THE CLEVELAND-CLIFFS IRON COMPANY

Ore Mining Department

ANNUAL REPORT OF GENERAL MANAGER

For Year Ending December 31, 1958

#2029

THE CLEVELAND-CLIFFS IRON COMPANY
ORE MINING DEPARTMENT

Manager's Annual Report Year 1958

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CLIFFS SHAFT MINE
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YEAR - 1958

1. GENERAL:

The production in 1958 was 448,112 tons, compared to the estimate of 444,252 tons. There was no stockpile over-run realized in 1958. The mine operated on a schedule of 2-8 hour shifts per day, 4 days per week from January 1 through February 28. The schedule was then reduced to operating 3 out of every 4 weeks until October 1, when the full 4 days per week was resumed. On December 8, the mine was placed on a 5 day per week schedule. In July the mine was idle two weeks for a scheduled vacation.

The Cost of Production was $4.728, and the Total Cost at Mine was $6.322 compared with $4.159 and $5.432 respectively in 1957. The higher costs in 1958 are attributable primarily to increased labor and supply costs. During the year there were increases in the standard hourly rates, cost of living adjustment, shift differentials, and vacation benefits. Increases also occurred in the increment between job class and Sunday premium time.

Strict grade controls were in effect throughout the year, and caused frequent shifts and changes in the contract locations. A large reduction in the labor force also brought changes and shifting of the crews. The above factors are chiefly responsible for the decrease in tons per man to 8.55 compared with 8.83 in 1957.

There was an average of 50 contracts mining at the end of the year, compared with 72 a year ago. This reduction was made in three steps. The first occurred late in January, the second in August, and the third early in October. There were 60 men transferred to other mines, and 25 were laid off. Numerous mining areas were depleted; however, slightly better than budget production was maintained by re-entering old workings to recover relatively small tonnages, and continuing a pillar recovery program.

Shipments totalled 421,020 tons, leaving a balance of 128,551 tons on stockpile at the close of the year. This compares with 101,459 tons at the end of 1957. The p roducts were screened to -1½" fines and +1½" lump until mid-January when a screen deck change was made and the products screened to +2" lump and -2" fines. The ratio of lump to fines was 67%, and 33% with 1½" screening, and a 56% and 44% ratio has been realized with the 2" screening. The screening size was increased to 2" to improve the structure and analysis of both the lump and fines products.

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2. PRODUCTION:

a. Production by Grade and Months

Month	Optg. Days	CLIFFS SHAFT Lump	CLIFFS SHAFT Crushed No. 1	BANCROFT Lump	BANCROFT Crushed No.1	SECTION 10 Lump	SECTION 10 Crushed No. 1	Total	Rock
Jan.	18	24,820	14,580	6,034	3,544	6,724	3,950	59,652	908
Feb.	16	20,402	12,461	5,410	3,304	5,890	3,597	51,064	574
Mar.	12	13,362	8,398	2,502	1,572	5,471	3,438	34,743	466
Apr.	14	15,941	11,070	3,075	2,134	5,547	3,853	41,620	2832
May	12	10,894	8,262	2,680	2,032	7,231	5,483	36,582	3036
June	12	12,072	9,423	2,735	2,135	3,464	2,705	32,534	2060
July	7	5,903	4,885	1,733	1,434	2,821	2,335	19,111	912
Aug.	12	9,368	8,451	1,083	977	4,212	3,799	27,890	274
Sept.	13	11,789	7,512	1,724	1,098	6,082	3,875	32,080	732
Oct.	18	10,812	8,469	2,390	1,790	7,304	5,542	36,307	896
Nov.	15	13,248	9,487	2,099	1,576	4,388	3,272	34,070	366
Dec.	19	14,911	11,468	2,504	1,927	6,584	5,065	42,459	330
Sub Total		163,522	114,466	33,969	23,523	65,718	46,914	448,112	13386
Current Year's Stkp. Overrun		-	-	-	-	-	-	-	-
Total	168	163,522	114,466	33,969	23,523	65,718	46,914	448,112	13386

b. Shipments

	Pocket Tons	Stockpile Tons	Total Tons 1958	Last Year Tons
Cliffs Shaft Lump	66,677	103,298	169,974	284,833
Cliffs Shaft Crushed #1	48,628	43,949	92,578	109,273
Cliffs Shaft Crushed #2	-	-	-	17,701
Bancroft Lump	12,703	22,555	35,258	54,405
Bancroft Crushed #1	9,487	9,510	18,997	22,583
Bancroft Crushed #2	-	-	-	2,873
Section 10 Lump	31,042	35,799	66,841	125,755
Section 10 Crushed #1	23,452	13,920	37,372	49,200
Section 10 Crushed #2	-	-	-	4,260
Total	191,989	229,031	421,020	670,883

c. Ore Statement

	On Hand 1-1-58	Output For Year	Overruns	Total	Shipments	Balance on Hand
Cliffs Shaft Lump	44,670	163,522	-	208,192	169,974	38,218
Cliffs Shaft Crushed #1	22,295	114,466	-	136,761	92,578	44,183
Bancroft Lump	8,789	33,969	-	42,758	35,258	7,500
Bancroft Crushed #1	4,084	23,523	-	27,607	18,997	8,610
Section 10 Lump	15,543	65,718	-	81,261	66,841	14,420
Section 10 Crushed #1	6,078	46,914	-	52,992	37,372	15,620
Total	101,459	448,112	-	549,571	421,020	128,551
Total Last Year	27,723	744,150	16,545	785,418	670,883	101,459

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2. PRODUCTION: (Cont'd.)

d. Working Schedule

The table below shows a comparison of working schedules for the past five years:

Year	Schedule
1958	2 8-hour shifts per day with hoisting on 1 8-hour shift per day, 4 days per week January 1 through February 28; 4 days per week for 3 out of every 4 weeks March 1 through September 30; 4 days per week October 1 through December 7; 5 days per week December 8 through December 31.
1957	2 8-hour shifts per day with hoisting on 1 8-hour shift per day, five days per week.
1956	2 8-hour shifts per day with hoisting on 1 8-hour shift per day, five days per week.
1955	3 8-hour shifts per day with hoisting on 2 8-hour shifts per day, 4 days per week January 1 through April 15; 5 days per week April 16 through November 28; then 2 8-hour shifts per day with hoisting on 1 8-hour shift per day for the balance of the year.
1954	3 8-hour shifts per day with hoisting on 2 8-hour shifts per day, 5 days per week January 3 through March 31; 4 days per week April 1 through December 31.

e. Production Delays

The following production delays were experienced during the year:

1. The drive on one of the feeders in the underground flowsheet broke down on February 4. Repairs were completed so that operation could be resumed on February 6. Loss of production on this account was approximately 4,000 tons.

2. The 5' x 20' feeder in the underground flowsheet broke down on June 11. Repairs were completed so that operations could be resumed on June 23. Loss of production on this account was approximately 5,800 tons.

3. The 6' x 20' picking feeder in the underground flowsheet broke down on July 2. Repairs were completed and production was resumed on July 3. This five hour delay resulted in a loss of production of approximately 1,500 tons.

4. On November 12 the tail ropes on the West skip hoist got twisted and snarled on the shaft divider near the loop at the shaft bottom, and caused both 1-3/8" ropes to break. No damage to other parts of the hoisting equipment resulted. Hoisting was done with one skip hoist until a new set of galvanized ropes were received and installed on December 1.

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3. ANALYSIS:

a. Average Mine Analysis of 1958 Output:

	Iron Dried	Phos.	Silica
Combined Cliffs Shaft Lump	59.93	,106	7.95
Combined Cliffs Shaft Crushed #1	55.77	.115	12.07

b. Average Analysis of Shipments for 1958:

Grade	Iron	Phos.	Silica	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moisture
(*) Lump Ore	60.70	.106	7.33	.20	2.25	.85	.85	.005	1.35	.75
(*) Crushed Ore #1	55.87	.108	12.16	.31	2.70	1.10	1.20	.011	1.90	2.38

(*) Cliffs Shaft, Bancroft and Section 10 ore are combined.

c. Average Analysis of Ore in Stock Dec. 31, 1958:

	Iron	Phos.	Silica	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
Combined C. S. Lump Dried	59.53	.106	8.68	.20	2.25	1.05	.95	.005	1.45	-
Nat'l	58.93	.105	8.59	.20	2.23	1.04	.94	.005	1.44	1.00
" C. S. Crushed #1 Dried	55.36	.108	12.65	.31	2.70	1.20	1.27	.011	1.90	-
Nat'l	54.25	.106	12.40	.30	2.65	1.18	1.24	.011	1.86	2.00

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

Comparative Mining Costs

Product	1958 448,112		1957 760,695	
	Amount	Cost/Ton	Amount	Cost/Ton
Underground Costs	$1,613,058.31	$3.599	$2,517,250.20	$3.309
Surface Costs	159,481.16	0.356	213,134.09	0.281
General Mine Expense	346,291.31	0.773	433,280.08	0.569
Cost of Production	2,118,830.78	4.728	3,163,664.37	4.159
Depreciation	395,258.49	0.882	678,920.75	0.892
Taxes	276,618.00	0.618	232,475.44	0.306
Loading and Shipping	42,438.08	0.094	57,275.66	0.075
Total Cost at Mine	$2,833,145.35	$6.322	$4,132,336.22	$5.432
Budget Cost of Production		$4.800		5.068
Number of Shifts and Hours		2-8 Hour		2-8 Hour
Number of Days Operated		168		243
Average Daily Product		2,652 Tons		3,137 Tons

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

Detailed Cost Comparison

	Total 1958		Total 1957	
	Amount	Per Ton	Amount	Per Ton
Underground Costs				
Development	$ 22,299.43	.050	51,408.98	.068
Mining	812,104.80	1.813	1,318,411.22	1.733
Tramming	195,143.84	.435	342,997.03	.451
Ventilation	5,572.70	.013	10,332.49	.014
Pumping	11,783.32	.026	13,744.58	.018
Compressors & Air Lines	43,979.46	.098	57,050.16	.075
Crushing and Screening - UG	50,902.49	.113	63,500.32	.083
Underground Superintendence	136,685.54	.305	191,122.88	.251
Maint: Pockets and Chutes	30,329.14	.067	54,211.08	.071
Mining Equipment	155,439.62	.347	239,355.33	.315
Shaft	1,013.80	.002	3,874.04	.005
Telephones & Safety Devices	16,180.92	.037	29,110.25	.038
Holiday Pay	38,649.42	.086	41,192.29	.054
Vacation Pay	92,973.83	.207	100,939.55	.133
Total Underground Costs	1,613,058.31	3.599	2,517,250.20	3.309
Surface Costs				
Hoisting	56,008.21	.125	71,023.43	.093
Crushing & Screening - Surface	10,493.48	.024	11,820.94	.016
Stocking	15,398.56	.035	22,950.04	.035
Timber Yard	2,752.27	.006	2,805.62	.004
Dry House	18,620.44	.041	18,369.60	.024
Policing	1,408.59	.003	16,274.00	.021
General Surface	20,917.46	.047	17,096.17	.023
Maint: Headframe Bldg. & Equip.	4,161.92	.009	11,058.95	.015
Other Mine Buildings	5,143.68	.011	14,026.08	.018
Telephones & Safety Devices	1,439.16	.003	2,856.84	.004
Holiday Pay	6,738.39	.015	7,039.56	.009
Vacation Pay	16,399.00	.037	17,812.86	.024
Total Surface Costs	159,481.16	.356	213,134.09	.281
General Mine Expenses				
Geological Department	-	-	13,040.63	.017
Mining Engineering Department	23,397.45	.052	14,795.54	.019
Mechanical Engineering Dept.	4,941.67	.011	5,110.14	.007
Safety Department	6,250.49	.014	6,221.31	.008
Research Laboratory	834.73	.002	2,202.56	.003
Analysis & Grading - Laboratory	25,085.58	.055	38,594.04	.055
" & " - Shipping	4,407.38	.010	4,363.87	.006
Special Expense - Pensions	-		79.48	-
" " - Retirements	5,061.23	.011	3,540.59	.005
" " - Hygiene Clinic	4,680.20	.011	5,258.58	.007
" " - Employment Office	-		1,207.13	.001
Ishpeming Office	75,493.69	.169	76,656.45	.101
Mine Office - Supt. & Clerks	36,527.87	.081	48,645.03	.064
Central Warehouse Overhead	9,184.53	.020	18,018.63	.024
Insurance- Property	4,058.80	.009	4,554.09	.006
" - Group, Health & Life	37,467.12	.084	41,327.08	.054
" - Group Annuity	8,415.99	.019	12,882.54	.017
" - Catastrophe	4,089.25	.009	3,517.78	.005

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

Detailed Cost Comparison

	Total 1958		Total 1957	
	Amount	Per Ton	Amount	Per Ton
General Mine Expenses (Cont'd)				
Personal Injury--Comp. & Doctors	25,876.15	.058	23,747.61	.031
Design Department	-		638.44	.001
Taxes - Unemployment Insurance	13,473.61	.030	22,498.89	.030
" - Old Age Benefit	26,525.65	.059	34,262.36	.045
Electrical Engineering Dept.	6,102.23	.013	14,018.52	.013
Employees Insurance & Compensation	4,706.77	.011	6,151.71	.008
Operating Research Laboratory	366.13	.001	1,432.63	.002
Supplemental Unemployment Benefits	19,344.79	.044	30,514.45	.040
Total General Mine Expenses	346,291.31	.773	433,280.08	.569
COST OF PRODUCTION	2,118,830.78	4.728	3,163,664.37	4.159

Underground Costs - This account increased over last year, chiefly because of the increase in wages and supply and equipment costs. The largest increases were in the following accounts; Mining, Underground Superintendence, Mining Equipment, Holiday Allowance, and Vacation Pay.

Lower costs were realized in the Development Expense because of the smaller development program, and the Tramming expense dropped mainly because there was less maintenance on equipment.

Slight decreases were also realized in several other accounts where it was possible to curtail to an absolute minimum repair and maintenance work.

Surface Costs - This account increased mostly in the Hoisting, Dry House, Holiday Allowance, and Vacation Pay accounts. The increase in the Hoisting expense is due entirely to replacing the original tail ropes on each of the skip hoists, and a set of hoist lines on the East skip. The Dry House fixed expenses, such as heating and maintenance, did not drop in proportion to the reduced operating schedule.

In the maintenance accounts there were slight decreases in costs due to curtailing this work to a minimum.

General Mine Expenses - The largest increase over the last year was in the Ishpeming Office and Engineering Department accounts. This was attributable chiefly to the reduced operating schedule and tonnage, and no proportional decrease in these expenses. The Mine Office cost increased slightly for the same reason.

Other expenses which did not reflect the reduced operating schedule, and therefore increased substantially, were the Property Insurance, Group Health and Life accounts, and Old Age Benefit Taxes.

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

Expenditure & Authorization Summary

E. & A. CC-928 - Trans-Weigh Belt Meter

This E.& A. covered the purchase and installation of a trans-weigh belt meter. The meter is used to improve control of skip weight determinations, and aid in the calculations of lump to fine ratios. Installation was completed early in March - 1958. The project amount authorized was $3,800.00, and the total expenditure was $4,022.06.

E. & A. CC-938 - Moro Shaft Ventilation Fan

A model No. 977 American Blower centrifugal type fan was purchased and installed at the collar of the Moro Mine "K" Shaft, early in 1958. This fan increased the ventilating air volume in the mine by 58%, and has improved conditions from this standpoint throughout the mine. The project amount authorized was $7,950.00, and the total expenditure was $8,087.86.

5. ESTIMATE & ANALYSIS OF ORE RESERVES

The reserves are estimated on the basis of the following factors:

High Grade of First Class Ore	- 8 cu. ft. per ton
Second Class Ore	- 9 cu. ft. per ton
Conglomerate & Second Class Ore	-10 cu. ft. per ton

The annual increase in the estimated reserves is due largely to the method employed in making up the tax estimates. Experience has shown that extension of proven ore reserves for any considerable distance away from a working area has been an unreasonable assumption at this property due to the complex mine geology. Therefore, much of the proven ore reserves and additions are based on an accumulated group of more or less standard breast extensions. This practice accounts for nearly the same magnitude of proven ore reserves each year fluctuating somewhat according to depletion and ore development. No significant ore reserve additions were realized this year.

The following table shows a comparison of developed ore with the previous year as reported to the State Tax Commission:

	Cliffs Shaft	Bancroft	Section 10	Total Lease	Total Tons
Estimated Reserves-Dec. 31, 1957	574,722	27,757	223,784	251,541	826,263
Less 1958 Production	277,988	57,492	112,632	170,124	448,112
Balance as of 1957 Estimate	296,734	29,735	111,152	81,417	378,151
Estimated Reserves-Dec. 31, 1958	500,365	28,102	190,042	218,144	718,509
New Developed Ore	203,631	57,837	78,890	136,727	340,358

Expected Average Analysis of Ore Reserves

	Iron	Phos.	Silica	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moisture
Natural	57.50	.107	10.00	.35	2.10	.80	.80	.014	1.20	.85

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5. ESTIMATE & ANALYSIS OF ORE RESERVES: (Cont'd.)

The geological and engineering study of hard ore reserves, which was originally made in 1952, was again reviewed in 1958. Based on the 1958 revision, the proven and probable ore reserve is estimated at 1,343,567 tons as of December 31, 1958. The necessity of improving product grades, and the additional information gained from mining in 1958, accounts for the reduction in reserves as compared with 1957.

6. LABOR AND WAGES:

Labor relations have been satisfactory although the Committee submitted several formal grievances. There were five grievances, one of which was held over from 1957 and four of which were submitted during the year. One has been appealed to arbitration and another will probably be appealed to arbitration. Both arbitration hearings will be held early in 1959. The remaining three grievances were dropped by the Union--two in the third step and one in the fourth step. There were two grievances pending at the end of the year.

Name	Nature of Grievance	Step of Grievance Procedure
Nels Santti	Vacation pay shortage	(3) Dropped
Reino Bessola	Disputes demotion from electrical crew while trainee and higher-rated craftsmen, all with less seniority, were retained.	Appealed to arbitration
Lawrence Salminen	Disputed placement of former sub-supervisor back into mining contract without posting.	(3) Dropped
Edwin Dawe	Protested performance of "hourly-rate work" by supervisors. Claims pay for shift he did not work.	(4) Dropped
Joseph Amel, et al	Protests retention of sub-supervisor in employment with less company service than the grievants.	(4) Pending

Employment

Number of men beginning of year		348
Separations	102	
Transferred in	10	
Decrease in men	92	92
Total End of Year		256

Average number of men as per labor statement (statistical) $305\frac{8}{4}$

Average absenteeism $15\frac{1}{2}$

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

Employment

The following table shows a classification of separation in 1958:

Nature of Separation	No. of Men
Quit	2
Retired	11
Transfers	60
Lay-offs	25
Discharged	1
Deceased	2
Absent for 2 years or more due to sickness	1
Total	102

During 1958, there were 76 employees entitled to 3½ weeks of vacation, 149 for 3 weeks of vacation, 71 for 2½ weeks of vacation, 27 for 2 weeks of vacation and none for one week of vacation.

Statement of Wages

a. Average Wages Per Day

	1958	1957
Total surface and underground	27.46	24.49

b. Average Wages Per Month

	1958	1957
Total surface and underground	400.92	517.47

The mine operated an average of 14.6 days per month as compared to 21¼ days per month in 1957.

c. Tons Per Man Per Day

	1958	1957
Total surface and underground	8.55	8.83

d. Labor Cost Per Ton

	1958	1957
Total surface and underground	3.21	2.78

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7. NEW CONSTRUCTION:

A larger American Blower centrifugal-type fan with a rated capacity of 120,000 C.F.M. was installed at the Moro Mine Shaft to replace the old fan which has a rated capacity of 35,000 C.F.M. This change increased the volume of ventilating air in the mine by 58%.

A trans-weight belt meter was installed on the conveyor in the surface flow sheet to aid in controlling skip weights and to obtain accurate production tonnage figures.

The work under R&M CC-12, which covered the rebuilding of badly worn underground tram cars, was completed early in the year. In all, thirty-six of the seventy-six cubic foot capacity cars were rebuilt in the mine shops and 4 sixty-five cubic foot capacity cars were repaired. As a result of this program, most of the underground tramming equipment is now in good condition.

