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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					
1959	976,869	2686.69	2026.71	363.60	482.00
1958	1,006,120	2860.32	2054.58	351.75	489.70
Ore for Roads, Etc.					
1959	2,930				
Ore in Process					
1959					
Fine Ore Bin to Concentrator					
1959	978,905	5776.00	5700.36	169.47	171.72
1958	1,005,436	6428.15	6233.30	156.41	161.30
Fine Ore Bin to Unit I					
1959	488,127	5613.26	5467.47	86.96	89.28
1958	523,887	6180.53	5889.81	84.76	88.95
Fine Ore Bin to Unit II					
1959	490,778	5611.25	5431.68	87.46	90.35
1958	481,549	5467.56	5227.90	88.07	92.11
Concentrates					
1959	475,338 *	5776.00	5700.36	82.32	83.41
1958	462,435	6428.15	6233.30	71.94	74.19
Operating Time - Concentrator					
1959	98.69%				
1958	96.97%				
Operating Time - Unit I					
1959	97.40%				
1958	95.30%				
Operating Time - Unit II					
1959	96.79%				
1958	95.62%				

*Not including 236 tons to Pilot Plant & Swindell-Dressler.

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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	405.02	177.13	92.93	91.91	81.59
February	365.98	158.17	83.92	84.93	74.05
March	375.91	174.46	89.81	89.05	84.41
April	347.00	152.02	78.62	79.55	75.20
May	370.52	167.09	86.46	84.23	82.16
June	356.80	175.05	90.55	87.07	82.69
July	340.07	172.04	89.68	87.01	82.20
August	-	-	-	-	-
September	-	-	-	-	-
October	-	-	-	-	-
November	332.90	172.15	84.23	89.37	86.61
December	360.28	179.83	86.95	94.40	93.50
Year	363.60	169.47	86.96	87.46	82.32
Long Tons per Net Hour					
January	499.77	177.42	93.85	93.88	81.72
February	476.86	158.34	84.99	85.62	74.13
March	449.16	175.62	90.78	90.68	84.97
April	496.57	164.81	89.79	87.46	81.52
May	496.38	168.18	88.31	85.67	82.70
June	490.40	175.17	91.07	91.51	82.75
July	470.59	172.81	91.32	91.77	82.57
August	-	-	-	-	-
September	-	-	-	-	-
October	-	-	-	-	-
November	466.59	173.12	85.10	91.34	87.10
December	486.05	180.65	88.07	96.14	93.93
Year	482.00	171.72	89.28	90.35	83.41

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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	147.11	22.29	5.48
Primary Crusher	52.58	7.97	1.96
Start-Up & Shutdown	36.77	5.57	1.37
Secondary Crusher	36.67	5.56	1.36
Chunks - Primary Crusher	29.50	4.47	1.10
Conveyors	28.27	4.28	1.05
Tertiary Crusher	24.17	3.66	0.90
Screens	20.82	3.15	0.77
Chutes, Feed Boxes, Etc.	14.76	2.24	0.55
Pan Feeder	10.33	1.57	0.38
Power	6.58	1.00	0.24
Metal Detector	5.24	0.79	0.20
Tripper	3.86	0.58	0.14
Experiments	2.50	0.38	0.09
Rotoclone	1.00	0.15	0.04
Loading Stockpile	.83	0.13	0.03
Miscellaneous	.16	0.02	0.01
Total	421.15	63.81	15.67
Surge Bin full	229.58	34.79	8.55
Fine Ore Bin full	9.25	1.40	0.34
Total	238.83	36.19	8.89
Grand Total	659.98	100.00	24.56

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7. PLANT: (Cont'd.)

g. Concentrator Time Distribution - Unit I:

Operational	Hours	Percent of Delays	Percent of Total Working Hours
No Feed - Crusher Repairs	51.17	35.08	0.91
Start-up & Shutdown	19.83	13.61	0.35
Rod Mill *	15.72	10.79	0.28
Power Failures	3.77	2.59	0.07
Experiments	.84	.57	0.01
Hydroscillator	.66	.45	0.01
Pumps	.34	.23	0.01
Total Operational	92.33	63.32	1.64
Equipment			
Rod Mill **	44.47	30.49	0.79
Pumps	6.06	4.15	0.11
Hydroscillator	1.00	.69	0.02
Flotation Cells	.92	.63	0.02
Ball Mill	.50	.34	0.01
Conveyors	.49	.33	0.01
Power (Electrical)	.08	.05	0.00
Total Equipment	53.52	36.68	0.96
Grand Total	145.83	100.00	2.60

* Includes rod charging, plugged chutes, etc.

