>	<u>Tons</u>	<u>Iron</u>	<u>Phos</u>	<u>Silica</u>	<u>Mang</u>	<u>Alum</u>	<u>Moisture</u>
Snyder	38,067	58.19	.055	11.17	.31	.66	7.28
Bovey	20,479	57.53	.056	11.06	.44	.56	6.57
Hemmens	<u>2,737</u>	<u>57.86</u>	<u>.039</u>	<u>10.84</u>	<u>.54</u>	<u>.72</u>	<u>7.74</u>
	61,283	57.95	.055	11.12	.36	.63	7.06

4. ESTIMATE of ORE RESERVES

a. Developed Ore - Factors Used

<u>Concentrates</u>	<u>Cubic Feet Per Ton</u>	<u>Rock Deduction</u>	<u>Per Cent Recovery</u>
Wash	14	0	55
Retreat	14	0	33

b. Ore Reserves as of December 31, 1957

<u>Lease</u>	<u>Reserve 12-31-56</u>	<u>Mined 1957</u>	<u>Balance after Mining</u>	<u>Reserve 12-31-57</u>
Bovey	1,378,938	227,589	1,151,349	1,151,349
Snyder	997,069	140,000	857,069	857,069
Hemmens	<u>1,232,824</u>	<u>39,252</u>	<u>1,193,572</u>	<u>1,193,572</u>
	3,608,831	406,841	3,201,990	3,201,990

Canisteo Mine  
Annual Report  
Year 1957  
Page Seven

c. Estimated Analysis of Reserves

<u>Concentrates</u>	<u>Tons</u>	<u>Iron</u>	<u>Phos</u>	<u>Silica</u>
<u>Bovey</u>				
Bessemer Wash	133,086	58.73	.029	8.93
Non-Bessemer Wash	440,164	58.19	.096	9.18
Bessemer Retreat	207,817	56.28	.029	11.66
Non-Bessemer Retreat	<u>370,282</u>	<u>56.20</u>	<u>.072</u>	<u>11.36</u>
	1,151,349	57.27	.068	10.30
<u>Snyder</u>				
Bessemer Wash	468,784	61.23	.036	8.75
Non-Bessemer Wash	<u>388,285</u>	<u>61.06</u>	<u>.054</u>	<u>7.82</u>
	857,069	61.15	.044	8.33
<u>Hemmens</u>				
Bessemer Wash	317,980	59.52	.027	9.37
Non-Bessemer Wash	297,945	58.71	.051	8.67
Bessemer Retreat	409,688	57.60	.032	11.08
Non-Bessemer Retreat	<u>167,959</u>	<u>56.78</u>	<u>.058</u>	<u>11.28</u>
	1,193,572	58.27	.039	10.05
<u>Mine Totals</u>				
Bessemer Wash	919,850	60.28	.031	8.99
Non-Bessemer Wash	<u>1,126,394</u>	<u>59.43</u>	<u>.070</u>	<u>8.58</u>
	2,046,244	59.80	.052	8.76
Bessemer Retreat	617,505	57.16	.031	11.27
Non-Bessemer Retreat	<u>538,241</u>	<u>56.38</u>	<u>.068</u>	<u>11.33</u>
	1,155,746	56.80	.048	11.30
Total Bessemer	1,537,355	59.03	.031	9.91
Total Non-Bessemer	<u>1,664,635</u>	<u>58.44</u>	<u>.069</u>	<u>9.47</u>
<u>Total Mine</u>	<u>3,201,990</u>	<u>58.72</u>	<u>.051</u>	<u>9.68</u>

Canisteo Mine  
Annual Report  
Year 1957  
Page Eight

5. LABOR & WAGES

a. Comments

Labor relations were generally satisfactory throughout the year. The following raises became effective in 1957: \$0.03 cost-of-living on January 1; \$0.04 cost-of-living on July 1; and an automatic \$0.07 an hour increase plus \$0.002 per job class on July 1.

b. Comparative Statement of Production & Wages

Production-Tons	436,694
Number of Days Operated	96
Number of Shifts Operated	140
Average Product Per Shift*	3,196
Average Number of Men Employed	142
Tons Per Man Per Day	55.70
Average Wages Paid Per Day	\$24.64
Total Amount Paid for Labor	\$241,516.57
Labor Cost Per Ton	\$0.553

\*Excludes fine ore concentrates

6. GENERAL SURFACE

a. Buildings & Repairs

No new buildings were constructed in 1957. Repairs were minor.

b. Roads, Transmission Lines, Etc.

None

c. Miscellaneous General Construction

E&A No. CC-836: Installation of scrubber facilities at an estimated cost of \$397,886. Work was started in the fall of 1956 and completion scheduled for May 1, 1957. This project was completed in December, 1957, at an actual cost of \$404,229. Because of a delay in the delivery of the scrubber, this unit did not go into operation until September 9. Because of an early shutdown, the

Canisteo Mine  
Annual Report  
Year 1957  
Page Nine

scrubber was not in operation long enough to have any appreciable effect on concentrates produced in 1957. Most of the time was spent on scrubber adjustments and test work which indicated a favorable comparison between plant results and laboratory work. The work was done by Cliffs personnel, with the exception of detailed design and some plant sheeting.