A new fence was installed around the old Barnum Pit which is located within the Cliffs Mine area. The drainage ditch from this pit was also cleaned and deepened during the year.

Fencing around the various old pits on the Cliffs Shaft property was repaired, and a new cyclone fence was installed around the new fan installation at the Moro Shaft collar.

A mechanical sampling device was installed at the end of the double-deck screen in the pocket building on surface. It is designed to sample only the lump product and, at the end of the year, it was being operated on an experimental basis to get comparative data with manual sampling.

The original set of hoist ropes on the east skip was replaced after hoisting 850,000 tons. Examination and tests of samples taken from the discarded ropes showed some loss in internal lubricant, but breaking strength was approximately 97% of catalog strength. As a result of these findings, the original set of hoist ropes on the west skip will be continued in service for a longer period. The tail ropes on both the east and west skip hoists were replaced during the year because of severe corrosion which caused premature failure of the west skip tail ropes early in November. The replacement ropes are galvanized wire construction--the east set having a single coating of zinc while the west set has a double coating of zinc.

Due to the very abrasive nature of the hard ore, considerable maintenance on the flow sheet has been necessary. Repairs have mostly consisted of replacing worn-out deck plates on the screens and feeders and bearings and gears on the drive mechanism. Jaw plate replacement has been frequent on the primary crusher and the frame in which the jaw plates are mounted was rebuilt. An experiment is being conducted with an abrasion resistant rubber covering on a feeder deck plate. Two inches of rubber is bonded to a 3/8" plate. The rubber appears to be holding up very well after two months of service, but a longer trial period is necessary before conclusive results are obtained. The feeder deck on which the trial is underway is handling crude ore ahead of the primary crusher. This material ranges in size from finesto about thirty inch cubes.

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7. NEW CONSTRUCTION: (Cont't.)

Work has continued on dust count control, particularly in the crusher room and also underground in general. Improvements have been made in the crushing station and elsewhere underground mainly by ventilation control and wetting at the source.

Noise control work was also continued in the crusher station. A new type of ear muff is now being used by the men working in the crushing station. Reports to date indicate that this muff is very effective and quite comfortable to wear.

8. UNDERGROUND:

a. General

The development program has continued on a small scale due to lack of new areas to develop for mining. Continued stress on analysis, depletion of a number of stoping areas and lack of possible ore exploration areas all contributed to a program of continual stoping area changes and revisions, together with a reduction in the number of contracts. At the end of the year, there were fifty active contracts in the mine as compared with seventy-two in 1957. Pillar recovery continued throughout the year but at a lower rate than in 1957. The proportion of contracts on this type of work decreased from 33% at the beginning of the year to approximately 25% by the end of the year. The contracts included in this category are not confined entirely to pillar recovery work but perform predominantly this type of work during the major part of a year. Pillar recovery has been carried on in all map areas during the year although only on a small scale in the Section 10 Lease.

The mine is split into mapping areas in which "A" and "B" Shaft map units represent the inlying areas in which a large proportion of the contracts are mining in old stopes. Bancroft and "A" Shaft Northeast, "A" Shaft East and the Section 10 Lease and Moro Mine represent the outlying or fringe areas which must be depleted prior to the inlying areas for orderly mining.

b. Mining Area

1. "A" Shaft East - (East of 2800 E and extending from the south boundary of the Bancroft Lease to 1200 S)

No development was done in the "A" Shaft East area this year. All known ore areas are presently being mined. There are two contracts working in this area which is a reduction of one as compared to last year as a result of depletion.

The remaining reserves here lie between the 2nd and 8th levels. Emphasis on mining the fringe areas will continue to be stressed in accordance with the plan to deplete the outlying ore structures before retreating towards shaft.

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8. UNDERGROUND: (Cont'd.)

b. Mining Area (Cont'd.)

2. "B" Shaft - (West of 400 E)

Development in "B" Shaft consisted of driving three sub-level drifts to develop ore body extensions and provide traveling roads. Most of this work was done above 1st level elevation.

The number of contracts working here was reduced from sixteen in 1957 to ten in 1958. This decrease was also the direct result of depletion. The bulk of the reserves remaining in this area are in the form of upright and floor pillars. The only new areas remaining are those presently being developed and mined on the 1220' sub-level.

3. "A" Shaft - (400 E - 2800 E, between the Bancroft and Section 10 Leases)

A short section of main level drift was driven on 8th level to provide access to a new chute location. Several contracts advanced sub-level drifts in their respective stopes to develop ore body extensions, provide hoist room and provide traveling roads.

Seven contracts have no reserves other than upright and floor pillars. The reserves are dispersed and, in part, tied up by tramming operations. During the year, mining of floor pillars continued on the 5th, 6th and 8th levels. A section of a 10th level floor pillar will be made available by mid 1959 and other such areas will be opened to mining after relocation of traveling and tramming roads. Removal of rock fill from two old stopes is planned to make available additional pillar reserves which are currently inaccessable.

4. Bancroft Lease and "A" Shaft Northeast

Development in the Bancroft Lease and "A" Shaft Northeast area consisted of driving sub-level drifts to develop small orebody extensions and most of the work was confined to 10th level and below.

The number of contracts working in this area was reduced from fourteen in 1957 to nine in 1958. The reduction was made in Bancroft contracts while the number working in the "A" Shaft Northeast area remained constant. The balance of the reserves here are concentrated between the 9th and 11th levels with a small tonnage remaining at the 6th level elevation. Reserves are rapidly being depleted in these areas and, very likely, operation will be completed here by the end of 1959. Three of the contracts have only pillars as ore reserves.

5. Section 10 Lease and the Moro Mine

Development in the Section 10 Lease was fairly extensive during the year and consisted entirely of sub-level drifting. Development on two elevations between 8th and 10th levels has continued and, to date, a fairly large mining area has been outlined on both elevations. The old Moro Mine workings adjacent to the Section 10 boundary had previously been filled with water to the 10th level elevation. The water was pumped out this year to about thirty-five feet below 10th level to make it possible to recover some additional ore along the boundary.

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8. UNDERGROUND: (Cont'd.)

b. Mining Area (Cont'd.)

5. Section 10 Lease and the Moro Mine (Cont'd.)

Mining during the year ranged in elevation from the 5th to 10th levels with crews spread throughout the area. The number of contracts has been reduced from sixteen in 1957 to twelve in 1958. This area contains the bulk of the reserves and is the major producing area in the mine. There will be very little pillar recovery work following the regular mining operations here since this work is currently being carried on in the normal course of mining.

c. Delimiting Ore

The underground diamond drilling program was completed in 1955. There was no drilling done underground or on surface for hard ore reserves in 1958.

d. New Equipment

A fairly large amount of new equipment and supply items were purchased in 1958 for maintenance of existing plant and equipment. The major expenditures were: two sets of skip hoist tail lines, fourteen jaw plates for the primary crusher and deck plates for the screens and feeders in the flow sheet. A list of the more significant items is shown below.

Item	Amount
10 - Sections screen and feeder decking	$ 3,369.38
2 - Spare bearings for Koepe Hoist	2,389.33
1 - Set of aluminum stage scaffolding	638.60
4 - Troughing idlers	506.00
24 - Wood wedge supports - Koepe Hoists	152.00
24 - Self rescuers	192.00
1 - 12½ KVA Westinghouse transformer	164.39
4 - Roller bearings - primary jaw crusher	571.14
8 - Roller bearing sleeves - primary jaw crusher	705.92
1 - Set gear box springs - Koepe Hoists	264.19
2 - 12" plug valves	592.00
1 - Solenoid valve - hoisting	162.78
14 - Primary jaw crusher plates	9,286.41
2 - Key plates for primary jaw crusher	258.00
2 - Battery locomotive wheels	165.03
48 - Cap lamp cells - MSA	530.03
102'- Skirt board rubber - conveyor	410.76
2 - Sets of skip hoist tail ropes	11,286.26
4 - Fire extinguishers	216.00
147 - Chute liners and wear plates	1,711.10
16 - Texrope drive belts - U.G. feeders	152.12
1015'- Rubber power cable - Mine equipment	1,216.02
18 - Rubber draft gear and springs - U.G. tram cars	237.96
Spare electrical parts for Koepe Hoists	1,027.17
Flow sheet equipment - (bearings, gears, etc.)	2,203.46
Total	$38,378.05

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8. UNDERGROUND (Cont'd.)

e. Explosives

The price of powder increased from $19.24 per cwt. to $19.69 per cwt. and there were slight increases in miscellaneous blasting supply costs also. Despite the price increases, the cost per ton for explosives was reduced $.013 per ton chiefly because of a slight drawdown of accumulated broken ore compared with a year ago. A reduction in the amount of development work also helped to reduce powder consumption. The explosives costs are summarized in the following tables:

TABLE I
Cost of Explosives - Operating

	Quantity	Avg. Price	1958	1957
Powder, Lbs., All Kinds	300,750	$19.69	$59,229.20	$110,668.11
Misc. Supplies (Caps, Fuse, Testers, Etc.)			31,609.09	53,887.94
Total			$90,838.29	$164,556.05

TABLE II
Unit Cost and Consumption of Explosives

	1958	1957
Pounds of Powder Per Ton of Ore	.671	.756
Tons Ore Per Pound of Powder	1.490	1.322
Cost Per Ton For Powder	.132	.145
Cost Per Ton For Blasting Supplies	.071	.071
Cost Per Ton For All Explosives	.203	.216

TABLE III

	1958	1957
Cost Per Ton Developing	.000	.001
Cost Per Ton Mining	.203	.215
Total	.203	.216

f. Tungsten Carbide Bits

Numerous tungsten carbide bit tests were made during the year and the results in small batch tests indicated that one grade of Kennametal bit is superior to other makes. A grade of Copco bit also indicated good results. Subsequent testing of the Kennametal bit on a production basis has not substantiated batch test results, so testing of the Copco bit on a production basis will be started early in 1959. The following table summarizes the 1958 carbide bit experience.

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8. UNDERGROUND (Cont'd.)

f. Tungsten Carbide Bits (Cont'd.)

Description	Quantity	Price	Amount-1958	Amount-1957
Ingersoll Rand, Series 113 - 1-3/8"	1,174	$11.80	$13,853.20	$28,469.00
Ingersoll Rand, Series 113 - 1-5/8"	---	---	---	730.00
Ingersoll Rand, Series 115 - 1-5/8"	---	---	---	3,483.00
Ingersoll Rand, Series 115 - 1-3/4"	25	15.00	374.89	1,498.75
Ingersoll Rand, Series 115 - 2"	10	14.45	144.50	---
Rok-Bits, Series 113 - 1-3/8"	246	10.90	2,681.40	5,101.20
Rok-Bits, Series 113 - 1-5/8"	18	13.50	243.00	1,741.50
Rok-Bits, Series 115 - 1-5/8"	1	13.50	13.50	1,593.00
Rok-Bits, Series 115 - 2-1/8"	---	---	---	459.60
Rok-Bits, Series 115 - 2-1/4"	6	23.57	141.42	141.42
Kennametal, Series 113 - 1-3/8"	100	10.90	1,090.00	---
Copco, Series 113 - 1-3/8"	---	---	---	100.00
Joy, Rap-Ons, 1-3/8"	---	---	---	132.00
Total	1,580	$11.74	$18,541.91	$36,483.47

Production - Tons	448,112	760,695
Cost Per Ton of Ore Produced	.041	.048
Feet Drilled - Rock and Ore	411,944	700,031
Average Feet Drilled Per Bit	260	224
Cost Per Foot of Hole	.045	.052

The average price per bit increased by approximately 1% compared with 1957. Two factors which aided in lowering over-all bit costs were: (1) a substantial reduction in the amount of development work, and (2) the use of bits in inventory which had been purchased in earlier years at more favorable prices.

g. Pumping

The automatic pumping system operated satisfactorily throughout the year, and costs were below last year's experience. Some maintenance was required on the No. 3 pump motor which had given trouble due to an unbalanced condition in the armature. Due to a complete breakdown in the armature late in the year, it has become necessary to replace it with a new one. Due to faulty construction, a claim for an adjustment in the cost of the replacement armature will be placed with the manufacturer.

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9. TAXES:

Comparative data for 1958 and 1957 is shown below:

	1958		1957	
	Valuation	Taxes	Valuation	Taxes
Realty	$ 2,655,000	$123,192.00	$ 3,530,000	$160,085.50
Personnel	1,161,100	53,875.04	316,100	14,335.13
Lot 2, Section 3, 47-27 Bancroft	330,000	15,312.00	440,000	19,954.00
Lot 174, Nelson's Addition	100	4.64	100	4.54
S.35.91' of Lot 179	50	2.32	50	2.27
S½ of NW¼ of Section 10, 47-27	630,000	29,232.00	840,000	38,094.00
Total Cliffs Shaft Mine	$ 4,776,250	$221,618.00	$ 5,126,250	$232,475.44
Taxes Per Ton Produced		$ 0.495		$ 0.306
Taxes Per Ton Shipped		$ 0.526		$ 0.347

The above statement shows a comparison of the actual realty and personal property taxes paid in 1958 and 1957. The total taxes shown on the mining cost statement include the actual 1958 taxes plus the estimated personal property taxes for 1959.

10. ACCIDENTS AND PERSONAL INJURY:

There were 13 compensable injuries in 1958 and the total lost time for all accidents was 6,364 days. In the previous year, the total lost time was 840 days. In December, Waino Kangas, a shift boss, was fatally injured while operating a loader on the 5th level. A brief description of this accident is given below.

The comparison of Frequency and Severity in 1958 and 1957 is as follows:

Year	Frequency	Severity
1957	37.33	1.254
1958	37.04	15,727

Frequency Rate - Number of accidents for every 1,000,000 man hours worked.
Severity Rate - Number of days lost per 1,000,000 man hours worked.

A summary of the compensable accidents is listed below:

#1379 - Clarence Shimmin (Welder Starter) - February 5, 1958

Slipped on ice and wrenched his right knee. He was closing the outside tunnel door. Ligamentous injury right knee. Time lost - 27 days.

#1380 - Edwin Penhale (Contract Miner) - May 5, 1958

Squeezed his little finger, right hand, while guiding a rope onto the drum of K4U tugger hoist which he was operating. Laceration and fracture of distal phalanx of right little finger. Time lost - 10 days.

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

#1381 - George Tamparri (Contract Miner) - May 12, 1958

Fell with drill machine when the rod broke and struck his arm and face on muck pile. Contusion of chin with contusion and abrasion of right arm. Time lost - 60 days.

#1382 - Robert Nelson (Euclid Truck Operator) - May 26, 1958

Dropped fir plank on instep of left foot while repairing railway crossing in stocking area on surface. Contusion of dorsum of left foot. Time lost - 11 days.

#1385 - Salvatore Nardi (Electrician Trainee) - August 5, 1958

Burned his right hand and arm when he inadvertantly touched the trolley line with another piece of trolley wire which was grounded on the rail. Electrical burn on right hand and forearm. Time lost - 11 days.

#1386 - Mason Chapman (Contract Miner) - August 21, 1958

Fell thirty-five feet from an arch onto a muck pile when the drill steel broke as he was drilling. Fractured vertebrae, pelvis and left heel. Chapman had forgotten to fasten his safety belt to the anchor pin in the bench. Time lost - 150 days.

#1387 - Alfred Hendra (Motor-Brakeman) - September 3, 1958

Twisted his left ankle while stepping over a drawhead between two tram cars. Sprained his left ankle. Time lost - 8 days.

#1388 - Matt Kamppinen (Contract Miner) - October 23, 1958

Struck on right hand with small chunk while starting a vertical hole for roof bolt installation. Laceration between 4th and 5th fingers on right hand. Time lost - 10 days.

#1389 - Earl Roberts (Sub-Supervisor) - November 3, 1958

Struck in face and chin with D-handle bar while barring down large chunks from a chute. Laceration of lips, two broken teeth and fracture of the maxilla (upper jaw). Time lost - 20 days.

#1390 - Leonard Anderson (Motor-Brakeman) - November 25, 1958

Struck on left foot by chunk while loading ore at a chute. Contusion of left fore foot and fracture of the fourth tow on left foot. Time lost - 9 days.

#1391 - Waino G. Kangas (Shift Boss) - December 13, 1958

Fatally injured when he was squeezed and crushed between an Eimco Model #40 Loader and the rib of the drift. Death was caused by traumatic shock. Time charge - 6,000 days.

There were no witnesses to the accident. After the investigation of this accidnet, no definite conclusion could be reached as to what exactly caused the accident. The general conditions in the working place were good and the loader itself was in good operating condition. The only conclusion that could be reached is that Kangas, for some unknown reason, left the operator's platform on the loader and this led to a sequence of events that resulted in his being crushed between the side of the drift and the moving loader.

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

#1392 - Ensio Kauppila (Contract Miner) - December 31, 1958

Struck on the right foot by a chunk thrown into the air by the scraper ropes. He was flagging the scraperman at the time. Fracture of 1st and 2nd metatarsals in the instep of his right foot. Estimated time lost - 40 days.*

#1393 - Joseph Billings (Contract Miner) - December 22, 1958

Struck right knee on back of scraper while walking out of stope. Contusions of right knee. Time lost - 8 days.

* Time lost in 1958 actual. Balance until man returns to work is estimated.

11. POWER:

	1958	1957
Total Cost	$ 52,361.35	$ 51,438.47
K.W.H.	6,320,441	8,302,354
Average Cost per K.W.H.	$ .0082844	$ .0061956
K.W.H. Per Ton	14.1	10.9
Cost Per Ton	$ 0.117	$ 0.068

The decrease in the total K.W.H. consumption is due to the reduced operating schedule in 1958. The sizable increase in the K.W.H. consumption per ton of ore produced is due to two factors. One was the installation of a larger ventilating fan at the Moro Shaft which increased the monthly power consumption from an average of 5,000 K.W.H. with the smaller fan to an average of 15,000 K.W.H. The other factor affecting the K.W.H. per ton is the power consumed in pumping despite the reduced operating schedule.

The average cost per K.W.H. increased sharply due to absorbing higher generating fixed charges per unit as a result of the lower power demand.

HUMBOLDT MINE
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1. GENERAL

The operating period of the Humboldt Mine was limited to approximately 2½ months during 1958 as the property became idle on March 13th, 1958 and did not reopen within the year. The total production for this abbreviated period was only 50,348 tons of concentrates as the mine was operated on a schedule of 15 shifts per week. The weekly hours of work for the mine employees averaged near 35, as most of the men were scheduled for only four shifts per week.

The 50,348 tons of concentrates were milled from 129,726 tons of crude, which is a weight recovery (wet basis) of 38.8%. Other material handled during the year was 7,675 cubic yards of overburden, 25,710 cubic yards of rock, and 3,873 cubic yards of waste. The grade of the concentrates produced was 61.73% iron, 0.060% phos., 9.70% silica, 0.017% sulphur and 6.81% moisture.

All work associated with the closing of the property was completed by March 21,1958, and at that time all entrances to the mine were blocked.

During the summer season, 108,912 tons of concentrates were shipped. Over and above the shipping, there was only limited activity at the mine other than the steady transferring of inventory to other properties and the loaning of equipment, principally to the Republic Mine and Pellet Plant.

During late summer, a siphon utilizing a 6" line was placed in service as a means of dewatering the pit and delivering the water to the Escanaba River. This experimentation proved successful and when preparation is underway to open the pit, it will be possible to lift several million gallons of water from the mining area by this inexpensive method.

A Winky Diamond Drill was tested in the north end of the Humboldt pit during October. Although further testing may be necessary, it appears possible that a small portable, hand-held drill rig such as this, may have application at Humboldt as an aid in planning short range development work.

A crew of maintenance men inspected the crushing plant and mill during late October and early November to check on the deterioration of equipment. Work was required on the grinding mill bearings, crushers, thickener,primary crushing plant pan feeder, and primary crusher motors.

The Proksch Construction Company moved into the Humboldt property on December 15, 1958 to begin preliminary work on the expansion project which was given final approval during that month. By the end of December, the contractor had poured eleven cubic yards of concrete, equally divided between a rod mill foundation and the pellet plant oil storage tank footing.