** Includes rod mill lining.

7. PLANT: (Cont'd.)

g. Concentrator Time Distribution - Unit II:

Operational:	Hours	Percent of Delays	Percent of Total Working Hours
No Feed - Crusher Repairs	48.66	27.10	0.87
Start-up and Shutdown	18.46	10.28	0.33
Rod Mill *	18.40	10.25	0.33
Power Failure	4.17	2.32	0.07
Hydroscillator	3.84	2.14	0.07
Filters	.62	0.35	0.01
Pumps	.18	0.10	-
Total Operational	94.33	52.54	1.68
Equipment			
Rod Mill	38.15	21.24	0.69
Ball Mill	22.95	12.78	0.41
Pumps	14.41	8.02	0.26
Hydroscillator	5.17	2.88	0.08
Conveyors	2.44	1.36	0.04
Flotation Cells	1.16	0.65	0.02
Electrical	.78	0.43	0.01
Cyclones	.18	0.10	-
Total Equipment	85.24	47.46	1.51
Grand Total	179.57	100.00	3.19

* Includes rod charging, plugged chutes, etc.

7. PLANT: (Cont'd.)

h. Monthly Rod, Ball and Reagent Consumption:

Month	Rods	Unit One #	Unit One #/Ton	Unit Two #	Unit Two #/Ton
January		53150	0.843	57090	0.913
February		61435	1.116	69115	1.256
March		55120	0.876	52454	0.837
April		55755	1.031	62445	1.128
May		81790	1.342	71400	1.203
June		59015	.915	66545	1.082
July		39227	1.480	33823	1.310
August		-	-	-	-
September		-	-	-	-
October		-	-	-	-
November		39427	0.944	48259	1.106
December		65856	1.120	69696	1.073
Total		510775	1.046	530827	1.082
	Balls				
January		35000	0.551	40000	0.640
February		39975	0.726	39975	0.726
March		45561	0.724	42880	0.684
April		37520	0.694	34840	0.629
May		37520	0.615	37520	0.632
June		45560	0.706	48240	0.784
July		16080	0.610	34840	1.350
August		-	-	-	-
September		-	-	-	-
October		-	-	-	-
November		32800	0.785	38200	0.875
December		46020	0.783	54180	0.834
Total		336036	0.688	370675	0.755
	Fatty Acids				
January		74836	1.179	74328	1.189
February		67432	1.225	66319	1.205
March		78744	1.251	77805	1.241
April		67206	1.242	69464	1.255
May		76746	1.259	74944	1.263
June		77964	1.208	74306	1.208
July		34862	1.312	33833	1.312
August		-	-	-	-
September		-	-	-	-
October		-	-	-	-
November		47992	1.147	50993	1.169
December		72582	1.234	80847	1.244
Total		598364	1.226	602839	1.228

7. PLANT: (Cont'd.)

i. Plant Testing

Crushing

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

A program was initiated during the year for testing the wire screen cloth used on both decks of the No. 2 screen. Screen cloth will be obtained from several manufacturers and the cost per ton determined for each type of cloth. This evaluation will determine whether or not a lower unit cost can be attained by using a screen cloth of a particular type or manufacture.

A remote rateograph with indicating, recording and totalizing instruments has been installed on No. 1 scale to allow supervision to immediately determine whether crushers are operating at established capacities. An indicator also was installed at the secondary crusher operator's control station to enable the operator to determine immediately if, while crushing, a load is being deposited on the conveyor beneath the tertiary crusher. This, in some respects, will indicate if the crushers are plugging.

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

Grinding

The No. 2 ball mill was charged with 1½" grinding balls to bring the mill to 415 to 425 horsepower, to determine whether grinding capacity can be increased as well as determining the size consist of the classifier overflow and of the finished concentrate. Indications were that capacity was increased when encountering hard to medium hard ore.

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

A study was made to determine whether the trommel oversize could be returned to the rod mill circuit.

Desliming

After the completion of a test program in 1958, the 6" Dorrclones were replaced by 4" Krebs cyclones in Unit Two. This was done as part of a program to increase the density in conditioning and improve the recovery of the micron material.

After the completion of a test using the "siphontrols" on the Dorrclones, the 24 - 6" Dorrclones in Unit One were fitted with siphontrol systems.

7. PLANT: (Cont'd.)

i. Plant Testing

Desliming (Cont'd.)

A test program was instituted whereby the 24" primary cyclone was compared with 3 - 12" Dorrclones. The primary purpose of this test program was to determine whether a better size separation could be affected using the 12" cyclones.