E&A No. CC-936: Resheeting of the washing plant at an estimated cost of \$24,863, let on contract to Abe Mathews Engineering Company, started on November 28 and will be completed in January, 1958.

E&A No. CC-941: Remodeling of the concentrate stockpiling system at an estimated cost of \$35,525 less \$18,087 for used conveyor equipment and \$3,230 for contingencies, for a net of \$14,208. Preliminary work started in December, 1957, with completion scheduled for May 1, 1958. Mine crews are doing the work which involves replacement of the existing 24-inch conveyor equipment with 36-inch equipment.

## 7. OPEN PIT

### a. Stripping

Stripping operations started on September 29 on a 3-shift, 5-day schedule using 2 shovels and 10 to 12 trucks, and continued until completion on November 29. Most of the material moved was surface from the north Bovey forties and waste from an old road fill in the pit bottom on the east Bovey forty. 80,690 cubic yards were hauled to raise and reinforce tailings dykes.

E&A No. CC-932: Authorized an expenditure of \$240,000 for the removal of 600,000 yards at \$0.40 per cubic yard. 681,338 cubic yards of surface and slough were removed from the Bovey lease at an average rate of 5162 yards per shift and a cost of \$0.298 per yard, for a total of \$204,487, leaving an unexpended balance of \$35,513 in this E&A as of December 31, 1957.

Canisteo Mine  
Annual Report  
Year 1957  
Page Ten

b. Open Pit Mining

The 1957 ore season started on April 29 on a 2-shift, 5-day schedule which remained in effect until shutdown of operations on September 27. The pit operated 117 shifts to produce 1,027,119 tons of crude ore which included 100,200 tons of screen rock. An additional 23 shifts removed 68,163 tons of pit rock, cleanup, and lean material. A total of 140 shifts operated removed 1,095,282 tons of material at a rate of 7823 tons per shift.

Gross crude ore removed from the various leases is shown as follows and includes 287,086 tons of crude mined from lean ore stockpiles in the pit:

<u>Lease</u>	<u>Tons</u>
Bovey	630,499
Hemmens	80,625
Snyder	<u>315,995</u>
	1,027,119

Bovey: Ore was produced from the north Bovey forties and from the Bovey lean ore stockpile. Since Sally ore could be mixed with the Bovey ore at the Canisteo, a considerable tonnage of low grade Bovey ore was absorbed.

Hemmens: Ore was mined in the upper horizon along the Hemmens-Walker line.

Snyder: Ore came from the west Snyder and from the middle Snyder forty along the Snyder-Hunner line. No particular difficulty was encountered in mining.

c. Pumping & Drainage

Automatic pumping equipment continues to operate satisfactorily. Mine water is pumped out of the pit, flows north, and eventually enters the Prairie River. Approximately 2692 gallons per minute were pumped from the pit at a cost of \$0.064 per ton of concentrates.

8. BENEFICIATION

a. Plant Operation

The concentrating plant, operating the same schedule as the pit, received 926,919 tons of crude and produced 8 tons of wash and 373,981 tons of retreat concentrates at an average rate of 3196 tons per shift and a weight recovery of 40.35 per cent of plant crude and 36.41 per cent of pit crude.

The Heavy-Media plant, operating the same schedule as the wash plant, received 271,996 tons of feed and produced 185,349 tons of concentrates at a weight recovery of 68 per cent. Coarse tailings from the Heavy-Media plant totalled 86,647 tons.

The fine ore plant operated on a 3-shift, 5-day schedule with the third shift on basin tailings. 60,261 tons of concentrates were produced from 474,799 tons of crude at a weight recovery of 12.69 per cent and an average rate of 273 tons per shift. This included 30,408 tons from classifier overflows at 262 tons per shift and 29,853 tons from basin tailings at 284 tons per shift. The fine ore plant operation was generally satisfactory. Major delays were caused by poor railroad service and main plant delays.

Concentration data for the year is as follows:

<u>Wash Product</u>	<u>Tons</u>	<u>Per Cent Weight</u>		<u>Per Cent</u>			<u>Iron Units</u>
		<u>Plant</u>	<u>Pit</u>	<u>Iron</u>	<u>Phos</u>	<u>Silica</u>	
Stockpile Overrun	8			57.61	.055	10.85	
<u>Retreat Product</u>							
Crude to Plant	926,919	100.00	88.55	46.43		27.07	
Pit Rock	19,670		1.88	24.82		60.78	
Screen Plant Rock	100,200		9.57	26.53		58.39	
Pit Crude	1,046,789		100.00	44.12		30.70	
Concentrates Produced	372,944	40.23	35.63	57.48	.058	10.95	
Stockpile Overrun-1956	1,037	0.07	0.06				
Total Concts Produced & Shipped	373,981	40.35	35.73	57.48	.058	10.95	