HUMBOLDT MINE
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1. GENERAL (Cont.)

During the last five months of the year, a concentrated effort was made to complete and assemble information and preliminary layouts of all phases of the Humboldt expansion plan. This work was climaxed by the general approval of the project and the selecting of two major contractors in December. The Arthur G. McKee Company of Cleveland, and the Western Knapp Engineering Company of Hibbing, were named to design and construct the pellet plant and mill additions, respectively.

2. PRODUCTION, SHIPMENTS AND INVENTORIES

a. Operating Schedule

	No. of Days	Shifts Per Day	Hours Per Shift	Total Shifts
Mining	50	1 & 2	8	57
Hauling & Crushing	50	1 & 2	8	57
Mill Operating	61	1,2 & 3	8	151

b. Production by Months

Month	Tons of Crude		Tons of Concentrates
	Crushed	Milled	
January	60,065	58,379	20,195
February	48,619	48,240	22,410
March	20,959	23,107	7,743
Total	129,643	129,726	50,348

c. Production Averages

	1957	1958
Average Crude Ore Per Day	2,466	2,748
Average Concentrate Per Day	937	825
Tons per Man per Day-Crude Ore	35.01	37.75
" " " Concentrate	13.31	13.00
Average Weight Recovery	38.42	38.81

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2. PRODUCTION, SHIPMENTS & INVENTORIES (Cont.)

d. Shipments, Inventories & Analyses - (Dried)

	Tons	Iron	Phos.	Sil.	Sul.	Moist.
On Hand 12-31-57	155,031	61.83	.085	9.70	.017	6.81
Production 1958	50,348	61.73	.060	9.72	.029	6.35
Stockpile to Presque Isle	71,328	61.70	.076	10.08	.015	4.55
Stockpile to Granite City	37,116	61.54	.070	10.39	.015	4.41
Pocket to Weirton Steel	468	61.04	.060	10.90	.029	6.50
On hand 12-31-58	96,467	61.81	.074	9.70	.015	6.67

3. ESTIMATE OF ORE RESERVES - JAN.1,1959

	Crude Tons	Concentrate @ 40% Recy Tons	Rock Stripping Cu.Yds.	Earth Stripping Cu.Yds.
Proven Reserves	30,058,923	12,023,569	7,904,458	2,466,055
Probable Reserves	11,441,705	4,576,682	5,186,925	1,283,109
Total	41,500,628	16,600,251	13,091,383	3,749,164

4. LABOR AND WAGES

a. General

The hourly rate crew at Humboldt averaged 71 men during the 2½ months' operating period. However, most of this total crew averaged less than 40 hours of work per week,as effective January 19, 1958, a reduced working schedule became effective, although the mill operated 15 shifts per week. The following table outlines the number of men involved in each working schedule that was utilized.

HUMBOLDT MINE PERSONNEL
1958

	HOURLY RATE					SALARY			
	32 Hour	34 Hour	36 Hour	40 Hour	Total Hour	36 Hour	Exempt	Total Salary	GRAND TOTAL
Pit	12	-	10	3	25	2	1	3	28
Crushing & Milling	3	-	7	18	28	1	3	4	32
Garage,Shops,Genl Surf.	12	-	1	-	13	-	1	1	14
Electrical	-	4	-	1	5	-	-	-	5
Office	-	-	-	-	-	4	2	6	6
Total	27	4	18	22	71	7	7	14	85

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4. LABOR AND WAGES (Cont.)

a. General (Cont.)

Following the mine shutdown, all salaried personnel were transferred to other properties as shown in the next table. In addition to the Superintendent, only Robert Gumerson, Mine Clerk, remained on a part time basis to handle Humboldt accounting.

All stockpile loading throughout the year was accomplished by employees from the Republic Mine.

The following changes were made involving salaried personnel during 1958:

Name	Title	Status		Date
Robert Berkhahn	Metallurgist	Transferred to	Research Lab.	March
Otto Urpila	Mill Foreman	"	Pellet Plant	"
Vivian Delbridge	Chemist	"	Research Lab.	"
Albert Henry	Engineer	"	" "	"
Robert Rodda	Storekeeper	"	Republic	May
Harriette Dougherty	Stenographer	"	Central Office	"
Donald Olson	Strhse. Clerk	"	" "	"
Matthew Drake	Pit Foreman	"	Republic	March
Lester Lundin	Shop Foreman	"	Ore Improv.Plant	"

b. Report of Men Hired, Transferred and Separated

Month	First of Month	Hire	Trans.from Other Mines	Separated	Trans. to Other Mines	End of Month
January	74	3				77
February	77			1		76
March	76			34	42	-

The above table includes hourly and four salaried men on the Humboldt Mine payroll.

The following table outlines the placing of Humboldt Mine hourly rate personnel at the termination of operations on March 13, 1958:

37 - Transferred to Republic under district seniority rules
1 - Transferred to Ore Improvement Plant.
2 - Transferred to Pellet Plant.
1 - Transferred to General Shops.
31 - Economic Layoffs.
72 - Men at Mine, March 13, 1958.

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4. LABOR AND WAGES (Cont.)

c. Report of Vacations Paid

Year	No. of Men	Total Hours	Total Amount	Average Rate
1958	97	7,979	$ 20,787.76	$ 2.605
1957	99	6,741	17,568.44	2.606

d. Annual Statement of Labor

Hourly Employees	Hours	Amount	Average Rate
Straight Time-Classified	26,957½	$ 70,344.26	2.609
Overtime-Classified	283	393.96	1.392
Shift Differential-Afternoon	8,469	514.42	.060
Night	2,184	197.28	.090
Holiday-Allowance	440	1,135.04	2.580
Worked-Premium Time Only	100	295.32	2.953
Sunday Premium Pay	446	243.91	.547
Vacation Pay Accrual		20,787.76	
Total Hourly Employees	26,957½	93,911.95	3.484
Salaried Employees			
Mine payroll-Straight time	2,125-3/4	7,745.44	3.644
Total Mine Payroll	29,083¼	101,657.39	3.495
General Payroll			
Salaries-Straight Time	3,804	11,657.62	3.064
Labor from other mines	4,490	14,310.57	3.198
TOTAL LABOR	37,377¼	127,625.58	3.414
Distributed as Follows			
Idle Expense	2,360	24,585.97	10.418
Operating Mine	30,993¼	91,331.80	2.947
Total	33,353¼	115,917.77	3.475
Stripping	2,810	8,127.71	2.892
Other Mines	346½	909.58	2.625
Other Accounts	867½	2,670.52	3.078
Total as Above	37,377¼	127,625.58	3.414

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4. LABOR AND WAGES (Cont.)

e. Labor Cost

Production of Concentrate - Long Tons	50,348
Number of Days Operated	61
Number of Shifts Operated	151
Average Daily Production	825
Average Production Per Shift	333
Tons of Concentrate per Man Day	13.00*
Average Wages per Man Day	$ 27.31
Average Job Class	9.15
Total Amount Paid for Labor (Production)	$ 91,331.80
Labor Cost per Ton of Concentrates	$ 1.814

* This figure was reduced during the year due to the crew loading stockpile during the summer. At the end of the operating period, the tons per man per day was 13.84.

5. GENERAL SURFACE

a. Buildings

Following the shutdown, all doors and windows throughout the property were barred or locked for the idle period. There was no evidence of vandalism or of any breaking and entering acts at Humboldt throughout the year.

b. Water Supply

The spillway of the earthen dam blocking the Lake Lory outlet was consistently dammed by beavers during the summer. Since any rise in the Lake level over the spillway elevation affects camp docks and boathouses, it was necessary to frequently inspect and remove the work of the beavers.

During the inspection of the plant in the fall, the two vertical fresh water pumps located at the end of the Lake Lory dock were removed and stored under cover for the winter.

6. OPEN PIT

a. Stripping

The principal development work completed during the short operating period was rock stripping in the central area of the pit. This material was a quartzitic and extremely lean iron formation, and amounted to 25,710 cubic

6. OPEN PIT (Cont.)

a. Stripping (Cont.)

yards. A small amount of overburden, totaling 7,675 cubic yards, was moved from the south area on the hanging wall side of the pit.

The following table summarizes the stripping program for 1958:

Month	Surface	Rock	Total	Man Days	Yds Per Man Day
January	-	11,133	11,133	161	69.15
February	7,675	9,393	17,068	149	114.55
March	-	5,184	5,184	42	123.43
Total 1958	7,675	25,710	33,385	352	94.84
Total 1957	184,335	155,780	340,115	3,738	90.99
Total to Date	911,716	437,185	1,348,901	13,363½	100.94

b. Stripping Expenditures

	Amount Authorized	Amount Expended	Amount Unexpended
E&A HM-43	$ 215,900.00*	$ 85,967.86	$ 129,932.14

* Excludes depreciation.

c. Open Pit Mining

Mining was conducted entirely on the 1545 foot bench within the operating period. During January and March, the bulk of the crude ore was mined from a face advancing to the north in the central pit area and was, in general, very lean. During February, the crude represented ore from the extreme southern end of the pit and was very hard and rich. A total of 129,643 tons of crude ore was hauled to the crusher for the year. Four primary blasts were fired, and one area containing 50,000 tons of crude along the southwest limits in the southern area of the pit was completely drilled but never fired. This ore is part of the Foxdale extension, and when mined should add much information on the quantity of ores available west of the present development in the south area.

A small tonnage of ore from the southern area utilized in January was closely associated with a series of dikes, and proved to be very difficult to treat. However, as the face extended into the extreme southern end of the pit during February, the dikes narrowed and the ore became rich, easily treatable and very hard.

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6. OPEN PIT (Cont.)

c. Open Pit Mining (Cont.)

The principal maintenance work undertaken was the yearly overhaul of the track assembly of the P&H 1500 production shovel.

Summary of Pit Production

Crude ore from Pit to Crushing Plant	129,643 tons
Waste Rock Pit to Dump - Yards	3,873
Total Footage Drilled-Jet Piercer	6,087
Total Footage Drilled-Wagon Drills	7,073
Jackhammer Hours - Secondary Drilling	180
Avg. Grade of Crude Ore	30.09 iron
Cost per Ton of Crude Ore	$ 1.006

Working Schedule

Wagon Drilling	1 & 2 shifts per day	5 days per week
Jet Drilling	2 & 3 " "	5 " "
Crude Ore Handling	1 & 2 " "	5 " "

Summary of Powder Used

Primary Blasting

Type	Unit Cost	Amount Used	Total Cost
1½ x 24" Gelamite	$ 19.70 C	50 lbs.	$ 9.85
2¼ x 16" "	19.70 C	2,047 "	403.26
3½ x 10" "	19.70 C	7,800 "	1,536.60
EP 152	19.57 C	29,048 "	5,687.18
EP 158	19.81 C	44,767 "	8,870.25
Ammonium Nitrate Fertilizer	3.71 C	37,900 "	1,659.92
Diesel Oil	12.70 C Gal	975 Gal.	123.90
Regular Primacord	31.68 M	13,275 Ft.	420.68
Plastic Primacord	36.30 M	12,525 Ft.	454.74
XC 45 Booster	50.00 C	81	40.50
Miscellaneous			1,298.06
Shop Labor & Trucking			950.29
Connectors MS-17	53.50 C	22	11.77
Total			$ 21,467.00

Cost per Ton Material Broken $ 0.108

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6. OPEN PIT (Cont.)

c. Open Pit Mining (Cont.)

Secondary Blasting	Unit Cost	Amount Used	Total Cost
7/8 x 8" Gelamite	$ 23.44 C	130 lbs.	$ 30.48
1¼ x 8" "	19.70 C	230 "	45.31

Summary of Footages Drilled

Month	2¼"	3"	4½"	Jet Piercing
January	-	1,789	2,112	2,543
February	-	1,173	911	3,175
March	-	373	715	369
Total	-	3,335	3,738	6,087

Summary of Jet, 3" and 4½" Diameter Drill Holes Blasted

Date	No. of Holes	Avg. Depth.	Avg. Spacing	Powder Factor***	Gross Tons Ore	Gross Tons Rock
1-8	23	39.0	18 x 18	1.59	14,000	17,100
1-21	234*	18.0	9 x 9	1.21	15,000	7,500
1-28	42**	43.6	18 x 18	1.43	49,000	18,400
2-19	63	39.9	18 x 18	1.51	37,000	40,720
Total	362				115,000	83,720

* 74 - 3" diameter and 160 - 4½" diameter holes.

** Includes 8 - 6½" diameter holes spaced at 15' x 15'

*** Tons of material broken per pound of powder used.

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6. OPEN PIT (Cont.)

c. Open Pit Mining (Cont.)

Summary of Jet Piercing Operating Costs

	Oxygen	Fuel Oil	Piping Labor & Supplies	Misc. Optg. Supplies	Misc. Maint. Supplies	Royalty	Maint. Labor	Optg. Labor	Misc. Optg. Labor	TOTAL
January	$ 6,191.28	1,121.05	399.94	1,267.52	1,236.50	1,470.44	1,075.50	1,591.02	341.60	$ 14,694.85
February	6,661.78	1,281.09	161.44	512.01	1,442.79	1,333.37	716.00	1,219.88	405.50	13,733.86
March	1,432.80	843.32	212.44	184.81	423.33	790.65	482.83	466.75	139.79	4,976.72
TOTAL	$ 14,285.86	3,245.46	773.82	1,964.34	3,102.62	3,594.46	2,274.33	3,277.65	886.89	$ 33,405.43

Total Loaded Footage Jet Drilled Holes		4,893
Total Drilled Footage " " "		6,087
Cost per Foot of Loaded Footage	$	6,827
Cost per Foot of Drilled Footage	$	5,488
Total Tons Blasted of Ore & Rock		170,620
Total Cost per Ton Blasted Ore & Rock	$	0.196

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7. PLANT (OPERATING)

a. General

The crude ore utilized during the year was slightly lower in grade but more amenable to concentration than that processed in 1957. The net feed rate for the year was 108 LTPH.

The various rates were:

	Crusher Feed LTPH		Concentrator Feed LTPH		Concentrate LTPH	
	Gross Time	Net Time	Gross Time	Net Time	Gross Time	Net Time
1958	283.99	347.10	106.95	107.98	41.51	41.91
1957	290.23	357.95	105.06	107.80	40.37	41.42

The recoveries from the crude were:

	Crude		Concentrate	
	Tonnage	% Fe.	% Wt.Recovery*	% Fe Unit Recvy*
1958	129,726	30.09	38.13	78.25
1957	737,081	30.69	37.54	75.81

* Based on dry tons of feed and concentrates.

The operating time for the crushing plant and mill was:

	Crushing Plant	Mill
1958	81.82%	99.04%
1957	81.08%	97.46%

b. Monthly Production & Grade - (Dried)

Month	Tonnage	Fe.	Phos.	Sil.	Sul.	Moist.
January	20,195	61.49	.060	9.72	.029	6.74
February	22,410	61.98	.060	9.75	.029	5.89
March	7,743	61.60	.060	9.59	.029	6.03
Total	50,348	61.73	.060	9.72	.029	6.25

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7. PLANT (OPERATING) (Cont.)

c. Metallurgical Balance

Product	% Wt.	% Wt. Crude	% Fe.	% SiO_2	% Fe Unit Recovery
Concentrate	40.36	38.13	61.75	9.70	78.25
Flotation Tailing	59.64	56.35	9.61		18.00
Flotation Feed	100.00	94.48	30.65		96.25
Secondary Cyclone overflow		5.52	20.44		3.75
Calculated Head		100.00	30.09		100.00

Concentrate Assay (Grading Dept.)	Iron	Silica	Moist
(Dry)	61.73	9.72	-
(Natural)	57.87	9.11	6.25
Guarantee for 1958 (Dry)	61.60	9.49	-
(Natural)	57.87	8.92	6.05

d. Hourly Operating Rates

Feed to Primary Crusher	Tons	Gross Hours Of Operation	Net Hours Of Operation	LTPH Gross	LTPH Net
1958	129,643	456.50	373.50	283.99	347.10
1957	744,718	2,566.00	2,080.50	290.23	357.95
Ore in Process	50				
Fine Ore Bin to Concentrator					
1958	129,726	1,213.00	1,201.33	106.95	107.98
1957	737,081	7,016.00	6,837.58	105.06	107.80
Concentrates					
1958	50,348	1,213.00	1,201.33	41.51	41.91
1957	283,206	7,016.00	6,837.58	40.37	41.42

Operating Time	Concentrator	Crushing Plant
1958	99.04%	81.82%
1957	97.46%	81.08%

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7. PLANT (OPERATING) (Cont.)

e. Monthly Hourly Operating Rates

	Feed to Primary Crusher	Fine Ore Bin To Concentrator	Concentrates
(1) Long Tons per Gross Hour			
January	256.14	110.57	38.25
February	310.66	100.50	46.69
March	319.98	112.72	37.77
Year	283.99	106.95	41.51
(2) Long Tons per Net Hour			
January	328.22	112.21	38.82
February	376.89	101.10	46.96
March	346.43	113.31	37.97
Year	347.10	107.98	41.91

f. Pit-Crusher Delay Time

Delays	Hours	% Total Yearly Delay	% Total Yearly Operating Time
Pit Delay - no trucks	45.00	54.23	9.85
Primary Crusher Jammed	12.50	15.06	2.73
Ore Frozen in Primary Rock Box	9.50	11.45	2.08
Pan Feeder	5.00	6.02	1.10
Chunks - Primary Crusher	4.50	5.42	0.99
Tertiary Crusher	4.00	4.82	0.88
Conveyors	1.00	1.20	0.22
Secondary Crusher	1.00	1.20	0.22
Ore Frozen in Surge Bin	.50	.60	0.11
Total	83.00	100.00	18.18

g. Concentrator Delay Time

	Hours Delay	Percent Delays	% of Total Yearly Delays	% of Total Yearly Optg. Hours
(1) Operational				
Weekend Shutdowns	8.58	88.73	73.52	0.71
Electrical	.67	6.93	5.74	0.06
Power Failure	.42	4.34	3.60	0.03
	9.67	100.00	82.86	0.80
(2) Equipment				
Pumps	2.00	100.00	17.14	0.16
GRAND TOTAL	11.67	100.00	100.00	0.96

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7. PLANT (OPERATING) (Cont.)

h. Monthly Rod, Ball and Reagent Consumption

Month	Rods		Balls		Reagents	
	#	#/Ton	#	#/Ton	#	#/Ton
January	80,700	1.380	48,800	0.836	68,900	1.180
February	94,100	1.951	62,200	1.289	94,555	1.961
March	17,000	.736	22,800	0.986	28,490	1.233
Year	191,800	1.479	133,800	1.031	191,945	1.480

i. Plant Testing

Plant testing during the year consisted of a reagent study and a test program with a magnetic separator. This latter investigation was initiated to obtain information on the possibility of combining magnetic separation with flotation on some of the higher magnetic ores encountered at Humboldt.

The reagent tested was F-508, a product of Swift & Company. A preliminary mill test was made with 1850 pounds of this reagent. The results of this work indicated that less selectivity and higher recoveries could be achieved with no important reduction in reagent costs.

A 30" x 36" single drum Dings magnetic separator was installed in the grinding circuit for testing a portion of the hydroscillator overflow. Magnetic concentrate was collected for tests at the Research Laboratory and daily samples were taken of the feed, concentrate, and tailing of the magnetic separator. The mill shutdown terminated this program before conclusive evidence on the value of a magnetic circuit could be obtained.

8. PLANT (MAINTENANCE)

a. Crushing Plant

In addition to routine repairs in the crushing plant, the following major repairs and plant changes were completed in 1958.

1. Installed the repaired main shaft assembly on the tertiary crusher.

2. Replaced the step bearing, piston wearing ring, bottom plate cover gasket, packing clamp, packing ring and packing on the tertiary crusher.

3. Replaced the inner bearing assembly on the #1 screen.

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8. PLANT (MAINTENANCE) (Cont.)

a. Crushing Plant (Cont.)