Conditioning

An intensive test program was started during the year in the conditioning phase of the flotation circuit. Experience in the coal field indicated that the so-called high intensity conditioning produced improved metallurgy.

Unit One was fitted with an additional conditioner capable of producing high speed agitation. A series of tests were conducted using various impeller designs. Some improvement in metallurgy was noted; however, the impeller wear with tips speeds up to 6000 ft. per minute has been excessive. Various types of impellers have been tested, but little success has been achieved in minimizing the wear problem.

A test of limited duration was conducted in which a small portion of the primary cyclone underflowwas saturated with 90% of the normal fatty acid requirements and this portion was added to No. 1 conditioner and through the conventional conditioning sequence. It was thought that this scheme would affect an improved reagent distribution of the flotation feed. Preliminary results indicated that the metallurgy did not improve and was similar to the conventional conditioning sequence.

A comprehensive test program on the conditioning phase of the flotation circuit is planned for 1960.

Flotation

The following changes were made in Unit Two as part of a test program to improve the overall plant metallurgy:

1. Replaced the No. 30 Denver scavenger mechanisms with the No. 30 Type M conversion units.
2. Replaced the Denver No. 30 Type M scavengers with No. 66 Fagergren conversions.
3. Replaced several Denver No. 24 roughers and cleaners with Fagergren No. 56 conversion units.
4. Improved sand bleeders in Unit Two scavengers.
5. Some cell speeds were changed in an effort to improve recovery.

7. PLANT: (Cont'd.)

i. Plant Testing (Cont'd.)

Flotation (Cont'd.)

The following changes were made in Unit One in an effort to improve plant metallurgy.

1. Added one additional No. 66 Fagergren mechanism to each of the west and center scavenger cells.
2. Provided additional launders for single stage cleaning.
3. Adjusted speeds of some cells in an effort to improve metallurgy.

Batch tests were conducted using various emulsions of fatty acids.

Aerosol OT-75, a wetting agent, is a reagent which was employed in the flotation circuit during 1959. A test program indicated that recovery is improved using this reagent.

Pamak 4A and FA-1 Special, low titer reagents, have been adopted as winter reagents for flotation.

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 recoveries 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.

Monthly structures and analyses were performed on the flotation circuit products.

General

Tests were conducted on the concentrate in railroad cars using several different agents and additives that produce a coating to the ore in an effort to minimize dust losses. Aerospray 52 was the most satisfactory of the agents tested. This was added in a dilute solution to car tops during summer operation and in a more concentrated form to protect the concentrate stockpile.

8. MAINTENANCE REPAIRS AND CHANGES: (Cont'd.)

b. Plant: (Cont'd.)

Crushing Plant: (Cont'd.)

change was started. There were six manganese changes for the secondary crusher and eight manganese changes for the tertiary crusher during the year. Because of a shaft failure, the 300 H.P. secondary crusher motor was replaced temporarily by the standby motor from Humboldt in November. No. 1 buffer belt was replaced in September and sent out for repairs. A bearing was replaced in No. 1 screen in June and the top section of the frame was completely rebuilt in September.

Early in the year, considerable work was done on the dust enclosures, both in the primary and the fine crushing buildings. Extensive remodeling under E&A MI-54 was started in November with replacement of the Aeroturn units by a Ducon cyclone type collector in the primary building and a Rotoclone in the fine crushing building. This work will be completed early in 1960.

Work was done as required on various chutes, hoppers and rock boxes to keep these in repair. Considerable vulcanizing and patching was done on various conveyor belts to keep these in good condition. Crusher feed chutes were remodeled in order to reduce the time required for manganese changes.

Concentrator:

No. 1 rod mill was relined with single wave type ABK alloy cylinder liners in April and the top row of feed end liners were replaced in May. In No. 1 ball mill, the top row of the feed end was replaced in March and the bottom row of the feed end in No. 2 ball mill was replaced in April. In addition, considerable patching of liners was done on all mills.

During the strike, the discharge end trunnion bearing was removed from No. 2 rod mill. The bearing had been rocking on the base plate, making it necessary to remove both parts and send them to Lake Shore where both surfaces were milled, after which they were regrouted into place.

The oscillating bowl was replaced in No. 1 hydroscillator in April and the rake mechanism was overhauled in No. 2 hydroscillator in May. During the strike, both rake mechanisms were completely worked over.

The 6" Dorrclones in No. 2 unit were replaced with 4" Krebs cyclones in March and April. Siphontrols were added to the 6" Dorrclones in No. 1 unit in November and December.