Canisteo Mine  
Annual Report  
Year 1957  
Page Twelve

<u>Retreat Product</u>	<u>Tons</u>	<u>Per Cent Weight</u>		<u>Per Cent</u>			<u>Iron Units</u>
		<u>Plant</u>	<u>Pit</u>	<u>Iron</u>	<u>Phos</u>	<u>Silica</u>	
Heavy-Media Concentrates	185,349	20.00	17.91	57.14		10.68	
Heavy-Media Rejects	86,647	9.35	8.28	43.97		28.58	
Heavy-Media Feed	271,996	29.34	25.98	53.24		15.53	
Total Fine Tailings (by difference)	466,291	50.30	44.54				
<u>Fine Ore Plant</u>							
Crude to Plant	474,799	100.00		26.87		57.33	
Total Concts Produced & Shipped	60,261	12.69		57.40	.039	12.32	
Total Fine Tailings (by difference)	414,538	87.31					

During the operating season it was necessary to stockpile 120,218 tons of concentrates. Of this amount, 58,935 plus 1,046 tons of 1956 overrun were shipped from stockpile, leaving a balance in stock on January 1, 1958, of 61,283 tons.

Following is a brief classification of delay time at the washing and Heavy-Media plants:

<u>Source of Delay</u>	<u>Hours</u>	<u>Per Cent of Total Working Hours</u>
<u>Washing Plant</u>		
Out of Ore	1.75	0.19
Screening Plant Machines	18.00	1.92
Plant Pocket & Rock Chute	4.00	0.43
Electric Power	6.50	0.69
Pump & Pipelines	3.50	0.37
Washing Plant Machines	15.25	1.63
Conveyors	4.50	0.48
Concentrate Stacker	5.00	0.53
Scrubber	1.00	0.11
Weather	2.00	0.22
	<u>61.50</u>	<u>6.57</u>

STANDARD  
MELLON BOND



Canisteo Mine  
Annual Report  
Year 1957  
Page Thirteen

<u>Retreat Plant</u>	<u>Hours</u>	<u>Per Cent of Total Working Hours</u>
Media Circuit	3.50	0.37
Conveyors	0.50	0.05
Electric Power	4.50	0.48
Heavy-Media Plant Machines	1.75	0.19
Pumps & Pipelines	1.25	0.13
Due to Mill	2.75	0.29
Concentrate Chute	0.00	0.00
Out of Feed	1.00	0.11
Minnesota Power & Light	2.00	0.22
Weather	2.00	0.22
	<u>19.25</u>	<u>2.06</u>

9. MAINTENANCE & REPAIRS

Repairs to plant equipment continued from January 1 until the start of ore season on April 29. Plant equipment repairs were resumed at the end of the operating season and continued until December 27 when all repair work was suspended. Limited truck and shovel repairs were made prior to the start of the 1957 ore season.

10. COST of PRODUCTION

a. Comparative Mining Costs

<u>Product</u>	<u>Budget</u>	<u>Actual</u>	
	<u>1957</u>	<u>1957</u>	<u>1956</u>
Wash Concentrates		8	2,334
Retreat Concentrates	425,000	373,981	930,075
Fine Ore Concentrates	50,000	60,261	86,708
Direct Ore		<u>2,444</u>	
	<u>475,000</u>	<u>436,694</u>	<u>1,019,117</u>
Per Cent Recovery		36.41	41.69
Average Product Per Shift		3,196	3,238
Tons Per Man Per Day		44.61	48.72
Days Operated		96	141

Canisteo Mine  
Annual Report  
Year 1957  
Page Fourteen

<u>Costs</u>	<u>Budget</u>	<u>Actual</u>	
	<u>1957</u>	<u>1957</u>	<u>1956</u>
Pit Operating	\$0.208	\$0.261	\$0.225
Beneficiating	0.170	0.157	0.158
Fine Ore Concentrating	1.098	0.924	1.155
Loading Stockpile Ore	0.011	0.015	0.010
Sampling & Analysis	0.030	0.029	0.028
Safety & First Aid Supplies	0.001	0.002	0.001
Employees Vacation	0.061	0.040	0.042
Personal Injury	0.002	0.002	0.002
Social Security	0.026	0.025	0.019
Total Pit & Beneficiation	\$1.173	\$1.232	\$1.071
General Mine Expense	0.143	0.199	0.105
Winter & Idle	0.374	0.726	0.320
Cost of Production	\$1.690	\$2.157	\$1.496
<u>Depreciation</u>			
Plant & Equipment		0.263	0.218
Motorized Equipment		0.047	0.050
Movable Equipment		0.012	0.004
<u>Amortization</u>			
Leasehold		0.126	0.126
Stripping		0.099	0.158
<u>Taxes</u>			
Ad Valorem		0.332	0.124
Occupational		0.504	0.559
Royalty		0.048	0.045
Total Depreciation, Amortization, Taxes		\$1.431	\$1.277
Royalty		0.338	0.338
Total Cost on Cars		\$3.926	\$3.111

b. Detailed Cost Comparison

Over-all mining costs were \$0.467 over the 1957 budget and \$0.661 over 1956 costs. Lower recovery, a variation in the method of allocating costs between the Sally and Canisteo, and reduced