4. Drained all water lines and filled all gear cases with oil in preparation for the plant shutdown.

b. Concentrator

The following major repairs and changes were completed in the mill during 1958:

1. Installed conical wearing parts in the cleaner and recleaner cells in the north bank of Denver flotation cells.

2. Rebuilt both heads and the pump body of the #1 vacuum pump.

3. Replaced the feed end liners in the ball mill.

4. Increased the speed of the #1 and #2 conditioners to a peripheral tip speed of 1800 feet per minute.

5. Replaced the countershaft assembly on the thickener.

9. E&AS

Construction & Stripping E&AS

	1958 Expenditures	Total Expenditures
HM-35	$ 16,472.74	$ 74,949.73
HM-36	22,751.01	119,315.70
HM-43	33,974.73	85,967.86
HM-44	2,262.52	2,262.52
	$ 74,461.00	$ 282,495.81

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10. COST OF PRODUCTION

a. Comparison

	Cost Per Ton of Concentrate 1958	1957
Pit Expense	$ 2.591	$ 1.953
Crushing & Screening	.842	.913
Milling Expense	2.551	2.327
Tailings Disposal	.049	.035
Stocking Expense	.109	.103
General Expense	.854	.702
Crude Charged to Optg.	-	.123
Miscellaneous	.107	.105
Taxes	.197	.135
Other Expense & Income	.556	.394
Depletion & Depreciation	.778	.891
Shipping Expense	.170	.057
Total Cost at Mine	$ 8.804	$ 7.738

b. Detail of 1958

	Cost per Ton of Concentrate January	February	March	TOTAL
Pit Expense	$ 2.462	$ 1.985	$ 3.799	$ 2.591
Crushing & Screening	.959	.713	.792	.842
Milling Expense	2.229	2.415	3.175	2.551
Tailings Disposal	.067	.016	.049	.049
Stocking Expense	.087	.111	.163	.109
General Expense	.912	.792	1.502	.854
Miscellaneous	.122	.058	.210	.107
Taxes	.178	.141	.409	.197
Other Expense & Income	.530	.291	.352	.556
Depletion & Depreciation	.736	.707	.876	.778
Shipping Expense	-	.003	-	.170
Total Cost	$ 8.282	$ 7.232	$ 11.928	$ 8.804
Production	20,195	22,140	7,743	50,348

3. Analysis of Costs

The cost of production at the Humboldt Mine for the year 1958 was $7.103. The five day working schedule and the overall short operating period makes it unrealistic to compare the 1958 costs in detail with previous operating years. Through February the cost of production was $6.444 compared to the yearly estimated average of $6.347. This slight

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10. COST OF PRODUCTION (Cont.)

c. Analysis of Costs (Cont.)

increase over the budget at that time was due to added maintenance costs associated with the pit and to a run of lean ore consumed during January. In general, the pit development was well advanced and the condition of the plant was excellent, which was the basis of estimates that the mine would have been operating at budgeted costs by the end of March.

Idle expense for the remainder of the year amounted to $181,863.94, the bulk of which was the cost of special research testing. Actual expense at the mine level amounted to $5,021.94 per month.

The following table outlines the 1957 and 1958 costs of production on both a crude and concentrate basis:

	Crude		Concentrate	
	1957	1958	1957	1958
Pit	$ 0.750	$ 1.006	$ 1.953	$ 2.591
Crushing & Screening	.351	.327	.913	.842
Milling	.894	.990	2.327	2.551
Tailings Disposal	.013	.019	.035	.049
Stocking	.040	.043	.103	.109
General Mine	.270	.331	.702	.854
Miscellaneous	.040	.041	.105	.107
Cost of Production	$ 2.358	$ 2.757	$ 6.138	$ 7.103

As previously mentioned, the short operating period during 1958 has made the production costs appear unrealistic, and are not readily comparable to past years' operations.

11. TAXES

Humboldt Mine including stockpile, supplies and equipment as placed by State Mine Appraiser:

	1958		1957	
	Valuation	Taxes	Valuation	Taxes
Real Estate	$ 887,000	$ 24,481.22	$ 813,000	$ 20,934.75
Personal Property	535,000	14,766.00	760,000	19,570.00
Dr.Burke Camp	400	11.04	400	10.30
SE-SW, 15,47-29	150	4.14		
SW-NE, 15,47-29	150	4.14		
		$ 39,266.54		$ 40,515.05
Collection Fee		392.67		405.15
Total Humboldt Mining Co.	$ 1,422,700	$ 39,659.21	$1,573,400	$ 40,920.20
Tax rate		27.60		25.75

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12. ACCIDENTS & PERSONAL INJURY

There were no lost time accidents during 1958.

13. PROPOSED NEW CONSTRUCTION

During September of 1958, approval was given to complete preliminary plans for expanding and adding pelletizing facilities at Humboldt and to request bids from contractors. This work was completed during the fall months and led to the eventual approval of E&A HM-44 during December, 1958. HM-44 covers the construction of a new flotation unit, an ACL pelletizing plant capable of producing 646,000 tons of pellets per year, an additional fresh water supply and a new tailings pond, an enlarging of the shops and dry, extensive general surface modifications, the necessary power supply extensions, and the purchase of additional pit equipment.

14. EXPLORATION

There was no diamond drilling in the Humboldt area during 1958. Exploration work was limited to a small amount of field mapping carried out early in the year.

MATHER MINE "A" SHAFT
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1. GENERAL:

Production for the Mather Mine, "A" Shaft for the year 1958 was 823,860 tons. Shipments from the stockpile were started on April 30th and were continued until November 22nd. Shipments from the pocket were started on April 10th and were continued until November 11th. A total of 583,382 tons was loaded out during this period. All of the product was of the Standard grade.

Operations for the first two months of 1958 were three shifts per day, four days per week. Commencing March 1st the operating schedule was three shifts per day, four days per week, with every fourth week idle. On October 6th the schedule was again changed, and the mine worked only two shifts per day four days per week, but the idle week was eliminated. These various operating schedule reductions necessitated reducing the working force from 578 men employed as of January 1, 1958 to 432 men employed as of December 31, 1958.

The analysis of the Mather Mine, "A" Shaft product for the year was 58.92 iron, 7.95 silica and .027 sulphur dried analysis. The analysis of the shipments for the year was 52.92 iron natural.

An automatic sampling system was installed in the headframe during the first part of the year. An 80# sample was collected from each skip. A hammermill set to 1/8" clearance was used to crush this sample and the material was then split so as to obtain approximately 1# of material for analysis for each 80# collected.

The cost of production was $4.619, an increase of $.685 per ton as compared to 1957. The unit production decreased from 10.71 tons per man per day in 1957 to 10.10 tons per man per day in 1958. This represents a decrease in unit productivity of approximately 5.7% and is attributable to the influx of transferred employees from other properties, into the Mather "A" working force. This, together with reassignment of jobs necessitated by the reduction in force, resulted in a certain loss in efficiency while the employees were learning their new job assignments. The cost of production however, increased by approximately 17.4%. Thus, approximately a third of the increased cost is attributable to the lower efficiency as explained above while two-thirds of the increase is attributable to increase in the cost of labor, supplies and general overhead.

Block caving continued as the principal mining method and steel sets continued as the principal means of ground support. Yielding steel sets were used in the caving drifts and rigid square steel sets were used for transfer drifts and for main level development. Where ground conditions would permit, roof bolts were used to support drifts developed in rock.

Mining operations were conducted principally on the 8th and 9th Levels, with the 7th Level contributing a lesser tonnage. By levels, production was as follows: 7th Level - 92,711 tons or 11.25% of the total product; 8th Level - 461,894 tons or 56.07% of the total product; and the 9th Level - 269,255 tons or 32.68% of the mine total.

Belt conveyors continued as the principal haulage method. 87.9% of the total production was handled exclusively by belt conveyor while the remaining 12.1% of the product was handled partially by belt conveyor and partially by rail haulage. All of the product was crushed underground.

MATHER MINE "A" SHAFT
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1. GENERAL: (Continued)

Capital expenditure for development was continued in the 12th to 9th Level belt conveyor incline and on the 10th Level. At the end of the year the incline drift had reached a distance of 1890' from the upper terminal and was 175' below the 10th Level elevation. Approximately 1700' of the conveyor, together with the dual drive unit consisting of two 350 H.P. motors driving the head pulley through eddy current couplings to the speed reducers, has been installed. This equipment is in service hoisting the development rock from the heading. Approximately 1540' of main level drift was completed on the 10th Level during the year.

Experiments with the Compton auger miner, which has been conducted intermittently throughout the year, were discontinued in December. It had been hoped, that the auger miner would prove practical in mining the interbedded ore zone which is too narrow to be mined economically by conventional methods. The reasons for discontinuing tests were, 1.- the high cost of development, 2.- low tonnage extraction, 3.- excessive drift repair work, and 4.- excessive down time for equipment repairs.

The 1958 diamond drilling program for the Mather Mine, "A" Shaft totaled 3,773 feet. Of the year's drilling, 20% was outlining ore reserves above the 8th Level and 80% was defining ore reserves below the 9th Level.

Labor relations were satisfactory as indicated by the fact that only one formal grievance was presented, and this grievance was dropped by the union in the second step of the grievance procedure.

The rate of water pumped to surface decreased slightly during 1958. Three hundred and sixty-one gallons per minute were pumped in 1957, whereas, three hundred and twenty-five gallons per minute were pumped in 1958.

Subsidence studies were continued by various means throughout the year. Microseismic activity was recorded in surface drill holes located over the 5th and 6th Level workings. Air movement and water levels in these holes were checked to determine if caving or ground fractures had reached the vicinity of the hole bottoms. A pin grid system located on surface over the area of suspected cave was regularly checked for slump or vertical displacement. The flow of water from the various levels underground was calculated and recorded.

Physical inventories were reduced considerably. The supply balance was decreased from $384,426.13 as of January 1, 1958 to $231,795.90 as of December 31, 1958; a reduction of $152,630.23.

On surface all repairs and maintenance were of a routine nature.

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2. PRODUCTION:

a. Production by Grade and Months:

Grade:	Product	Stockpile Overrun	Total	1957 Total
Mather	823,860	-	823,860	1,350,201
Mather Special	-	-	-	-
Total	823,860	-	823,860	1,350,201
			61%	
Rock			37,235	42,328

Months:	Ore	Rock
January	98,725	6,710
February	89,350	5,016
March	70,200	3,300
April	79,439	4,422
May	59,219	3,476
June	64,698	2,574
July	39,771	1,034
August	63,644	2,970
September	66,220	2,772
October	73,710	1,562
November	57,659	759
December	61,225	2,640
Total	823,860	37,235

b. Shipments:

	Pocket	Stockpile	Total	1957 Total	Decrease
Mather	171,923	411,459	583,382	1,361,260	
Mather Special	-	-	-	-	
Total	171,923	411,459	583,382	1,361,260	777,878
			43%		

MATHER MINE "A" SHAFT
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2. PRODUCTION: (Continued)

c. Ore Statement:

	Mather	Mather Special	Total	1957 Total
On Hand January 1, 1958	219,266	-	219,266	230,325
Output for Year	823,860	-	823,860	1,335,417
Transfers	-	-	-	-
Overruns	-	-	-	14,784
Total	1,043,126	-	1,043,126	1,580,526
Shipments	583,382	-	583,382	1,361,260
Balance on Hand	459,744	-	459,744	219,266
Decrease in Output			526,341	
Increase in Output				98,009
Decrease in Ore on Hand				11,059
Increase in Ore on Hand			240,478	

Working Schedule:

1958 - 3-8 hr. shifts, 4 days per week, Jan. 1st to Mar. 1st.
3-8 hr. shifts, 4 days per week, 3 weeks a month with every 4th week idle, Mar. 1st to Oct. 6th.
2-8 hr. shifts, 4 days per week, Oct. 6th to Dec. 31st.

1957 - 3-8 hr. shifts, 5 days per week, Jan. 1st to Nov. 3rd.
3-8 hr. shifts, 4 days per week, Nov. 3rd to Dec. 31st.

1956 - 3-8 hr. shifts, 5-1/3 days per week, Jan. 1st to Nov. 11th.
3-8 hr. shifts, 5 days per week, Nov. 11th to Dec. 31st.

1955 - 2-8 hr. shifts, 4 days per week, Jan. 1st to Apr. 18th.
2-8 hr. shifts, 5 days per week, Apr. 18th to Aug. 1st.
3-8 hr. shifts, 5-1/3 days per week, Aug. 1st to Dec. 31st.

1954 - 3-8 hr. shifts, 5 days per week, Jan. 1st to Mar. 1st.
(Excluding a small production crew, Saturday, day shift.)
3-8 hr. shifts, 5 days per week, Mar. 1st to Apr. 5th.
3-8 hr. shifts, 4 days per week, Apr. 5th to May 15th.
2-8 hr. shifts, 4 days per week, May 15th to Dec. 31st.

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2. PRODUCTION: (Continued)

d. Division of Product by Levels and Months:

Months	Seventh (2400') Level	Eighth (2590') Level	Ninth (2810') Level	Total	Rock
January	24,563	45,910	28,252	98,725	6,710
February	19,587	51,046	18,717	89,350	5,016
March	6,837	48,292	15,071	70,200	3,300
April	11,513	45,710	22,216	79,439	4,422
May	11,633	23,521	24,065	59,219	3,476
June	6,667	32,077	25,954	64,698	2,574
July	854	22,198	16,719	39,771	1,034
August	4,863	37,073	21,708	63,644	2,970
September	2,785	39,173	24,262	66,220	2,772
October	2,723	49,945	21,042	73,710	1,562
November	448	38,166	19,045	57,659	759
December	238	28,783	32,204	61,225	2,640
Total	92,711	461,894	269,255	823,860	37,235

e. Production Delays:

Delays during the year were few and minor with no delays of more than a single shift duration.

MATHER MINE "A" SHAFT
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3. ANALYSIS:

a. Average Mine Analysis on Output:

Grade	Iron	Phos.	Silica	Sulphur
Mather	58.92	-	7.95	.027

b. Average Analysis of Shipments:

Grade	Iron	Phos.	Silica	Mang.	Alum.	Sulphur	Lime	Mag.	Loss	Moist.
Mather	58.95	.094	7.96	.36	3.03	.025	.60	1.10	2.09	10.23

c. Average Analysis of Ore In Stock: (Natural)

Grade	Tons	Iron	Phos.	Silica	Mang.	Alum.	Sulphur	Lime	Mag.	Loss	Moist.
Mather	459,744	52.41	.084	7.15	.32	2.70	.024	.53	.98	1.86	10.95

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

Capital account expenditures amounted to $882,233.56, which brought the total at the end of the year to $13,273,383.07. The total figure does not include an additional $318,223.11 charged in a prior year to Negaunee Mine Company "Idle Expense". By including the "Idle Expense" the grand total expended to date amounts to $13,591,606.18. The following table shows the main items of capital expenditures which are included in the total capital account charges above.

	Percentage of Total Capital Account Charges in 1958
Main Level Development	24.0
12th to 9th Level Inclined Belt Conveyor System	59.8
Underground Conveyors	10.0
Underground Exploration	6.2

Total Charge-Offs	$697,229.60
Total Capital Account Charges as Above	882,233.56
Actual Net Increase in Capital Account	$185,003.96

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4. COST OF OPENING, EQUIPPING, DEVELOPING AND OPERATING: (Continued)

Comparative Mining Costs:

The cost of production of $4.619 per ton, increased $.685 per ton over the 1957 cost due principally to higher labor and supply costs, as well as increases in general overhead expenses. The increase in overhead was due to the reduced operating schedule. Reductions in the working force and the reassignment of employees resulted in a somewhat lesser degree of efficiency as indicated by the decrease in unit productivity as stated below.

The 1958 production of 823,860 tons was 526,341 tons below the 1957 production. The underground costs increased $.313 per ton or 10.3%, surface costs increased $.115 per ton or 30.1%, and general mine expense increased $.257 per ton or 47.5%.

The unit production decreased from 10.71 tons per man per day in 1957 to 10.10 tons per man per day in 1958.

		1958	1957
Product		823,860	1,350,201
Underground Costs		3.323	3.010
Surface Costs		.497	.382
General Mine Expense		.799	.542
Cost of Production		4.619	3.934
Depreciation:	Pre-Production Development	.016	.013
	Plant & Equipment	.255	.214
	Movable Equipment	.011	.006
	Development	.104	.104
	Miscellaneous Equipment	-	.001
	Amort. of Defense Facilities	.006	.014
	Current Year's Development	.454	.424
Taxes		.655	.296
Administration		.050	.050
Loading and Shipping		.050	.060
Total Cost at Mine		6.220	5.116
Budget - Cost of Production		4.516	4.058
Budget - Total Cost at Mine		5.635	4.805
Number of Shifts and Hours		30 1-8 hr.	49 1-8 hr.
		74 2-8 hr.	48 2-8 hr.
		90 3-8 hr.	187 3-8 hr.
Total 8 Hour Operating Shifts		448	706
Number of Operating Days		165	235-1/3
Average Daily Product		3,711	5,737

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4. COST OF OPENING, EQUIPPING, DEVELOPING AND OPERATING: (Continued)

		Proportion of Labor and Supplies	
Labor	$2,432,210.27	2.952/ton	51%
Supplies	2,313,133.76	2.808/ton	49%
Total Cost At Mine	$4,745,344.03	*5.760/ton	100%

* Does not include Amortization of Defense Facilities and Allowance Under Section 616.

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4. COST OF OPENING, EQUIPPING, DEVELOPING AND OPERATING: (Continued)

Detailed Cost Comparison:

	1958		1957	
	Amount	Per Ton	Amount	Per Ton
Underground Costs:				
Development	655,452.29	.796	1,013,141.39	.750
Mining	940,568.27	1.142	1,449,236.19	1.073
Tramming	448,686.22	.544	622,844.99	.461
Power Adjustment	592.00	.001	2,772.65	.002
Ventilation	15,774.95	.019	16,210.28	.012
Pumping	55,335.37	.067	101,722.45	.076
Compressors and Air Lines	56,342.63	.068	68,576.45	.051
Crushing and Screening - UG	22,972.64	.027	39,694.54	.029
Underground Superintendence	155,193.07	.189	231,574.78	.171
Maintenance:				
Pocket and Chutes	8,825.14	.011	10,170.54	.008
Mining Equipment	98,383.79	.119	184,228.99	.136
Levels and Cross-cuts	45,800.03	.056	67,293.42	.050
Shaft	6,806.74	.008	12,673.58	.009
Telephones and Safety Devices	32,751.73	.040	52,629.89	.038
Vacation Pay	129,917.18	.158	134,681.63	.100
Holiday Allowance	64,224.21	.078	65,504.56	.048
Wage Adjustment			1,205.03	.000
Total Underground Cost	2,737,626.26	3.323	4,066,206.00	3.010
Surface Costs:				
Hoisting	158,911.22	.194	199,084.33	.147
Crushing and Screening - Surface	10,211.53	.012	17,713.24	.014
Stocking	66,949.92	.081	87,484.67	.065
Timber Yard	44,549.08	.054	58,350.83	.043
Dry House	38,305.76	.046	45,100.06	.033
Policing	14,517.38	.018	25,083.49	.019
General Surface	18,039.30	.022	17,744.34	.013
Maintenance:				
Headframe Bldg. & Equipment	7,407.43	.009	9,037.93	.007
Other Mine Buildings	7,612.85	.009	10,704.91	.009
Telephones and Safety Devices	1,160.02	.001	871.57	.000
Vacation Pay	32,479.54	.039	33,670.41	.025
Holiday Allowance	9,658.58	.012	9,434.21	.007
Total Surface Cost	409,802.61	.497	514,279.99	.382

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4. COST OF OPENING, EQUIPPING, DEVELOPING AND OPERATING: (Continued)

Detailed Cost Comparison: (Continued)

	1958		1957	
	Amount	Per Ton	Amount	Per Ton
General Mine Expenses:				
Geological Department	13,771.87	.017	15,606.99	.012
Mining Engineering Department	48,125.34	.058	56,725.90	.042
Mech. Engineering Department	8,517.31	.010	5,878.61	.004
Safety Department	10,775.35	.013	10,238.12	.008
Research Laboratory	21,322.45	.026	6,954.24	.005
Analysis & Grading - Laboratory	33,513.91	.041	38,532.37	.029
" " " - Shipping	6,225.39	.008	9,103.90	.007
Project Engineering	556.31	.001	1,264.75	.001
Special Expense-Pensions			132.21	.000
" " -Retirements	8,732.63	.011	5,889.03	.004
" " -Hygiene Clinic	9,366.69	.011	10,404.47	.008
" " -Employment Office			2,007.83	.001
Ishpeming Office	129,353.67	.157	131,352.28	.098
Mine Office - Supt. & Clerks	64,355.76	.078	80,765.26	.060
Central Warehouse Overhead	18,596.54	.023	35,097.69	.026
Insurance - Property	4,454.02	.005	3,922.40	.003
" - Group, Health & Life	63,178.04	.077	67,412.40	.050
" - Group Annuity	11,752.87	.014	16,572.09	.012
" - Catastrophe	7,719.68	.009	5,981.79	.004
Personal Injury - Comp. & Doctors	52,783.54	.064	38,437.31	.028
Operating Research Department	10,602.59	.013	14,351.79	.011
Taxes - Unemployment Insurance	35,068.54	.043	54,254.81	.040
" - Old Age Benefit	49,292.13	.060	56,592.23	.042
Electrical Engineering Department	8,346.19	.010	4,541.55	.003
Employees Insurance & Compensation	8,120.95	.010	10,232.09	.007
Design Department			72.91	.000
Supplemental Unemployment Benefits	33,292.20	.040	49,517.68	.037
Total General Mine Expenses	657,823.97	.799	731,842.70	.542
COST OF PRODUCTION	3,805,252.84	4.619	5,312,328.69	3.934

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5. ESTIMATE AND ANALYSIS OF ORE RESERVES:

The net ore reserves as of December 31, 1958 were 7,424,140 tons. This is a decrease of 2,926,379 net tons from the 1957 estimate. Included in the 1958 estimate is 411,009 net tons in Section 1, 47-27, to be mined by the Mather Mine, "A" Shaft.