The No. 30 Denver cell mechanisms were replaced with Fagergren 66" mechanisms in the period from May to November. Two 56" Fagergren mechanisms were also installed in No. 24 Denver cells. The usual maintenance work was done on flotation cells generally.

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8. MAINTENANCE, REPAIR AND CHANGES:

a. Pit:

Shovels

Marion 4161, Nos. 101 and 104; Bucyrus-Erie 54B, No. 97

A broken shipper shaft, broken dipper stick, broken sway brace and a burned out crowd motor were repaired on the Marion shovels. There were five hoisting rope changes made on these shovels.

There were no major repairs to the 54B shovel.

Brownhoist Crane and Dropball

There were no major repairs to this machine.

Jet Piercer JPM-3

The exhaust ducting was changed and a new fan installed. The track roller system was completely overhauled and a new set of pads was installed on the right side. The turntable and drive were completely overhauled.

Tractors

The crawler shoes on the D-8 and the D-7 were replaced with new manganese shoes and the transmission on the D-7 was overhauled.

Euclid Trucks

Major repair work consisted of brake jobs on six trucks, the overhaul of differentials on four trucks, and the overhaul of engines in five trucks. The truck boxes all required some work.

Miscellaneous

The engines in the Michigan 12B loader, the Pettibone-Mulliken swing loader and a 2½ ton service truck were overhauled.

b. Plant:

Maintenance crews were occupied largely in the routine work of replacing worn machinery parts and in making improvements aimed at reducing the time required for repair work. Since considerable experimental work was done on classifying, desliming, conditioning and flotation, a part of the crew worked on these projects as needed.

Crushing Plant:
In the primary crusher, the top mantle, bottom mantle and two rows of concaves were replaced in April and at the end of the year a second concave

8. MAINTENANCE REPAIRS AND CHANGES: (Cont'd.)

b. Plant: (Cont'd.)

Concentrator: (Cont'd.)

Two experimental conditioners were installed in No. 1 unit. Various types of agitating mechanisms were tested.

Safety hand rails were installed on all conveyors in the crushing plant and concentrator.

A rate chart and totalizer was installed in the mill office which shows the feed passing over the weightometer on No. 4 belt.

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9. E & A's:

a. Construction and Stripping E&A's:

E&A No.	Description	1958 Expenditures	1959 Expenditures
MI - 5	Pellet Plant - Republic Mine	$ 170.56	$
MI - 6	Preliminary Design - Republic Mine	11359.68	
MI - 13	MOC Testing	16640.38	
MI - 17	Empire Mine, Cost of Field Work, Etc.	12505.29	
MI - 32	Stripping - Republic Mine - Year 1958	112089.73	
MI - 34	(Six) Conditioners	14284.19	
MI - 35	House Moving - Year 1958	59375.45	
MI - 38	Gear Spray for Grinding Mills	2271.05	
MI - 39	Feed Rate Comp. for Jet	3579.99	
MI - 44	Pickup Truck	-0-	1850.96
MI - 46	Stripping - Republic Mine - Year 1959	-0-	119130.80
MI - 47	House Moving - Year 1959	-0-	93396.67
MI - 48	Expansion of Present Facilities	-0-	41351.71
MI - 50	TD-20 Tractor	-0-	25952.50
MI - 51	Main Shaft Assembly for Secondary Cr.	-0-	25848.06
MI - 53	Diamond Drilling - Republic	-0-	23414.50
MI - 54	Dust Collection Facilities	-0-	39194.25
MI - 55	Siphontrols for Desliming	-0-	3667.99
MI - 56	Research Expenditures for 1959	-0-	465149.01
MI - 57	Rotary Drill	-0-	-0-
MI - 59	Dorrclones with siphontrols	-0-	4676.24
	Total	$ 237123.21	$ 843632.69

R&M No.			
MI - 16	Pit Fencing	$ -0-	$ 1672.42
MI - 18	Fagergren Mechanisms	-0-	5258.84
	Total	$ -0-	$ 6931.26

10. COST OF PRODUCTION:

a. General:

Improvement in production cost, both over previous years and also over the budget estimated, was achieved for the year. The cost of production per ton of concentrates was $3.502 compared to a budget estimate of $3.683 while the cost for 1958 was $3.974. In terms of crude ore, the cost of production was $1.700 per ton compared to a budgeted figure of $1.767. The difference in actual and budget cost occurred largely in pit expense which was $.888 per ton of concentrate compared to a budgeted figure of $1.093.

In comparing the 1958 costs with 1959, it is noted that the average hourly cost of hourly rate labor increased from $2.885 to $3.147 or 9.1% while the labor cost of concentrate dropped from $1.162 to $1.020 per ton or 12.22%. Supply costs showed an improvement from $2.084 per ton of concentrate in 1958 to $1.828 in 1959 for an improvement of 12.3%. Power cost decreased from $.576 in 1958 to $.553 in 1959 for a decrease of 4.0%.

10. COST OF PRODUCTION: (Cont'd.)

b. Detail of 1959 Operating Costs:

	January	February	March	April	May	June	July	August	September	October	November	December	Total 1959	Total 1958
Pit Expense	.970	1.049	1.087	.909	.882	.928	1.075	On	Strike		.553	.672	.898	1.075
Crushing & Screening	.538	.621	.543	.607	.569	.588	.638	"	"		.675	.586	.590	.664
Milling Expense	1.517	1.603	1.561	1.589	1.488	1.551	1.823	"	"		1.667	1.605	1.583	1.625
Tailings Disposal	.001	.000	.000	.013	.025	.017	.020	"	"		.006	.003	.008	.023
Stocking Expense	.021	.000	.010	.011	.021	.025	.025	"	"		.008	.018	.016	.033
Gen'l Mine Expense	.317	.346	.321	.349	.292	.393	.432	"	"		.161	.310	.322	.457
Tele. & Safety	.002	.002	.003	.004	.004	.003	.008	"	"		.006	.001	.003	.008
Holiday	.039	.000	.040	.000	.035	.000	.097	"	"		.056	.036	.029	.031
Vacation	.039	.043	.037	.041	.038	.038	.039	"	"		.112	.088	.053	.058
Cost of Production	3.444	3.664	3.602	3.523	3.354	3.543	4.157	"	"		3.244	3.319	3.502	3.974
Shipping Expense	.068	.069	.063	.075	.062	.044	.053	"	"		.068	.043	.060	.092
Total Cost	3.512	3.733	3.665	3.598	3.416	3.587	4.210	"	"		3.312	3.362	3.562	4.066

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10. COSTS OF PRODUCTION: (Cont'd.)

c. Strike Costs:

	July	August	September	October	November	December	Total Year
Pit Expense	353.50	729.49	2003.10	5451.78	179.73	-	8717.60
Crushing & Screening	-	1852.02	72.89	3357.95	200.00	-	5482.86
Milling Expense	1784.82	15380.04	6099.07	17411.41	1235.46	-	41910.80
Tailings Disposal	-	-	-	-	-	-	-
Stocking Expense	-	-	238.00	-	-	-	238.00
Gen'l. Mine Expense	6632.52	13386.93	13000.86	14390.68	3767.99	1656.64	52835.62
Tel. & Safety	-	-	-	-	-	-	-
Holiday	-	-	-	-	-	-	-
Vacation	1265.60	2240.00	2240.00	2240.00	605.00	-	8590.60
Shipping Expense	-	-	-	-	-	-	-
Total Cost	10036.44	33588.48	23653.92	42851.82	5988.18	1656.64	117775.48

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11. TAXES:

Republic Mine	1959 Valuation	1959 Taxes	1958 Valuation	1958 Taxes
Real Estate	1,291,000	36,587.73	1,292,000	33,732.18
Personal Property (Stkpiles, Supplies and Equipment)	251,000	7,113.50	459,000	11,983.80
Total by State Mine Appraiser	1,542,000	43,701.23	1,751,000	45,715.98
Local Assessor				
Parcels in Sec. 7, 46-29	(Included in Mine description in 1959)		1,600	41.77
TOTAL REPUBLIC TWSHP.	1,542,000	43,701.23	1,752,600	45,757.75
Humboldt Township				
Tailings Basin Area in Sections 9 & 16, 46-29	5,000	160.34	5,000	139.38
TOTAL REPUBLIC MINE	1,547,000	43,861.57	1,757,600	45,897.13

Tax Rate: Republic Township 28.06 25.85
Humboldt Township 31.75 27.60

Note: Above taxes all include the 1% collection fee added by Township Treasurer.