Reserves on the 8th Level and above, and between the 8th and 9th Levels were decreased, whereas, reserves below the 9th Level were increased. The decrease in reserves, over and above the decrease due to mining operations, is the result of a revised method of estimating ore reserves. This revised method is necessary due to the present demand for a higher grade of ore. In general, the new method employed is as follows.

In determining ore estimates, consideration is given to the complex pattern of intrusives and their effect on mining operations. Mining experience has shown that developing and mining to within a distance of less than 15' from the hanging side of the intrusives causes excessive contamination of the product. Therefore, in outlining the ore areas, a 15' pillar is left adjacent to the hanging side of all the intrusives. The ratio of the volume of the intrusives and pillars to the volume of the total ore area, intrusives and pillars included, is the reduction factor applied to all cross-sectional estimates. The factor presently used is 20.9% and is applied to the reserves both above and below the 9th Level.

As a result of mining, and of the revised method of calculating, the 1958 estimate indicates a net decrease in ore reserves of 2,102,519 tons as compared to an increase of 3,462,678 tons in 1957.

Estimated Net Reserves as of December 31, 1957	10,350,519
Production, January 1, 1958 to December 31, 1958	823,860
Net Reserves December 31, 1958 by Subtraction	9,526,659
Estimated Net Reserves as of December 31, 1958	7,424,140
Net Decrease in Reserves	2,102,519

Expected Average Natural Analysis of Ore Reserves as of December 31, 1958

Grade	Tons	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
Mather - Underground Development.....	7,424,140	52.15	.100	8.00	0.20	2.45	1.00	.50	.030	2.25	11.00

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6. LABOR AND WAGES:

a. Employment:

The total mine payroll at the end of the year was 432 with a decrease of 146 men from the previous year.

Number of Men 1/1/58.....	578
Added to Roll During the Year.....	211
Total.....	789
Separations.....	357
Total on Payroll 12/31/58.....	432
Average Number of Men as per December Labor Statement.....	430

The separations and additions to the roll as indicated in the table above were as follows:

Laid Off	338
Transferred Out	8
Died Natural Causes	4
Mine Fatality	1
Discharged	1
Retired	4
Disability Pension	1
Total Separations	357
Transferred In	210
Rehired	1
Total Additions	211

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6. LABOR AND WAGES: (Continued)

b. Statement of Wages:

	1958	1957
Average Wages Per Day		
Surface	$24.44	$21.45
Underground	27.85	25.78
Total	$27.11	$24.90
Average Wages Per Month		
	(13-3/4 Days)	(19-2/3 Days)
Surface	$336.05	$421.70
Underground	382.94	506.83
Total	$372.76	$489.53
Tons Per Man Per Day		
Surface	46.44	52.34
Underground	12.91	13.47
Total	10.10	10.71
Labor Cost Per Ton		
Surface	$ .526	$ .410
Underground	2.157	1.914
Total	$2.683	$2.324

A substantial increase in the average wages per day is shown in the table above. The increase was attributable to three causes. First, there was the increase in wage rates plus cost-of-living increases. A second cause was the increase in the total vacation money paid out, as related to the total man-hours worked. In 1958, vacation pay amounted to $.260 per man-hour as compared to $.152 per man-hour in 1957. This represents an increase of $.108 per hour or $.864 per day. The third cause was an increase in the average job class.

c. Labor Relations:

Labor relations were good during the year with only one formal grievance being presented. Clifford Powers, a contract miner, contended that he had not received the proper pay for incentive work performed. The grievance was denied by management with the decision being accepted by the union.

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

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7. SURFACE:

Buildings:

All work consisted of routine repairs.

Headframe and Trestles:

An automatic sampling system was installed in the headframe early in 1958. Favorable results were obtained by removing an 80# sample as each skip dumped, crushing this material by hammermill to -1/8" size and splitting the crushed product to obtain a 1# sample per skip.

New scrolls were installed at the skip dump for both the north and south skips.

Rail ties were replaced on a 200' section of the north loading trestle.

Stocking:

Stocking of iron ore was continued during the winter months and a large proportion of the production during the shipping season was also placed on stock. All six top tram cars operated with only minor delays. Underground development rock was trucked by Euclids to a dump west of the shaft.

Engine House:

Three 8 hour delays in hoisting were attributed to breakdowns in the skip hoist equipment. Two delays involved short circuits in motors and generators and the third was caused by excessive clutch slippage.

The skip hoist clutch was overhauled during the Thanksgiving Day weekend. New basswood clutch blocks and a number of worn pins and bushings were replaced. Other engine house maintenance consisted of cleaning motors and generators and repairing compressor valves.

Skips:

The north and south skips were removed and replaced with spare units on September 22nd and November 1st respectively. The skips had operated for approximately a year, before being sent to the Brownstone Shops for a general overhaul.

Hoist Ropes:

No hoist ropes were removed from service during the year.

Shops:

A new steel punch machine was installed early in 1958 and used to help fabricate all steel set materials that were formerly made at the Brownstone Shops. In addition, the shops performed the general maintenance and repairs of surface and underground equipment as needed.

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7. SURFACE: (Continued)

Subsidence Studies:

Microseismic activity at the Mather Mine, "A" Shaft subsidence area was recorded daily throughout the year. From the recordings and other related information, it was concluded that a small amount of subsidence did take place but at a depth or distance far enough from the recording geophones that only the stronger of the microseisms were detected.

During the year two attempts were made to repeat the velocity survey conducted in 1957. Both failed due to the fact that the bottoms of the shot holes were not at ledge and it was impossible to get energy through the overburden to the recording geophones. The pin grid system, set up by the Engineering Department over the surface area of suspected cave, was checked regularly throughout the year. The vertical displacement of the steel pins was very minor and gave no indication of surface subsidence. Weirs and flumes, located in the main level drift water ditches, were checked regularly and readings taken. The flow of water from the various levels was calculated and recorded. By this means any increase in surface water entering the mine would substantially increase the volume measured and should be readily detected.

On all main levels, dam facilities are present so that dams can be constructed at any time to control the amount of water flowing to the pump stations at the shaft.

Microseismic Activity:

Microseismic activity over the old 5th and 6th Level workings was recorded throughout the year from geophones located in surface subsidence holes D.D.H. #65, D.D.H. #68, and D.D.H. #69. D.D.H. #65 and D.D.H. #68 are located over the 5th Level workings and D.D.H. #69 is located over the 6th Level workings. The geophone in D.D.H. #68 is positioned north of the Mather Fault and the phones in D.D.H.'s #65 and #69 are positioned south of the Mather Fault.

The highest microseismic count for the year was in March for D.D.H.'s #65 and #69 and in July for D.D.H. #68. It is of interest to note that the microseismic count from D.D.H. #65 was 200 in January, increased to 562 in March and decreased to 4 in July, while the count from D.D.H. #69 increased from 200 in January to 546 in March and decreased to 19 in July. During this same period the count from D.D.H. #68 reached a maximum of 45 in July with only 1 recorded in March. Therefore, it is concluded that during the first part of the year there was definite movement on the south side of the Mather Fault. It is highly possible that the reason for the lack of noise recorded from D.D.H. #68 is due to the fact that the geophone is located north of the fault and the fault zone attenuated the propagation of the microseisms. It is further concluded that the areas under test are fairly stable as the maximum counts recorded are extremely low as compared with areas of subsidence that have been studied elsewhere.

Since there was no indication of air movement either in or out of the subsidence holes under study, plus the fact that the water levels remained fairly constant in all three holes, it is considered that the area of cave is still in excess of 950 feet from surface.

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8. UNDERGROUND:

Block caving with the radial drilling system of undercutting continued as the mining method.

Steel sets continued as the principal means of support. Three types of sets were used during the year. A yielding arch set was used in the undercutting drifts, rigid arch sets were used in sub-level belt conveyor drifts, and for tugger rooms, and cutting raises. Square sets were used for transfer drifts and for main level drifts. In the transfer drifts, 7' caps with 7½' legs were used and in the main level drifts, 9' caps with 9' legs were used.

Use of steel raise tube sections to line transfer raises was continued. Osmose treated cribbing was used in permanent travel and supply raises.

7th Level:

Mining above the 7th Level was completed in October. A total of 3,889,196 tons was produced during the eight years that the level was in operation. The production from the 7th Level during 1958 amounted to 92,711 tons or 11.25% of the total mine output. The production came from five areas; two in Section 1 and three in Section 2. The areas in Section 1 were over the #8B and #9B Cross-cuts and the areas in Section 2 were over the #2 and #7 Cross-cuts, and the North Block East. The latter area was approximately fifty feet above and immediately to the north of the loading end of the 7th Level main conveyor belt.

Of the two areas in Section 1, the #8B Cross-cut produced 31,100 tons during the year and the #9B Cross-cut produced 44,202 tons.

In Section 2, the North Block East produced 4,452 tons during the year. Production from the #7 South Cross-cut was 8,419 tons. A small tonnage was left in this area when the area was abandoned due to excessive weight conditions. Mining from the #2 Cross-cut produced a total of 2,329 tons. This tonnage came from experimental work with the auger miner.

Exclusive of rock, the main level belt conveyor carried a total of 3,861,095 tons during its period of service on the 7th Level.

8th Level:

Production from the 8th Level during the year totaled 461,894 tons or 56.07% of the entire mine output. Total tonnage to date from this level is 1,861,655 tons.

The tonnage came from eight areas in Section 2 and one area in Section 1. Production by areas was as follows: #9B Cross-cut (Section 1) - 40,966 tons; #8 Cross-cut - 1,249 tons; #7 Cross-cut - 42,455 tons; #3 Cross-cut - 59,456 tons; #811 Block - 59,741 tons; #812 Block - 79,831 tons; #821 Block - 54,782 tons; #822 Block - 80,430 tons; #823 Block - 47,975 tons.

All of the available block cave areas above the 8th Level are being mined or are in the process of being developed for mining.

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8. UNDERGROUND: (Continued)

8th Level: (Continued)

All the ore from the 8th Level except 6,940 tons from the #3 Cross-cut was transferred to the 9th Level through a raise in #5 Cross-cut. The #3 Cross-cut tonnage was trammed to the shaft and hoisted from 8½ Level. During the year approximately 77% of the ore on 8th Level was handled by sub-level belt conveyors with the remainder being transported by rail haulage.

9th Level:

Production from the 9th Level amounted to 269,255 tons or 32.68% of the mine total. Total tonnage to date from the level is 384,307 tons.

Three areas were in production during the year and development of two additional caving areas was practically completed. Production by areas was as follows: #911 Block 33,345 tons; #921 Block - 190,633 tons; #941 Block - 17,633 tons. Development is proceeding in the #942 and #946 Blocks, both of which are over the #94 belt conveyor.

All of the ore mined between the 8th and 9th Levels is transported to a crushing station on the 9th Level by a system of sub-level conveyors. The belt system is arranged so that the #93 and #94 belts feed the #92 belt, and the #92 belt in turn feeds the #91 belt which then transfers the ore to the 9th Level storage trench and crusher station. In addition to handling ore from the other belts, the #91 and #92 belts each have one loading point which serves a block caving area.

#94 Conveyor

The 250 foot long, 36" wide #94 sub-level conveyor located above the 9th Level was installed and placed in operation during the year.

9th Level Main Conveyor

The 3200 foot 9th Level main conveyor operated efficiently, transporting 727,009 tons of ore during the year. Troughing idlers were substituted for flat carrying idlers on the short buffer belt that feeds the main conveyor, so as to improve its operation. A magnet was installed over the discharge of the buffer belt to remove tramp iron.

Development Below the 9th Level:

Development of the 12th to 9th Level inclined belt conveyor drift continued during the year. At the end of the year the heading had reached a distance of 1890' from the drive pulley and was 175' below the 10th Level elevation.

The connecting drift between the 10th Level and the inclined belt conveyor drift, together with 1,540' of drift on the 10th Level were completed during the year. The 10th Level drift crosses over the inclined belt conveyor drift, and development rock from the 10th Level is passed to a reciprocating plate feeder installed directly over the 12th to 9th Level belt and then fed onto the belt.

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8. UNDERGROUND: (Continued)

Development Below the 9th Level: (Continued)

Special ore and rock separation facilities were installed on the 9th Level immediately below the incline belt discharge point. By means of a butterfly door and a short conveyor, ore and rock can be directed into storage raises feeding the 9½ Level skip loading facilities.

A dual drive consisting of two 350 H.P. motors, eddy current couplings, speed reducers, backstops and thruster brakes were installed at the head pulley end of the 12th to 9th Level conveyor during the year. A temporary 75 H.P. drive unit was then removed and three 1,130 foot rolls of permanent belting was installed. The temporary drive was utilized along with old conveyor belting to convey all development rock from the first 1,000' of drift to the 9th Level where it was loaded into tram cars. The special scraper slide and conveyor sections were advanced in 150' to 250' increments to remove development rock from the drift heading.

Diamond Drilling:

The 1958 diamond drilling program for the Mather Mine, "A" Shaft consisted of drilling eight holes, three of which were drilled under the supervision of the Mather Mine, "B" Shaft. A total of 3,773 feet of drilling was completed, of which approximately 16% was 1st class ore. Of the year's drilling, 20% was used to outline ore reserves above the 8th Level and 80% to outline the ore reserves below the 9th Level. The average depth of the holes drilled to outline the reserves below the 9th Level was 875 feet with approximately 66% of the footage being drilled in hard hematitic iron formation.

8th Level

Four diamond drill holes were drilled from the 8th Level during the year.

U.H. #479 was drilled from the end of the 8300 Cross-cut at S. 3,099 and 11,923 W., at an inclination of -60°, and S. 1°16' W. This hole was drilled to a depth of 1,101 feet for the purpose of outlining ore reserves below the 9th Level south of the Jackson Fault* and west of the previous drilling on the 11,350 W. section. Approximately 60 feet of interbedded ore was disclosed and the hole bottomed in footwall formation. With the completion of U.H. #479 there is sufficient information to suspect that the Jackson Fault forks somewhere in the area between the 11,350 W. and 11,950 W. sections, and diverges toward the west. Major displacement is down along the south side of the north limb, with minor displacement, also down along the south side of the south limb. U.H. #479 was collared between the two limbs of the fault and it is highly probable that since there was no enrichment of the iron formation above the interbedded ore, the hole bottomed between the two limbs of the fault.

U.H. #485 was drilled from a drill station in the 8300 Cross-cut at S. 2,473 and 11,944 W., at an inclination of -45°, and S. 00°31' E. This hole was drilled to investigate the area above the 8300 Cross-cut south of a small east-west trending fault that has formed a limit to the ore body on the north side. With the completion of this hole, it was concluded that there is no enrichment south of the 2,450 S. coordinate in the area above the 8300 Cross-cut. This hole intersected the north limb of the

*Previously referred to as the E-W Fault.

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8. UNDERGROUND: (Continued)

Diamond Drilling: (Continued)

8th Level (Continued)

Jackson Fault giving another point and establishing the dip of the fault in this area.

U.H. #492 was drilled from the 8th Level elevation at S. 2,298 and 11,706 W., at an inclination of ∠50°, and N. 45°25' W. and U.H. #493 was drilled from the end of the 8400 Cross-cut at S. 2,210 and 11,697 W., at an inclination of ∠27° and S. 55°13' W. Both of these holes were drilled above the south end of the 8400 Cross-cut and northeast of the Mather Fault so that mining could be planned for this area.

9th Level

One hole, U.H. #446, was completed from the 9th Level, -1325 sub-level, during the year. The hole was drilled from a top timber drift that was driven to the south off the end of the 9620 East drift. The hole was drilled at S. 3,451 and 10,873 W. and at an inclination of -90°. This drilling further outlines the ore body below the level along the 10,850 W. section. Approximately 150' of ore was disclosed by this hole.

10th Level

During the year three holes located on the 10,600 W. section, were drilled from a top timber drift driven southwest off the end of the 10900 "A" Cross-cut. The drilling of these holes was supervised by the Mather Mine, "B" Shaft. U.H. #462 was drilled at S. 3,299 and 10,601 W. at an inclination of -90°; U.H. #470 was collared at S. 3,295 and 10,601 W. at an inclination of -65° and N. 4°10' W.; and U.H. #475 was collared at S. 3,304 and 10,599 W. at an inclination of -65° and S. 4°00' W. These holes were drilled to correlate and further outline the ore disclosed by the drilling on the 10,850 W. section, which is south of the Jackson Fault and west of the Mather Fault, and the drilling on the 10,400 W. section that is also south of the Jackson Fault but east of the Mather Fault. U.H. #462 disclosed 232' of ore, U.H. #470 disclosed 80' of ore and U.H. #475 disclosed 140' of ore.

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8. UNDERGROUND: (Continued)

Statement of Timbering Supplies Used in Operating Accounts

ITEM	AMOUNT	COST PER TON
Cribbing	$ 9,445.61	$.0115
Stulls	150.52	.0002
Lagging	12,524.31	.0152
Poles	10,744.56	.0130
Steel	278,201.88	.3377
Minecrete Supplies	47.50	.0001
Total 1958	$311,114.38	$.3777
Total 1957	$480,778.70	$.35608

Explosives:

The following tables show the cost of explosives used in mining 823,860 tons of ore (Table I), the unit costs and consumption of explosives (Table II), and the cost per ton of explosives used in Development for Mining as compared to the cost per ton for mining (Table III).

TABLE I

Cost of Explosives - Operating

	1958	1957
Powder - All Kinds and Miscellaneous Blasting Supplies (Fuse, Caps, Bags, etc.)	$106,412.01	$154,236.73

TABLE II

Unit Costs and Consumptions of Explosives

	1958	1957
Pounds of Powder Per Ton of Ore	0.426	0.387
Tons of Ore Per Pound of Powder	2.347	2.590
Cost Per Ton for All Explosive Supplies	$0.129	$0.114

TABLE III

	1958	1957
Cost Per Ton in Development for Mining	$0.043	$0.042
Cost Per Ton in Mining	0.086	0.072
Total	$0.129	$0.114

MATHER MINE "A" SHAFT
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8. UNDERGROUND: (Continued)

Pumping:

Pumping of underground water decreased approximately 10% in 1958 from 361 gallons per minute average in 1957 to 325 gallons per minute average in 1958. This decrease is directly attributed to a decrease in water flow to the Mather "A" from the Mather Mine, "B" Shaft.

	Mather Mine, "A" Shaft Water G.P.M. Average	Mather Mine, "B" Shaft Water G.P.M. Average	Total Water Pumped G.P.M. Average
1957			
3rd Level	49	-	49
6th Level	170	142	312
Total			361
1958			
3rd Level	63	-	63
6th Level	170	92	262
Total			325

All mine discharge water is carried through a 16" pipe line and then by ditch to the Carp River, approximately two miles towards the west. In the event of emergency pumping conditions, a second pipe line will provide additional capacity and allow water to discharge at the west end of the timber tunnel.

MATHER MINE "A" SHAFT
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9. TAXES:

Taxes for the year totaled $409,855.84. The 1957 taxes were exceeded by $10,746.36. Valuation in 1958 was increased by only $32,450; however, the tax rate was also increased from $45.35 per $1,000.00 of assessed valuation to $46.40 per $1,000.00 of assessed valuation. As indicated in the table below a pre-payment of $130,000.00 was made on the 1959 property tax.

	1958		1957	
	VALUATION	TAXES	VALUATION	TAXES
Mather Mine "A" Shaft including Stockpiles, Supplies & Equipment as placed by State Mine Appraiser:				
Real Estate	$6,570,000	$304,848.00	$6,595,000	$299,083.25
Personal Property	2,260,000	104,864.00	2,205,000	99,996.75
Pipeline - Cloverdale Tract NE-NE, Sec. 3, 47-27	650	30.16	650	29.48
	2,450	113.68		
Total Mather Mine "A" Shaft (City of Ishpeming)	$8,833,100	$409,855.84	$8,800,650	$399,109.48

	1958		
	TAXES	PER TON PRODUCED	PER TON SHIPPED
Total Operating - Assessed	$409,855.84	$0.497	$0.703
Paid	*$539,855.84	$0.655	$0.925

	1957		
	TAXES	PER TON PRODUCED	PER TON SHIPPED
Total Operating	$399,109.48	$0.296	$0.293

*Includes a pre-payment of $130,000.00 to be credited against 1959 taxes.

MATHER MINE "A" SHAFT
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10. ACCIDENTS AND PERSONAL INJURY:

There were 18 compensable injuries during the year with a lost time of 6,818 days. Six thousand of the lost time days were charged against a fatality which occurred during the year. There were 3 non-compensable injuries, which added 7 days of lost time making a grand total of 6,825 days. The severity was 9,637 and the frequency was 29.65 compared with company averages for underground mines of 8,969 in severity and 30.80 in frequency. The total hours worked was 708,236 as compared with 1,088,387 in 1957 for a decrease of 34.9%.

A regrettable accident occurred on August 18th when Glenn Veale, a contract miner, was fatally injured in a haulage accident. Mr. Veale, in violation of the safety rules, was riding on the coupling between a haulage locomotive and a tram car next to the locomotive. He either fell or attempted to jump from the moving train and sustained a broken neck and other internal injuries that resulted in his death.

DATE	NAME	NATURE OF INJURY	NUMBER OF DAYS LOST
1/10/58	Angelo Moretti	Fracture left second toe.	11
1/30/58	Leslie Hakala	Contused puncture wounds left knee over patella. X-ray negative for fracture.	7
2/18/58	Arthur Spears	Severe sprain both ankles. Possible fracture.	54
3/ 6/58	Onni Ketola	Compound fracture, complete lower jaw, left.	40
4/ 1/58	Leroy Hill	Fracture shaft middle phalanx, right index finger.	24
4/ 8/58	Walter Hill	Broken nose and cut upper lip.	14
4/18/58	Lawrence Girard	Contusion of lumbo sacral region. Contusion left buttock.	176
5/ 1/58	Waino Roose	Fracture four toes, left foot.	150
6/ 5/58	Carl Champion	Contusion dorsum, right foot.	22
6/28/58	Eino E. Maki	Fracture third metatarsus, right foot.	25
8/18/58	Glenn Veale	Fatality.	6,000
8/18/58	Richard Storti	Contusion right leg and extensive ecchymosis.	30
9/ 2/58	Chester Bignall	Back strain.	20
10/ 6/58	Isaac Hulkoff	Fracture distal head of 5th metacarpal & proximal phalanx, 5th finger.	15
11/10/58	John Johnson	Multiple lacerations & abrasions of scalp & forehead. Contusion of back with fractures - 4th, 5th, 6th, 7th, 8th, 9th ribs.	60
11/20/58	Albert Saari	Contusion dorsum left foot.	32
11/26/58	Glenn Pohlman	Two cuts in thigh, left leg, swollen.	8
12/ 9/58	Paul Villeneuve	Fracture (crushed) 1st & 2nd lumbar vertebrae.	130
		Total Days Lost	6,818

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11. POWER:

A total of 14,918,766 kilowatt hours of electric power was consumed in 1958 as compared to 19,663,002 kilowatt hours consumed in 1957, a reduction of approximately 4,500,000 hours. The difference is directly related to the reduced work schedule.

The power rate was determined by dividing the total operating cost of The Cleveland-Cliffs Electric Power Department by the total kilowatt hours sold and charging the consumer proportionately. To this is added a wheeling charge by the Upper Peninsula Power Company for distributing this power to the mine.

An additional charge was made for the rental of The Cleveland-Cliffs Iron Company generating equipment. This rental charge is a proportionate amount of $28,450 to be divided between The Cleveland-Cliffs Iron Company, The Humboldt Mining Company, The Negaunee Mine Company, and Marquette Mining Company according to the amount of power consumed at each property.

	CONSUMPTION K.W. HOURS	AVERAGE MAX. DEMAND	AVERAGE DEM. FACTOR	COST OF CURRENT	AVERAGE PRICE PER K.W. HOUR
1958	14,918,766	4250 K.W.	41%	$197,306.03	$.0132
1957	19,663,002	4200	54%	219,090.30	.0111
1956	18,229,341	3120	68%	164,413.16	.0090
1955	16,245,161	3620	52%	150,266.76	.0092
1954	14,249,248	3550	46%	132,087.61	.0093

MORRIS MINE
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1. GENERAL:

The production for the year was 339,300 tons as compared with 309,150 tons in 1957. Of this total, 36.7% was mined on Fee Lands from three operating stopes between 10th and 9th Levels. Sixty-three and three-tenths percent of the production was mined by sub-level caving methods on Leased Lands above 9th Level.

A small reduction was gradually made in the working force during the year, but the recession which was keenly felt by most of the iron mining industry did not affect the Morris Mine. A working schedule of 2-8 hour shifts per day for 5 days per week was maintained throughout the year. An increase in efficiency over the previous year is reflected in the comparison of 7.27 tons per man per day in 1958 with 6.50 tons per man per day in 1957. Total shipments, 335,215 tons, were slightly less than the production, 339,300 tons. The stockpile carry-over at the end of the year was 47,243 tons.

The estimated ore reserves increased 272,964 tons; 225,892 tons in the Chase Lease and 47,072 tons in The Cleveland-Cliffs Iron Company's Lands. The principal increase was in Deposits #75C and #33 above and below 9th Level in Chase Lease #9. One underground diamond drill hole (#14) and mining development work on and above 9th Level revised the estimate in this area. As of October 1, 1958, total reserves were 3,454,004 tons.

Deep-well surface pumping has been continued and an average of 640 g.p.m. was pumped compared with 914 g.p.m. in the previous year. In March, May and August, no surface pumps were operated and in December, three of the wells were shut down as part of a well testing program. An average of the eight months when all surface well pumps were in normal operation was 889 g.p.m. The volume of underground water averaged 1654 g.p.m. as compared with 1644 g.p.m. in 1957. Pumping costs were $.03 per ton for surface drainage and $.56 per ton for underground pumping, a total of $.59 per ton.

Approximately 250 feet of main level drifting was done on 9th Level in Deposits #86 and #75C. The 10th Level drift was advanced 825 feet to the West in Fee and Leased Lands.

2. PRODUCTION, SHIPMENTS AND INVENTORIES:

a. Production

Year	Grade	Tons
1958	Morris	339,300
1957	Morris	309,150

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2. PRODUCTION, SHIPMENTS AND INVENTORIES: (continued)

The 1958 production came from Fee and Leased Lands in the following proportions:

	Fee	Leased	Total
Production - Tons	124,679	214,621	339,300
Percentage	36.7%	63.3%	100.00%
Percentage - 1957	20.8%	79.2%	100.00%

Leased Land production was as follows:

Chase Lease #9	191,351 tons
Chase Lease #24	23,270 tons
Total 1958	214,621 tons

A summary of the total production, Fee and Lease, since the Inland Steel Company took over the Morris Mine Lease is listed below:

	Tons	Percent
Lease Ore Production 1933-1958	5,914,285	75.02
Fee Ore Production 1933-1958	1,969,315	24.98
Total	7,883,600	100.00

b. Shipments

Grade	Pocket	Stockpile	Total
Morris	154,245.49	180,969.92	335,215.41

Grade	Fee	Lease	Total
Morris	118,521	216,694	335,215

The following table shows the shipments for the past five years:

Year	Total
1958	335,215
1957	295,685
1956	302,710
1955	335,939
1954	326,001

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2. PRODUCTION, SHIPMENTS AND INVENTORIES: (continued)

Total shipments since Inland acquired lease in 1933 - 7,826,791 tons.

c. Ore in Stock December 31, 1958

Grade	Tons
Morris	47,243

d. Production by Months

Month	Days Worked	Average No. of Men	Tons Per Man Per Day	Production
January	22	193	6.86	27,368
February	20	188	7.26	27,304
March	21	187	7.78	30,534
April	21	187	6.88	27,020
May	21	184	7.69	29,716
June	21	184	7.70	29,730
July	22	186	7.95	32,545
August	21	186	7.82	30,554
September	21	186	6.26	27,622
October	23	182	7.01	29,322
November	19	182	6.61	22,863
December	20	179	6.90	24,722
Total	252	185.3	7.27	339,300

e. Working Schedule

The mine operated 2-8 hour shifts per day 5 days per week.

f. Delays

There were no significant delays to operations during the year. On November 18, the day shift did not operate the mine because of considerable smoke from a minor mine fire.

3. ANALYSIS:

a. Shipments

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3. ANALYSIS: (continued)

Grade	Tons	Iron Dried	Iron Nat'l	Moisture
Morris	335,215	57.201	50.583	11.57

b. Ore in Stock December 31, 1958 (Natural)

Grade	Tons	Iron Dried	Iron Nat'l	Phos.	Silica	Mang.	Moisture
Morris	47,243	57.23	50.93	.072	10.41	.37	11.00

c. Ore Reserves - Expected Natural Analysis

Grade	Tons	Iron	Phos.	Silica	Mang.	Alum.	Sulphur	Moisture
Morris	3,242,469	48.75	..075	12.00	.44	2.40	.015	12.00
Hi-Sul	239,157	49.06	.090	12.00	.40	2.40	.385	12.00

4. ESTIMATE OF ORE RESERVES:

The estimated reserves, after allowance for ore mined in 1958, shows 272,964 tons of new ore developed.

The Cleveland-Cliffs Iron Company's Lands had an increase of 47,072 tons. New development on 10th Level increased the reserves in Deposit #84 below 10th Level. In Deposit #87 between 8th and 9th Levels and below 9th, additional tonnage was reflected in the Engineer's estimate. Stoping operations between 10th and 9th Levels made some areas above 9th Level inaccessible for mining.

The Chase Leases increased 225,892 tons. In the Chase Lease #24, a gain of 9,656 tons in Deposit #79 (Hi Sulphur) below 9th Level was offset by 12,990 tons in Deposit #79 (Hi Sulphur) between 8th and 9th Levels being marked off as inaccessible. The remaining deposits in this lease are the same as the previous year.

The major change in the Morris Mine reserves was in the Chase Lease #9. Deposits #75C and #33 between 8th and 9th Levels increased 157,495 tons. The same deposits below 9th Level increased 59,238 tons. Diamond Drill Hole #14 plus mining development revised the estimates in this area.

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4. ESTIMATE OF ORE RESERVES (continued)

	Estimate 9-1-57	Production 9-1-57 to 9-1-58	Estimated Deducting Product	Actual Estimate 10-1-58	Incr. or Decr. from 1957 Estimate
Total Chase Lease #24	39,342	-	39,342	39,342	-
Total Chase Lease #24 (Hi Sulphur)	262,093	19,602	242,491	239,157	3,334
Total Chase Lease #9	1,714,452	204,469	1,509,983	1,758,478	248,495
Total Chase Lease #9 (Hi Sulphur)	26,831	7,562	19,269	-	19,269
Total Chase Leases	2,042,718	231,633	1,811,085	2,036,977	225,892
C.C.I. Co. Lands	1,496,362	106,203	1,390,159	1,444,649	54,490
C.C.I. Co. Lands (Hi Sulphur)	7,418	-	7,418	-	7,418
Total C.C.I. Co. Lands	1,503,780	106,203	1,397,577	1,444,649	47,072
Grand Total	3,546,498	337,836	3,208,662	3,481,626	272,964
Grand Total (Using Oct. 1st Figures)	3,519,878	338,838	3,181,040	3,454,004	272,964

5. LABOR:

The labor force went from a high of 193 in January to a low of 179 in December. The average of 185 men in 1958 compared with the yearly average of 194 in 1957.

6. SURFACE:

The ramp at the air shaft was dismantled and rebuilt with waste rock.

An automatic continuous recording device was installed where the mine water discharges into the settling basin to measure the variation in underground pumping.

A surface well testing program was initiated to determine the effect of surface pumping on underground water inflow. In March, May and August, all of the surface wells were shut down, and in December, three of the wells were not operated. This program will continue in 1959.

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6. SURFACE: (continued)

Surface Pumping

RECAPITULATION OF SURFACE AND UNDERGROUND PUMPING FOR 1958

Month	Surface Pumping G.P.M.	Drop In Test Hole Feet	Underground Pumping G.P.M.
January	859	.23	1628
February	853	.20	1581
March	Down	.25	1635
April	932	.01	1646
May	Down	.30	1677
June	931	.01	1670
July	943	.00	1633
August	Down	.35	1679
September	876	.07	1686
October	887	.05	1666
November	834	.18	1651
December	567*	.06	1690
Average 1958	640	.01	1654

Down - Surface wells shut down for experimental purposes

* Nos. 1, 8 and 9 surface wells shut down for experimental purposes

Pumping cost for surface drainage was $.03 per ton in 1958 as compared to $.06 per ton in 1957.

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7. UNDERGROUND:

a. Pumping

The following table shows a comparison of the mine water pumped over a six year period:

Year	4th	6th	7th	8th	9th	10th	Total
1958	38	88	107	523	878	20	1654
1957	46	112	111	495	865	15	1644
1956	51	109	109	476	840	15	1600
1955	57	52	108	509	791	15	1535
1954	72	44	97	554	797	15	1574
1953	76	37	77	546	882	-	1621

The following table shows a comparison of underground pumping cost per ton for the last eight years:

Year	Cost Per Ton
1958	$.56
1957	.56
1956	.61
1955	.51
1954	.46
1953	.55
1952	.65
1951	.49

b. Development

Two contracts, #30 and #4, mined in Deposit #79 in the Chase Lease #24 during 1958. Number 30 sub-caved from the -150' Sub below 8th Level utilizing the 8th to 9th Level ore pass raise. Number 4 worked in the same deposit immediately above 9th Level.

Ten contracts operated in the Chase Lease #9. Early in the year, #6 Contract completed a small "scram" stope in Deposit #87 above 9th Level. By the end of the year, #24 finished the one remaining stope above 9th Level in Deposit #86.

Contracts #2, #3, #5, #7, #12, #15 and #20 sub-caved in Deposits #75C, #33, #76 and #87 between 9th and 8th Levels. Contract #17 extended the 9th Level drift West in Deposit #86, then South in Deposit #75C, a total of 250 feet. A pillar on the Northeast side of the #24 stope will be recovered from a top timber over this drift. The 9th Level drift was

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7. UNDERGROUND: (continued)

repaired near #927 Raise to facilitate development into the area of the ore intersected by D.D.H. #14. D.D.H. #14 was drilled along the 2325 West coordinate from 9th Level cutting approximately 62 feet of ore.

An average of six contracts worked between 10th and 9th Levels in Fee Lands during 1958. Production came from three operating stopes, #101, #102 and #103, in Deposit #84. Two more stopes are being developed. In the #104 stope the transfer and intermediate sub-levels are almost completed and ore will be mined from this stope early in 1959. The #105 Contract completed the raise from the 10th Level and the transfer drift. Contract #150 on 10th Level drifted Northwest on Fee Lands for approximately 425 feet, then due West in the Chase Lease 400 feet.

On 10th Level, installation of a new type water door will be completed early in 1959. The opening, formed in the conventional manner by concrete placed in hitches in the rock, will be closed by a prefabricated sliding steel door.

Respectfully submitted,

Ralph E. Magnuson, Jr.

Ralph E. Magnuson, Jr.
Chief Mining Engineer

DPI:jcj

March 19, 1959

OHIO MINE
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1. INTRODUCTION

The Ohio Mine was completely idle throughout the year 1958 as there were no concentrates produced or shipped.

It became definite by March that the Ohio would remain idle, and at that time the status of the layoff was changed from seasonal to economic. This resulted in eleven Ohio employees being recalled and transferred to the Republic Mine as permanent employees, according to district seniority rules.

The water in the West pit rose steadily following the removal of the pumps in December of 1957. By April it was estimated that there was 60 feet of water at the west end of the Norwood pit and by midsummer the depth was approximately 82'.

A crew of maintenance men inspected the plant and attempted to retard any weather damage and machinery deterioration in the mill during a one week period in May and later during the first half of November. The principal work completed during these periods was the removal of belts Nos.1,2,3,5,6 and 7, the filling of gear cases with rust preventative oil, and the partial disassembling of the magnetic separators. During the latter period, part of the remaining inventory and some items of the equipment such as the welders and cutting torches, were moved to the Humboldt Mine Shops. The final work before locking up the property for the winter was the checking and repairing of all fire extinguishers.

Throughout the year, the property was opened and equipment transferred to the Republic concentrator to aid in research work at that property.

Over the weekend of September 13th and 14th, 1958, all buildings at the Ohio Mine were entered and a number of small items were stolen. It was estimated that the burglary resulted in $25 damage to locks and doors and that approximately $200 worth of tools were removed. Although the State Police and County Sheriff's Department assisted CCI personnel in the investigation, none of the stolen equipment was recovered.

2. ORE RESERVES

	(Concentrate) Ohio-Norwood
Proven - Probable	245,000
Prospective	48,000
Total	293,000 tons
Wt.Recovery	40%

Estimated Analysis for Remaining Reserves

	Iron	Phos.	Sil.	Sul.	Moist
Ohio-Norwood Conc.(dried)	52.33	0.19	7.18	0.15	-
Ohio-Norwood Conc.(natural)	48.97	0.18	6.72	0.14	6.42

88% Heavy media concentrates
12% Spiral and jig concentrates

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3. TAXES

	1958		1957	
Ohio Mine	Valuation	Taxes	Valuation	Taxes
Real Estate	$ 281,600	$ 13,618.17	$ 295,600	$ 14,788.84
Personal Property	111,000	5,367.96	60,000	3,001.80
Total		$ 18,986.13		$ 17,790.64
Collection Fee		189.86		177.91
Total Ohio Mine	$ 392,600	19,175.99	$ 355,600	17,968.55
Webster Mine-N½-NE,SE-NE,26,48-31	600	29.30	600	30.30
Total Spurr Township	$ 393,200	$ 19,205.29	$ 356,200	$ 18,988.85
Tax Rate	48.36		50.03	

4. IDLE EXPENSE - 1958

Pit Expense	$ 213.61
Crushing & Screening	240.00 (credit)
Milling expense	895.39
Tailings Disposal	-
Stocking Expense	-
General Mine Expense	7,502.87
Rental of Pumps	3,195.18 (credit)
Vacation Pay	962.55
Total	$ 6,139.24
Taxes	19,205.29
GRAND TOTAL	$25,344.53

Average Cost per Month (excluding taxes) $ 511.60

REPUBLIC MINE
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1. GENERAL:

The Republic Mine operated on ore production all through the year. A four day per week schedule was in effect from the first of the year until June 2nd, at which time the schedule was extended to six days per week. This schedule was further extended to seven days per week on September 14th and continued on this basis for the remainder of the year. There was a one week shutdown for vacations, extending from July 28th to August 4th, which coincided with a maintenance shutdown at the pelletizing plant.