12. ACCIDENTS AND PERSONAL INJURY:

Report No.	Name	Date of Injury	Days Lost	Nature of Injury	Compensation Paid
13	Henry Lundstrom	1-29-59	15	Amputated end of right index finger	$ 110.50
14	Bolisus Martinkewiz	2-10-59	37	Broken & bruised left thumb	276.00
15	Clarence Manninen	4-27-59	10	Sprained left ankle	46.67
16	Raymond Brunet	11-21-59	7	Strain in thigh & hip, right leg	132.00
17	Douglas Cain	12-1-59	30	Fractured rib, left side	6.00
				TOTAL	$ 571.17

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

	Year 1958	Year 1959
Compensable Injuries	3	5
Non-Compensable 1 - 7 Days	5	0
Compensable Days Lost	70	99
Days Lost Non-Compensable	6	0
Frequency	21.42	30.74
Severity	389	609

13. EXPLORATION:

Four diamond drill holes were drilled in the Park City area during the year. Two of the holes (D.D.H. 14 & 15) were drilled from the hangingwall quartzite conglomerate through the conglomerate ore and normal hematitic iron formation and into footwall material which was silicate iron formation in one hole and granitized sediment in the other. D.D.H. 16 was drilled to locate a fault along the hangingwall in the northeast part of the area. D.D.H. 13 was an experimental hole drilled to test the use of the portable "Winkie" drill. All of this drilling, except hole No. 13, was done under E&A MI-53. The total footage drilled was 1735.5 feet. The footages for each of the holes are as follows: D.D.H. 13 - 53.5 ft., D.D.H. 14 - 704 ft., D.D.H. 15 - 602 ft. and D.D.H. 16 - 376 ft.

Metallurgical tests were run on the core from holes #14 and #15. The preliminary results of these tests are summarized in the following table. Further tests will be run on some of this core. Testing is not complete on core from hole #16. The crude ore iron content was determined on the core from hole #13. The weighted average for 53.5 feet of drilling was 39.97% iron.

The results of the concentration tests on core from holes #14 and #15 indicate that both the conglomerate ore and the normal hematitic ore can be successfully treated by flotation. The weight recovery to be expected for this ore will be approximately 40% in comparison with 50% for ore from the main pit, however.

			Concentrate			
Hole No.	Footage	Crude % Fe	% Wgt. Rec.	% Fe	% SiO_2	% Fe Rec.
14	559	33.81	42.25	62.62	8.82	78.65
15	412	33.77	42.18	65.18	5.60	81.52
14 & 15	971	33.79	42.22	63.71	7.45	79.87

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14. PROPOSED NEW CONSTRUCTION:

In preparation for expanding the production facilities at the Republic Mine, Roberts and Schaefer Company have been given the contract to do the preliminary engineering for the expansion of the crushing plant and concentrator while Arthur G. McKee and Company has been given the contract to do the engineering for an ACL pelletizing plant. It is proposed that an additional 100,000 tons per year of capacity will be added to the present concentrator and an additional 800,000 tons per year of new duplex concentrating and pelletizing capacity will be added. It is possible that this expansion program will get under way in 1960.

The tailing line will be relocated and extended to provide more storage room in the tailing storage area. A trestle will be constructed over the railroad track and 1200' of 20" diameter pipe will be installed. Dikes Nos. 2, 10 and 11 will be raised.

With the extension of mining to the south, approximately 2300' of power line and 2000' of oxygen line will be constructed to service this area.

Fencing projects started under R&M MI-16 will be completed. Also the dust collection installations in the primary and fine crushing buildings under E&A MI-54 will be completed. Some remodeling work will be done in the flotation sections of the concentrator.

A conveyor-elevator will be installed to close circuit the trommel oversize from one of the rod mills.

15. EQUIPMENT RECEIVED AND PROPOSED NEW EQUIPMENT:

a. Equipment Received:

1 - Conditioner WEMCO
1 - 50 H.P. Motor
1 - Ford 1/2-Ton Pickup
1 - TD-20 Tractor
24 - 6" Siphontrol Attachments
1 - Band Saw
1 - Bench Grinder
1 - Rotoclone Dust Collector
1 - Welder, Portable
3 - 12" Dorrclones with siphontrols
1 - Ducon Dust Collector
6 - 66" Fagergren conversion units
1 - Rateograph and remote Totalizer for No. 1 Weightometer
2 - 56" Fagergren conversion units
2 - 66" Fagergren mechanisms