Ore hauling from the pit and crushing required one to one and a half shifts per day. Primary drilling and concentrator operations were scheduled on a three shift per day basis. While on the four day per week schedule, the concentrator worked 12 shifts on production with one additional repair shift. With the nominal six day per week schedule, there were 16 shifts on operating and one on repairs, which was increased to 20 operating shifts and one on repairs on the seven day schedule.

Stripping was done by the afternoon shift pit crew after fulfilling ore haulage requirements. In addition, a small day shift crew was maintained on stripping during a part of the year.

There was no major construction program at the mine during the year, however, the program of removing houses from the vicinity of the mining area was continued. A total of seven houses were moved from the north end of the pit, all but one of which were relocated at the new plat. In addition, three houses were torn down by their previous owners and three other houses were purchased outright.

The performance and operation of pit and plant facilities during the year was excellent. There were no major unscheduled repair shutdowns and operating time continued to be high. Hourly feed rates to the concentrator showed improvement and the dry analysis of the product also showed some improvement over the two previous years.

Ore was mined predominantly from the north end of the pit with the 1600 N. and 1640 N. benches supplying most of the tonnage. This ore was quite soft, permitting high feed rates but it was lower in grade than the overall pit average and somewhat difficult to treat, which is reflected in a somewhat lower weight recovery than was anticipated.

A major adjustment in the crew took place in March, when under provisions of the labor agreement, it was necessary to lay off fifty low seniority men from the Republic Mine crew and replace them with higher seniority men from the open pit economic layoff list.

A five mile section of new highway M-95, which by-passes the mining area and the Village of Republic, was opened to traffic in August.

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2. PRODUCTION, SHIPMENTS AND INVENTORIES:

a. Operating Schedule:

	No. of Days	Shifts Per Day	Hours Per Shift	Total Shifts
Mining	274	1 & 2	8	376
Hauling & Crushing	274	1 & 2	8	376
Mill Operating	279	1, 2 & 3	8	808

b. Production by Months:

Month	Tons of Crude Crushed	Tons of Crude Milled	Tons of Concentrates
January	67,427	71,093	29,931
February	66,323	65,979	27,551
March	67,807	66,401	29,188
April	76,589	76,762	34,473
May	71,671	73,611	36,220
June	99,083	96,255	45,324
July	79,675	79,529	37,145
August	96,442	95,540	47,519
September	77,114	78,267	45,832 *
October	67,168	65,930	30,569
November	113,080	113,288	48,469
December	123,741	122,781	50,214
TOTAL YEAR - 1958	1,006,120	1,005,436	462,435
TOTAL YEAR - 1957	670,240	666,186	323,860

* Includes 9097 tons stockpile overrun.

c. Production Averages:

	Year 1957	Year 1958
Average Crude Ore Per Day	3765 Tons	3672 Tons
Average Concentrates Per Day	1779 Tons	1657 Tons
Tons Per Man Per Day - Crude Ore	40.98 Tons	44.47 Tons
Tons Per Man Per Day - Concentrate	19.80 Tons	20.44 Tons
Average Weight Recovery	48.61%	45.99%

d. Tonnage and Analysis of Concentrate Produced and Shipped:

	Tons	Iron	Phos.	Sil.	Sul.	Moist.
On Hand Dec. 31, 1957	139,968	63.23	.035	8.39	.007	5.67
Produced Year 1958	462,435	63.38		8.19		6.73
Pocket to Pellet Plt.	346,745	63.23		8.44		6.76
Stkpile to " "	196,757	63.38		8.12		5.84
On Hand Dec. 31, 1958	58,901	63.76		7.60		6.67

e. Estimated Production and Analysis:

	Tons	Iron	Phos.	Sil.	Sul.	Moist.
Dried		63.10	.028	8.82	.013	-
Natural	446,900	59.31	.026	8.29	.011	6.00

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3. ESTIMATE OF ORE RESERVES:

a. Estimated Reserves:

Since there has been no exploration drilling during the year, the estimates of last year have merely been brought up to date to reflect the ore removed during 1958. As mining has progressed, actual mining limits have been established which have been plotted on the geological maps. In addition, studies of surface exposures have been made in the Park City area which have adjusted some of the previously assumed contacts. This information is being compiled and will be used in the future to adjust the reserve estimate as required.

Proven and Probable Ore as of January 1, 1959

Main pit to elevation 1100 and Park City to elevation 1200 using a conversion factor of 11 cu. ft./ton.

Elevation	Total Crude Ore	Total Concentrates *
1500	24,978,968	12,489,484
1400	28,366,913	14,183,456
1300	29,403,430	14,701,715
1200	29,956,799	14,978,400
1100	17,259,612	8,629,806
Total	129,965,722	64,982,861

* Concentrates calculated at 50% weight recovery.

	Stripping		Cu. Yds.
Elevation	Cu. Yds. Surface	Cu. Yds. Rock	Equiv. Stripping *
1500	730,996	720,828	2,388,900
1400	741,039	2,966,742	7,564,546
1300	602,344	4,976,437	12,048,149
1200	718,963	8,654,711	20,624,798
1100	1,013,751	8,623,810	20,848,514
Total	3,807,093	25,942,528	63,474,907

* Rock calculated at a factor of 2.3 for equivalent stripping.

b. Estimated Analysis:

	Iron	Phos.	Sil.	Sul.	Moist.
Dried	63.10	.028	8.82	.013	-
Natural	59.00	.026	8.25	.012	6.50

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4. LABOR AND WAGES:

a. General:

The number of hourly rate and salaried employees on the mine payroll ranged from 89 at the first of the year while on the four day per week schedule to 115 at the end of the year on the seven day per week schedule. In addition, there were five salaried employees on the general payroll. From other departments, an engineer and surveyor were assigned to the mine on a full time basis and a geologist on a part time basis.

A cost of living increase amounting to $.05 per hour went into effect on January 1, 1958. On July 1st, an additional cost of living increase of $.04 was added, bringing the total cost of living adjustment to $.16 per hour. Also effective July 1st, a 7 cent across-the-board increase in the hourly wage rate and a .2 of a cent increase in the increment between job classes went into effect, while the Sunday premium was increased from 20% to 25% and holiday premium was increased to double time and one-quarter. At the same time, shift differentials were increased from $.06 to $.08 for afternoon shift and from $.09 to $.12 for night shift.

Labor relations were generally satisfactory during the year. One grievance was filed, which was dropped by the Union in the second step.

The IBM system of payroll calculation and control went into effect November 1st.

b. Report of Men Hired, Transferred and Separated:

Month	Total Beginning of Month	Rehires & New	Trans. Fr. Other Mines	Total Men	Trans. To Other Mines	Lay-Off	Quits	Total End of Month
January	89	1		90		2		88
February	88			88				88
March	88		53	141	2	50		89
April	89			89	1			88
May	88			88			1	87
June	87	27		114			1	113
July	113		1	114				114
August	114		2	116		1		115
September	115			115				115
October	115			115				115
November	115			115				115
December	115			115				115
Total Yr.	89	28	56	173	3	53	2	115

The above table includes only hourly and salaried men on the Republic Mine payroll.

c. Report of Vacations Paid:

	Year	No. Men	Total Hours	Total Amount	Avg. Rate Per Hour
Actual	1956	35	2080	$ 5728.48	$ 2.754
Actual	1957	87	4870	12652.86	2.598
Est.	1958	85	5420	14880.00	2.745
Actual	1958	89	5660	15456.67	2.731

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

d. Annual Statement of Labor:

	Stat. Men	Hours	Amount	Average Rate
Hourly Employees				
Straight Time	77¼	172176½	$ 455550.62	2.646
Overtime		2037	2798.94	1.374
Sunday Premium Time		3277	2102.67	0.642
Shift Diff. - Aft.		56460	4225.92	0.075
Shift Diff. - Nite		18582½	2041.38	0.110
Holiday Allowance		5370	14455.12	2.692
Physicals & Allowed Time		13	38.32	2.948
Vacation Pay		5660	15456.67	2.731
Total Hourly Employees	77¼	172176½	$ 496669.64	2.885
Salaried Employees				
Mine Payroll	5¾	12794½	48087.85	3.758
Total Mine Payroll	83	184971	$ 544757.49	2.945
General Payroll				
Salaried Straight Time	3½	8007½	23457.78	2.929
Overtime		8	10.30	1.287
Labor from Other Mines	4¼	9246½	34186.86	3.697
TOTAL LABOR	90¾	202225	602412.43	2.979
Distributed as Follows:				
Operating Republic Mine	81	180980½	538385.90	2.975
Stockpile Regrind	-	-	-	-
Idle Expense	-	-	-	-
Stripping	6¼	13775½	41014.96	2.977
Uncompleted Construction	½	1069	3277.18	3.066
Other Mines	2¾	5963	18076.38	3.031
Other Accounts	¼	437	1658.01	3.794
Total as Above	90¾	202225	602412.43	2.979

e. Labor Cost:

	Year 1957	Year 1958
Production of Concentrates - Long Tons	323,860 Tons	462,435 Tons
Number of Days Operated	182	279
Number of Shifts Operated	535	808
Average Daily Production - Concentrates	1779 Tons	1657 Tons
Average Production Per Shift	605 Tons	572 Tons
Tons Concentrate Per Man Per Day	19.80 Tons	20.44 Tons
Average Wages Per Man Per Day	21.90	23.83
Average Job Class	10.1	10.7
Total Amount Paid for Labor (Production)	$356,420.97	$ 538385.90
Labor Cost Per Ton of Concentrate	$ 1.101	$ 1.164

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5. GENERAL SURFACE:

a. Buildings and Repairs:

All garage doors in the shop-office-dry building were painted and a number of the operating mechanisms were repaired.

A contract was let to Kielinen & Son to extend the "E" line retaining wall on the north side of the mill in preparation for plant expansion. Concrete for footers was poured on this project before the end of the year.

b. Roads and Grading:

A permanent access road 50' wide and 900' long was built north of the primary crusher and east of the ultimate stripping limits on the footwall side of the ore body.

Various portions of the stockpile area were widened totaling an area of approximately 100 ft. wide and 900' long.

c. Water Supply:

No major changes or additions were made to the existing water system. One stage was removed from one of the reuse water pumps in order to reduce the capacity of this unit.

Monthly samples were taken of water returning from the tailing basin to Milwaukee Lake and to Michigamme River for analysis of solids content. and pH.

d. Tailings Disposal:

The No. 1 tailings dam dike was raised approximately 3 feet by using 2842 cu. yds. of earth stripping. The rate of build-up of tailings along No. 1 dike ranged from .44 ft. to .61 feet per month, for an average increase of .50 feet per month for the entire year.

During the summer months, thickened tailings were pumped from the tailing cyclone plant to No. 4 dike to fill in the deepest part of the pool and to reinforce the dike

The profile of the 20" tailing line extending from the mill to No. 1 dike was modified in order to reduce pipe line wear. The slope of the line on the upper and lower ends was flattened and a 35' vertical drop was installed in about the middle of the pipe line to dissipate the velocity of the pulp flow.

e. Miscellaneous

To facilitate mining and stripping operations, the north pit pole line was extended 2200 ft. along the footwall side of the pit.

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5. GENERAL SURFACE: (Cont'd.)

e. Miscellaneous (Cont'd.)

The 4" oxygen line was extended 1600 ft. to the north paralleling the new power line.

The fire hydrant northeast of the primary crusher was moved 40 ft. east in conjunction with the road building in that area.

6. OPEN PIT:

a. Stripping:

The expenditures for the year, exclusive of depreciation, amounted to $93,640.73 of the $100,000.00 that was authorized.

The shovel stripping of overburden consisted of: the start of a 1560 bench in the southeast corner of the present pit between coordinates 900 N. and 1000 N. and from 200 E. to 600 E.; the continuation of the 1520 stripping cut on the hangingwall from 1900 N. to 2200 N., and the 1560 hangingwall stripping from 2700 N. to 3200 N.

Dragline stripping was continued along the footwall zone from 350 N. to 700 N. between 250 E. and 550 E., and from 800 N. to 1400 N. and 1850 N. to 2200 N. between 1700 E. and 1800 E.

Rock stripping was done in conjunction with the north footwall road extending from the primary crusher to the 1600' bench. This work was in the area bounded by 1800 N. to 2150 N. and 1600 E. to 1750 E.

The map on the back of this report shows the location of these various work areas.

The following tabulation summarizes the stripping operations:

Month	Cu. Yds. Surface	Cu. Yds. Rock	Total Cu. Yds.	Yds. Per Man Days	Man Days	Before Depr'n Cost Per Yd.
January	14934	0	14934	121.1	123¼	.393
February	12464	0	12464	112.5	110⅞	.416
March	5149	135	5284	96.5	54¾	.535
April	5111	1185	6296	114.5	55	.396
May	10982	0	10982	114.4	96	.335
June	16983	0	16983	121.3	140	.400
July	10740	3615	14355	140.4	102¼	.552
August	8007	1815	9822	89.7	109½	.586
September	8109	6465	14574	84.8	171¾	.734
October	9112	8745	17857	73.8	241¾	.569
November	13192	5970	19162	108.3	177	.628
December	306	20823	21129	62.2	339¾	.957
Total 1958	115089	48753	163842	95.2	1721¾	.572
Total 1957	179882	80725	260607	93.4	2789¼	0.498
Total 1956	361282	35480	396762	133.1	2981	0.474
Total 1955	165635	0	165635	154.4	1073	0.395
Total to Date	821888	164958	986846	115.2	8565	0.483

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6. OPEN PIT: (Cont'd.)

b. Stripping Expenditures:

E&A MI-32:	Amount Authorized	Amount Expended	Amount Unexpended
Stripping	$ 100,000.00	$ 93640.73	$ 6359.27
Depreciation	17,400.00	18449.00	1049.00
Grand Total	$ 117,400.00	$ 112089.73	$ 5310.27

Detail:

	Authorized			Expended		
	Cu. Yds.	Rate	Amount	Cu. Yds.	Rate	Amount
Earth	230175	.40	$ 92070.00	115089	0.400	$ 46035.67
Rock	8000	.99	7930.00	48753	0.976	47605.06
Total	238175	.42	$100000.00	163842	0.572	$ 93640.73
Depreciation			17400.00			18449.00
TOTAL			$117400.00			$ 112089.73

c. Open Pit Mining:

The major portion of the crude ore mined during the year was produced from the 1600 bench. The north face (53% of the production) was extended easterly to the footwall and advanced 300' to coordinate 2300 north. The south face (which provided 15% of crude ore requirements) advanced 60 feet to 1040 north.

The 1640' bench was extended to the hangingwall and then advanced northward to 2650 north. This bench produced 26% of the crude tonnage.

A cut was started in the 1560' bench hangingwall ore at 1900 north which will be raised to the 1600' bench on the footwall where it will meet the road extending north from the primary crusher. This development produced 6% of the crude ore mined during the year.

The jet piercing machine produced 99% of the tonnage mined during the year. The remaining tonnage was produced with 3" wagon drill, and a 6¾" "down the hole drill", which was used on a test program.

Twenty major field blasts were fired during the year. The continued used of the 4" submersible pump made it possible to increase the amount of prilled ammonium nitrate to 60% of the total explosives used. The remaining 40% consisted of 4", 5" and 6" cartridges of EP 152 and EP 158 (pellets).

Normally, one Marion 4161 - 5 cu. yd. shovel was used for loading ore into three 34-ton Euclid end dump trucks for transportation to the primary crusher. A dozer worked in conjunction with the loading operation. Some blending of ores was done during the year.

In February, some test work was done with a 6¾" Ingersoll-Rand "down the hole drill". When available in a 9" size or larger, this type of unit will merit further testing.

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6. OPEN PIT: (Cont'd.)

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

Summary of Pit Production:

	Year 1957	Year 1958
Crude from pit to crushing plant	670,240 Tons	1,006,120 Tons
Crude from stockpile to crushing plant	-0-	-0-
Total Crude from pit to crushing plant	670,240 Tons	1,006,120 Tons
Waste Rock, pit to dump - yards	-0-	-0-
Total Footage drilled jet piercing machine	22,246 Ft.	33,882 Ft.
Total Footage drilled wagon drills	29,176 Ft.	20,158 Ft.
Total Footage drilled Joy drilling machine	-0-	539 Ft.
Total Footage drilled 6¾" Down-the-Hole		369 Ft.
Average Grade of crude ore	37.73 % Iron	36.24 %
Average Grade of crude ore	43.10 % Sil.	
Cost Per Ton of Crude Ore	$ 0.485	$ 0.447

Summary of Powder Used:

Type	Quantity	Unit Cost/100	Total Cost
EP 152	130,390 #	$ 19.70	$ 25,686.85
EP 158	74,150 #	20.24	15,005.25
EP 146	11,425 #	18.81	2,149.14
Dynatex-WR-B	9,000 #	9.94	995.00
Dynatex-B	3,000 #	8.00	240.00
Herco-Prills	332,550 #	4.44	14,767.83
M.S. 17 Connectors	728 Pcs.	53.50	389.48
Wirebound Primacord	69,500 Ft.	4.26	2,961.73
Regular Primacord	70,000 Ft.	3.17	2,219.00
X645 Boosters	3,114 Pcs.	55.54	1,729.50
Total			$ 66,143.78

Material broken (Ore and Rock) 1,127,187 Tons

Cost Per Ton of Material Broken	.059	1958
	.075	1957

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6. OPEN PIT: (Cont'd.)

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

Summary of Jet Drill Holes Blasted:

Date	No. of Holes	Average Depth	Average Spacing	Powder Factor *	Gross Tons Ore	Cu. Yds. Rock
1 - 9	71	28.4	16.2 x 16.7	1.78	58,000	
1 - 28	48	35.6	14.8 x 15.6	1.82	46,561	
2 - 17	74	25.6	16.1 x 16.0	2.01	54,450	
3 - 6	60	35.6	15.7 x 16.5	1.86	57,752	
3 - 11	10	44.0	18.0 x 18.0	1.77	14,000	
4 - 3	82	27.4	17.0 x 17.9	1.80	62,562	
4 - 24	45	35.3	20.2 x 21.1	1.95	54,663	
5 - 1	52	45.5	17.2 x 20.3	1.82	76,382	
5 - 19	61	26.8	17.0 x 17.2	1.84	46,499	
6 - 9	65	30.2	16.3 x 16.4	1.86	59,687	
6 - 10	50	30.1	18.7 x 18.8	2.31	49,046	
7 - 3	35	40.0	17.2 x 17.3	2.77	61,000	
8 - 18	40	33.2	18.8 x 17.7	2.31	43,000	
8 - 25	66	27.1	16.0 x 16.5	2.08	49,097	
9 - 2	8	44.1	18.9 x 18.9	3.24	21,774	
9 - 16	80	36.8	18.7 x 18.6	1.87	84,475	3,300
11 - 12	14	43.3	19.0 x 19.0	2.19	22,000	
11 - 17	46	45.7	18.5 x 18.4	2.04	72,211	1,000
12 - 5	54	41.6	18.7 x 19.0	2.16	78,508	1,900
12 - 22	41	42.7	18.8 x 18.8	2.08	50,000	5,500
Total	1,002			2.01	1,061,667	

* Tons of material broken per pound of powder used.

Summary of Joy Drill Holes Blasted:

11 - 21	18	41.8	17.0 x 17.0	8,000
12 - 22	11	44.0	17.3 x 17.6	5,500

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6. OPEN PIT: (Cont'd.)