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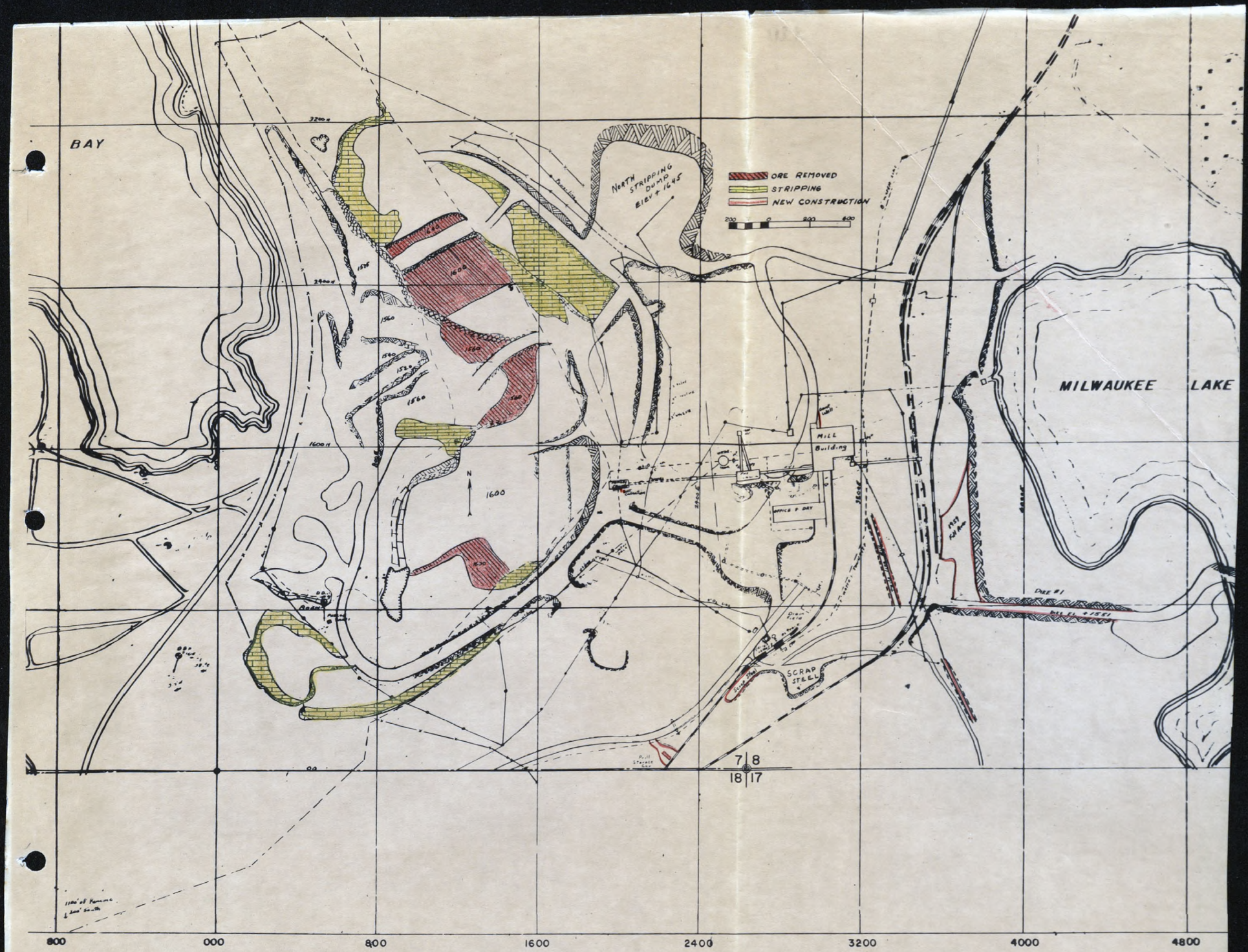
15. EQUIPMENT RECEIVED AND PROPOSED NEW EQUIPMENT: (Cont'd.)

b. Proposed New Equipment:

E&A No.	Description	Amount Authorized or Requested
MI-57	Rotary Drill	$ 155850.00
MI-63	Tailings disposal, Dikes & Pipelines	25000.00
MI-64	Pole Line - South Pit	6770.00
MI-65	Oxygen Line Extension - South Pit	6860.00
MI-67	Vari-Drive #1 Flotation Feed Pump	3600.00
MI-68	Flotation Cell - Unit 1 - Modification	11500.00
MI-69	Sand Spreader	1760.00
MI-70	Blast Analysis - Seismograph	2800.00
MI-71	3/4 Ton Pickup Truck	1990.00
R&M No.		
MI-16	Pit Fencing	3500.00
MI-18	Fagergren Mechanisms	17500.00
MI-20	Dam Control Gate (Power Dept.)	1000.00
MI-25	Track Pads - Marion Shovel	6500.00
MI-26	Pump - Unit #1	5000.00
MI-27	Pile Hammer	2500.00
Others		
	Dropball	2400.00
	Rod Mill Conveyor	5000.00


BAY
NORTH STRIPPING DUMP ELEV. + 1645
ORE REMOVED
STRIPPING
NEW CONSTRUCTION
MILWAUKEE LAKE
MILL Building
OFFICE & DRY
SCRAP STEEL
7 | 8
18 | 17
800
000
800
1600
2400
3200
4000
4800

REPU

OPEN

TILDEN MINE
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1. INTRODUCTION

There was no activity at the Tilden Mine during the first quarter of the year. Repairs to the crushing plant were started in mid-April and late in the month a production drilling program was started, utilizing the Joy Heavyweight Rotary drill.