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

Summary of Footages Drilled

Month	Joy	Jet Piercing	"Down the Hole"	Wagon Drilling
January		2985	218	668
February		2735	151	649
March		3145		576
April		2659		1077
May		3112		1814
June		2279		2633
July		3018		2208
August		2167		3418
September		2488		3040
October		2067		2476
November	362	2917		1599
December	177	4310		-
Total - 1958	539	33882	369	20158
1957	-	22021	-	29176
1956	1731	15390	-	22052

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

Summary of Jet Piercer Operating Costs

Month	Oxygen	Fuel Oil	Misc. Optg. Supplies	Maint. Supplies	Royalty	Maint. Labor	Optg. Labor	Total Cost	Feet Drilled	Cost Per Ft.
January	6426.11	1282.20	300.57	1655.31	1431.18	1772.33	1618.82	14486.52	2985	4.855
February	6613.20	933.58	872.84	1362.40	1384.65	2731.81	1448.73	15347.21	2735	5.611
March	7985.45	1455.39	983.25	2867.94	1479.69	2832.46	1771.90	19376.08	3145	6.160
April	6572.12	1071.10	164.37	1109.98	1184.13	1051.29	1588.69	12741.68	2659	4.791
May	6878.30	892.69	174.21	628.47	1354.95	2006.14	1857.30	13792.06	3112	4.432
June	6214.07	1162.40	254.90	2892.80	980.15	2936.58	1405.67	15846.57	2279	6.953
July	6622.52	1003.33	220.04	2382.51	1346.16	2182.03	1632.94	15389.53	3018	5.100
August	5699.00	650.98	203.27	1205.34	893.00	2172.07	1350.43	12174.09	2167	5.618
September	6106.40	909.18	213.91	1799.99	1059.86	1173.91	1490.54	12753.79	2488	5.126
October	5596.19	890.65	552.03	1087.55	960.89	1499.72	1370.68	11957.71	2067	5.785
November	7244.12	997.94	415.15	2893.75	1191.50	1316.00	1651.03	15709.49	2917	5.385
December	9289.73	1928.05	1075.10	1022.42	1757.78	2179.30	2098.24	19350.62	4310	4.490
Year - 1958	81247.21	13177.49	5429.64	20908.46	15023.94	23853.64	19284.97	178925.35	33882	5.281
Year - 1957	49259.96	7916.78	2278.65	13220.35	10832.97	10915.51	14401.04	108825.26	22021	4.942
Year - 1956	46709.57	6912.08	6846.30	11893.23	7302.18	5439.68	10920.09	96023.13	15390	6.239

	Year 1957	Year 1958
Total Drilled Footage Jet Drilled Holes	22021	33882
Cost Per Foot of Drilled Footage	4.942	5.281
Total Tons Drilled Ore and Waste	715007	1061667
Total Cost Per Tons Ore Drilled	0.152	0.169
Hours Jet Operated	3108.9	3915.0

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7. PLANT:

a. General:

Plant performance was generally good throughout the year. There were no major unscheduled delays due to breakdowns. The routine replacement of manganese in the primary crusher was the greatest single cause of down time in the concentrator.

Compared to 1957, improvement was noted in net feed rates to the crushing plant and to each of the mill units. Operating time for the concentrator was 97% of scheduled operating time, same as in 1957.

An experimental program to upgrade flotation concentrates was operated from September 22nd to October 22nd during which time 15709 tons of concentrates were produced, which had a dry analysis of 66.05% iron and 4.64% silica with a moisture content of 7.78%.

After deducting the above high grade product from the year's production, the dry analysis of the concentrate produced was 63.29% iron and 8.31% silica with a moisture content of 6.71%. Except for moisture content, this was better than the guarantee. The higher moisture was largely intentional since this tends to lower dust losses both in transit and in stockpile. The budget tonnage of concentrate was exceeded by 15535 tons.

Weight recovery for the year was lower than budgeted for several reasons. An attempt was made to mine ores that generally seemed to be more readily pelletized. The grade of this crude was substantially lower than the average and in some areas of the pit it was quite difficult to treat. In addition, there has been a limitation on collector used in the flotation process to 1.25 pounds per ton of crude ore. When more reagent is used, the pelletizing plant has difficulty in treating the concentrate. There are times when an additional amount of reagent would improve the weight recovery.

The consumption of grinding steel and reagents again showed improvement over the previous year.

Experimental work continued as availability of personnel permitted. With the extended schedule during the latter part of the year, manpower was spread so thin that very little time was left over from routine processing of samples for new investigations.

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7. PLANT: (Cont'd.)

b. Production by Months:

Month	Tonnage	% Fe	% P.	% SiO_2	% Sul.	% H_2O
January	29931	62.63		9.10		6.85
February	27551	62.66		9.06		6.88
March	29188	62.92		8.79		6.64
April	34473	63.31		8.31		6.89
May	36220	63.08		8.61		6.56
June	45324	63.71		7.81		6.29
July	37145	63.56		8.17		6.35
August	47519	63.49		7.72		5.95
September	45832*	63.75		7.84		6.48
October	30569	64.30		6.95		7.34
November	48469	63.46		8.07		7.10
December	50214	63.39		8.32		7.67
Total - 1958	462435	63.38		8.19		6.73
Total - 1957	323860	63.27	.038	8.03	.066	5.32

* Includes 9097 tons stockpile overrun.

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7. PLANT (Cont'd.)

c. Metallurgical Balance:

Product	% Wt.	% Wt. Crude	% Fe	% Fe Unit Recovery	% Fe Unit Recovery (Flot. Circuit)
Concentrator					
Concentrate		43.56	63.40*	76.20	
Tailing		56.44	15.29	23.80	
Head		100.00	36.24	100.00	
Unit One					
Concentrate	47.20	44.80	63.15	77.91	80.93
Flotation Tailing	52.80	50.12	13.30	18.36	19.07
	100.00	94.92	36.83	96.27	100.00
Slime Tailing		5.08	26.69	3.73	
Head		100.00	36.31	100.00	
Unit Two					
Concentrate	44.76	42.37	63.66	74.56	77.63
Flotation Tailing	55.24	52.29	14.87	21.49	22.37
	100.00	94.66	36.71	95.05	100.00
Slime Tailing		5.34	26.76	4.95	
Head		100.00	36.17	100.00	

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

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7. PLANT (Cont'd.)

d. Hourly Operating Rates:

	Tons	Gross Hours of Operation	Net Hours of Operation	LTPH (Gross)	LTPH (net)
Feed to Primary Crusher					
1958	1,006,120	2860.32	2054.58	351.75	489.70
1957	670,240	1813.75	1410.68	369.53	475.12
Ore for Roads, Etc.					
1958	2,280				
Ore in Process					
1958	138				
Fine Ore Bin to Concentrator					
1958	1,005,436	6428.15	6233.30	156.41	161.30
1957	666,184	4330.38	4198.66	153.84	158.67
Fine Ore Bin to Unit One					
1958	523,887	6180.53	5889.81	84.76	88.95
1957	328,264	4293.74	4100.86	76.45	80.05
Fine Ore Bin to Unit Two					
1958	481,549	5467.56	5227.90	88.07	92.11
1957	337,920	4292.34	4081.34	78.73	84.30
Concentrates					
1958	462,435	6428.15	6233.30	71.94	74.19
1957	323,860	4330.38	4198.66	74.79	77.13
Operating Time - Concentrator					
1958	96.97%				
1957	96.96%				
Operating Time - Unit One					
1958	95.30%				
1957	95.51%				
Operating Time - Unit Two					
1958	95.62%				
1957	95.58%				

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7. PLANT (Cont'd.)

e. Monthly Hourly Operating Rates:

	Feed to Primary Crusher	Fine Ore Bin to Concentrator	Fine Ore Bin to Unit One	Fine Ore Bin to Unit Two	Concentrates
Long Tons Per Gross Hour					
January	354.88	157.96	81.13	85.73	66.50
February	369.67	158.35	79.64	87.64	66.12
March	329.96	155.99	78.87	82.85	68.57
April	350.12	173.41	88.67	90.35	77.88
May	390.58	159.24	86.54	87.99	78.35
June	378.06	171.58	90.06	89.94	80.79
July	353.98	162.38	84.79	87.93	75.84
August	389.93	175.05	91.71	93.18	87.07
September	340.46	144.96	79.02	82.10	71.08
October	210.82	74.63	74.63	On Reflot.	30.95
November	345.26	157.30	83.76	87.12	69.43
December	374.97	176.41	93.08	90.89	72.15
Year	351.75	156.41	84.76	88.07	71.94
Long Tons Per Net Hour					
January	450.02	161.42	85.77	88.23	67.96
February	478.59	160.07	83.43	88.66	66.84
March	457.91	157.53	80.23	84.47	69.25
April	485.76	174.60	89.39	91.37	78.41
May	489.79	164.35	89.70	91.55	80.87
June	506.74	173.96	91.85	93.74	81.91
July	505.10	165.43	88.91	92.40	77.26
August	495.64	177.00	93.54	95.86	88.04
September	468.52	161.58	91.13	94.33	79.23
October	518.43	82.00	82.00	On Reflot.	34.01
November	498.08	164.20	90.43	93.68	72.69
December	505.93	177.41	94.36	94.90	72.55
Year	489.70	161.30	88.95	92.11	74.19

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7. PLANT (Cont'd.)

f. Pit-Crusher Time Distribution:

	Hours	Percent of Delays	Percent of Total Working Hours
Pit - no trucks	119.39	14.82	4.17
Chunks - Primary Crusher	55.78	6.92	1.95
Primary Crusher	43.32	5.38	1.52
Chutes, Feed Boxes, etc.	38.54	4.78	1.35
Screens	29.44	3.65	1.03
Secondary Crusher	27.13	3.37	.95
Metal Detector	20.41	2.53	.71
Conveyors	20.00	2.48	.70
Power Failures	19.80	2.46	.69
Start-up and Shutdown	14.89	1.85	.52
Tertiary Crusher	14.70	1.82	.51
Loading Stkpile Cars - No trucks	14.08	1.75	.49
Electrical	6.87	.85	.24
Pan Feeder	4.00	.50	.14
Special Tests	2.17	.27	.08
Miscellaneous	1.44	.18	.05
Rotoclone	1.08	.13	.04
	433.04	53.74	15.14
Surge Bin Full	221.50	27.49	7.74
Fine Ore Bin Full	151.20	18.77	5.29
Total	805.74	100.00	28.17

7. PLANT (Cont'd.)

g. Concentrator Time Distribution - Unit I:

Operational	Hours	Percent of Delays	Percent of Total Working Hours
Out of Feed	103.44	35.58	1.67
Start-up and shutdown	68.32	23.48	1.10
Power Failure	16.22	5.58	.26
Rod Mill tangles	14.17	4.87	.23
Changing Ball Mill Charge	11.50	3.96	.19
Chutes, Feed Boxes, Etc.	2.76	.95	.04
Conversion to Regrind Flotation	2.08	.72	.03
Hydroscillator Overloaded	1.20	.41	.02
Cyclone Classifier Experiment	.50	.17	.01
Charging Rod Mill	.50	.17	.01
Rod Mill Overloaded	.08	.03	-
Total Operational	220.77	75.92	3.56
Equipment			
Electrical	17.76	6.11	.29
Thickener	14.02	4.82	.23
Ball Mill Motor	13.58	4.67	.22
Hydroscillator	8.83	3.04	.14
Pumps	5.95	2.05	.10
Rod Mill	2.93	1.01	.05
Conditioners	2.49	.86	.04
Ball Mill	2.05	.71	.03
Conveyors	1.76	.61	.03
Fresh Water Pumps Frozen	.58	.20	.01
Total Equipment	69.95	24.08	1.14
Grand Total	290.72	100.00	4.70

7. PLANT (Cont'd.)

g. Concentrator Time Distribution - Unit II:

Operational	Hours	Percent of Delays	Percent of Total Working Hours
Out of Feed	79.32	33.10	1.44
Start-up & Shutdown	50.57	21.10	.92
Power Failure	7.59	3.17	.14
Rod Mill Overloaded	2.08	.87	.04
Charging Rod Mill	1.58	.66	.03
Conversion to Regrind Flotation	1.50	.63	.03
Hydroscillator Overloaded	.79	.33	.01
Total Operational	143.43	59.86	2.61
Equipment			
Hydroscillator	42.55	17.75	.78
Rod Mill	26.25	10.95	.48
Chutes, Feed Boxes, Etc.	7.18	3.00	.13
Ball Mill	4.43	1.85	.08
Miscellaneous	4.07	1.70	.07
Flotation Cells	3.10	1.29	.06
Pumps	2.67	1.11	.05
Electrical	2.51	1.05	.05
Conditioners	2.00	.83	.04
Conveyors	1.47	.61	.03
Total Equipment	96.23	40.14	1.77
Grand Total	239.66	100.00	4.38

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7. PLANT:(CONT'D.)

h. Monthly Rod, Ball and Reagent Consumption:

Month	Rods	Unit One #	Unit One #/ton	Unit Two #	Unit Two #/ton
January		42200	1.224	34200	0.934
February		40100	1.286	36700	1.055
March		70559	2.164	45300	1.340
April		35090	0.917	38900	1.011
May		49400	1.333	36559	1.102
June		52400	1.084	42590	0.889
July		48222	1.227	46853	1.165
August		53788	1.127	53118	1.111
September		29200	0.868	27127	0.895
October		14900	0.912	33282	1.135
November		58400	0.912	52100	1.135
December		45840	0.728	48896	0.818
Total		540099	1.031	495625	1.029
	Balls				
January		38896	1.128	29491	0.805
February		21448	0.688	24129	0.693
March		21448	0.658	29491	0.873
April		29491	0.771	34840	0.905
May		21448	0.579	26810	0.733
June		45577	0.942	42896	0.896
July		26810	0.682	29491	0.733
August		37520	0.786	42880	0.897
September		21500	0.639	21500	0.709
October		13400	0.600	8040	0.698
November		34853	0.600	44470	0.698
December		37500	0.595	37500	0.627
Total		349891	0.668	371538	0.772
	Fatty Acid				
January		31486	0.913	40139	1.096
February		29717	0.952	42428	1.219
March		26627	0.817	33208	0.983
April		38389	1.003	41091	1.067
May		43912	1.185	47439	1.298
June		45321	0.937	48143	1.005
July		41266	1.050	45829	1.139
August		56971	1.194	57543	1.204
September		42400	1.260	39114	1.290
October - November		89662	1.115	86803	1.153
December		69915	1.110	69330	1.116
Total		515666	0.984	551067	1.144

7. PLANT: (Cont'd.)

i. Plant Testing

Crushing

An experiment was performed to determine the capacity of the secondary crusher when set at 1½". It was possible to put through 900 LTPH. Amperage readings were obtained on motors throughout the crushing circuit at the same time. This work was done to aid in expansion planning.

A cast manganese deck was installed on the top deck of the #1 screen to obtain information on the wear and costs as compared to the usual punch plate screen decks.

Tests of 9" x 18" wear plates were conducted throughout the year. Specific brands tested were Wearpact, Amsco HC 250, and Tisco cast manganese wear plates.

Columbia Steel Casting Company manganese bowl liners and mantles were tested in the secondary and tertiary crushers to obtain a comparison with the manganese obtained from the Nordberg Mfg. Company.

The fine ore bin feed was checked twice daily to determine the size of crusher products and the crusher adjustments were made accordingly.

Grinding

A mill test of Ni-Hard grinding balls was conducted throughout most of the year. The +1" forged steel balls were removed from the ball mill in Unit One with 1¼" and 1½" Ni-Hard balls added to complete the charge. The make-up balls to this unit were 1½" Ni-Hard. The purpose of this test was to obtain a cost comparison between Ni-Hard and forged steel grinding balls.

A 24" Dorrclone was installed in the Unit One grinding circuit to obtain data on the performance of this unit as a classifier.

Monthly structure analyses were performed on the grinding circuit products.

Desliming

A 4" Krebs cyclone and a 6" Krebs cyclone were installed and tested for comparison with the 6" Dorrclones now being used. This was done as part of the program to increase the density in conditioning and improve the recovery of micron material.

The Dorr-Oliver "siphontrol" arrangement was tested briefly on the 6" cyclones. Additional testing of this device will follow early next year.

As an experiment, the primary cyclone overflow in Unit One was diverted into the densifier with the densifier sands going into the #1 conditioner and

7. PLANT: (Cont'd.)

i. Plant Testing (Cont'd.)

Desliming (Cont'd.)

the densifier overflow going to the 6" cyclones. This was done to see if some part of the 6" cyclone feed could be scalped off.

Conditioning

Three additional conditioners were added to Unit One and two were added in Unit Two. Both units now have a total of seven conditioners.

Plant tests were conducted in which the point of addition of the secondary cyclone underflow was varied between the #4 and the #7 conditioners. This was done to determine the best point of addition for optimum metallurgy on the various ore types. Batch tests were also conducted on this problem.

Flotation

In Unit Two some cell speeds were increased in the roughing circuit in an effort to improve recovery.

In Unit One, the speed of some of the rougher cells was decreased to minimize the wear on the rubber wearing parts.

Other cell changes in Unit Two consisted of the following:

1) Shrouding over the impellers in some cells to better distribute the air in the pulp.
2) Installation of conical parts in some cells.
3) Installation of deep crowding boards in some cells to increase capacity and agitation.
4) Installation of a weir between the #1 and #2 scavenger cells in one line.
5) Increasing of air pressure in the rougher and scavenger cells.

Batch tests were conducted using various emulsions of fatty acid.

A system of floating the coarse primary cyclone underflow separately from the finer secondary cyclone underflow was tested in Unit Two.

An experimental program for the upgrading of reground concentrate was conducted on a plant scale from September 22nd through October 22nd.

A test was conducted in Unit One in which the middling products were recirculated through a 12" cyclone to increase the percent solids in the roughing circuit.

7. PLANT: (Cont'd.)

i. Plant Testing (Cont'd.)

Flotation (Cont'd.)

Heat was added by steam injection to the conditioners in a test conducted during the winter in an effort to approach approximate pulp temperatures obtained in the flotation circuit during the summer. Higher weight recovery and better iron unit recovery is normally attained during the summer months and better metallurgy during these months is generally attributed to warmer water and higher pulp temperatures in the flotation circuit. Additional testing of the heat addition system will be necessary to determine the economics involved.

Reagents tested on a plant scale consisted of the following:

1) Fatty acid - petroleum sulfonate emulsions.
2) Emulsol 4150 mixed with fatty acid collector.
3) Caustic soda added to the #1 conditioner, the #4 conditioner, and the roughing cells.
4) Pamak 4A, a low titer variation of Pamak 4 was tested for use as a winter reagent.
5) Aerosol OT-75 and fatty acid emulsion.

Monthly structures and analyses were performed on flotation circuit products.

Filtration

The use of one vacuum pump to operate both filters was instituted instead of one for each filter. The advantages gained are longer filter cloth life and longer vacuum pump impeller life.

General

Batch tests and stockpile plot tests were made using agents and additives that give a protective coating to the stockpile and thereby minimize dust and water erosion losses.

A test program was instituted in which "Kemcote" was sprayed on the inside of railroad cars to prevent the concentrate from freezing to the sides of the cars.

Monthly checks were made on water consumption.

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8. MAINTENANCE, REPAIR AND CHANGES:

a. Pit:

Shovels

#101 - 4161 Marion

The track rollers, idlers and sprockets as well as the track pads were rebuilt and rebushed where necessary. The extension shaft pinion and bearings were changed. A broken shipper shaft and shipper pinions were changed. The boom sockets and boom base were rebuilt. There were two hoist rope changes.

#104 - 4161 Marion

The track rollers, idlers and sprockets as well as the track pad were rebuilt and rebushed where necessary. The bucket was changed and there were four new hoist ropes installed.

#97 - 54B Bucyrus-Erie

There were 2 broken propelling shafts and a vertical swing pinion shaft that were repaired. The machine was used both as a shovel and a dragline.

Brownhoist Crane and Dropball

There were no major repairs to this machine. A new dropball was placed in service on August 6th. The old ball was placed in service August 8, 1956.

The propelling gear on this machine requires constant attention.

Jet Piercer JPM-3

A badly bent kelly bar had to be repaired and the kelly bar was changed two times. The propelling system was overhauled completely. The exhaust ducting was changed and a new fan was installed. A feed rate compensator was installed on the JPM-3 but by the end of the year no valid information was available on this unit.

Tractors

The D-8 tractor required extensive repairs after failure of the rear main case assembly. The transmission and clutch were overhauled. A new set of pads, rails, rollers and sprockets were installed. The tractor was repainted.

The engine of the D-7 was overhauled with new pistons, sleeves, rings and bearings. New rollers, sprockets, rails and rebuilt pads were installed.

Euclid Trucks

There were major repairs consisting of relining with wear plate and