Production commenced on May 18th and had advanced to a 3 shifts per day - 5 days per week basis by June 2nd. Mining operations were completed on July 10th with production totaling 220,175 tons, of which 206,113 tons were Tilden Silica ore and 14,062 tons were Tilden Low Phosphorus ore.

A small stripping program was started on July 7th with a total of 12,322 cubic yards of overburden being moved from the southwest corner of the West Pit area.

Post season crushing plant repairs, which were started on July 13th and interrupted by the USW strike on July 15th, were completed in December.

Shipments for the year amounted to 158,091 tons of Tilden Silica and 8,436 tons of Tilden Low Phosphorus.

2. PRODUCTION, SHIPMENTS & INVENTORIES

a. Ore Statement

	Tilden Silica	Tilden Low Phos.	Total
On hand 1-1-59	70,403	17,580	87,983
Output for Year	206,113	14,062	220,175
Total	276,516	31,642	308,158
Shipments, 1959	159,091	8,436	167,527
Balance on hand 12-31-59	117,425	23,206	140,631

b. Shipments (Gross Tons)

	Pocket	Stockpile	Total
Tilden Silica	37,608	121,483	159,091
Tilden Low Phos.	5,296	3,140	8,436
Total	42,904	124,623	167,527

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2. PRODUCTION, SHIPMENTS & INVENTORIES (Cont.)

c. Comparison of Shipments - 10 Year Period 1950-1959

	Tons Silica	Silica Low Phos.	Total
1950	91,510	23,926	115,436
1951	78,627	9,959	88,586
1952	64,590	15,859	80,449
1953	83,896	19,497	103,393
1954	77,781		77,781
1955	101,437		101,437
1956	140,401	25,027	165,428
1957	189,371	3,156	192,527
1958	81,079		81,079
1959	159,091	8,436	167,527

d. Production Data

	Days Operated	Shifts Operated	Avg.Tons / 8 Hr.Shift	Total Tons
Total Year	39	99	2,224	220,175

e. Production by Pits

West Pit Lower Bench	West Pit Upper Bench	East Pit Upper Bench	Summit Pit
150,168	17,484	38,461	14,062

3. ANALYSIS

a. Grading Dept. Analysis (Dried)

Grade	From	To	Tons,	Iron	Phos	Sil.	Sul.	Moist.
Tilden Silica		Stockpile	168,505	40.36	.045	40.41	.005	
"	Stockpile	Presque Isle	109,335	40.00	.044	40.91	.007	3.21
"	"	D.S.S.& A.	11,867	40.13	.038	40.08	.006	3.37
"	"	Edison Industs.	281	41.45	.039	39.21	.005	3.06
"	Poc ket	Presque Isle	37,495	40.24	.043	40.95	.005	2.65
"	"	Edison Industries	113	42.61	.056	39.27	.005	3.60
Tilden Low Phos.		Stockpile	8,766	35.91	.015	47.30	.005	
"	Stockpile	Presque Isle	3,140	35.70	.011	48.20	.005	1.95
"	Pocket	" "	5,296	34.83	.013	48.79	.005	1.36

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3. ANALYSIS (Cont.)

b. Composite Analysis of Shipments

Grade	Tons	Iron	Phos.	Sil.	Mang	Al	Lime	Mg.	Sul.	Loss	Moist
Tilden Silica	159,091	40.09	0.043	40.82	0.06	0.71	0.15	0.17	0.006	0.02	3.08
Tilden Low Phos.	8,436	35.16	0.012	48.60	0.07	0.66	0.08	0.08	0.005	0.16	1.58

c. Analysis of Ore Remaining in Stockpile (Estimated)

Grade	Tons	Iron	Phos.	Sil.	Sul.	Moist
Tilden Silica	117,425	40.25	0.046	40.51	0.005	3.00
Tilden Low Phos.	23,206	35.60	0.015	47.65	0.005	3.20

4. LABOR & WAGES

a. Comments

On a 3 shift per day basis, peak employment reached 47 hourly rate employees and one full time salaried foreman. A Superintendent, Clerk and Mining Engineer served on a part time basis.

No grievances were filed during the operating period.

b. Statement of Production

	1959
Production	220,175
Number of Days Operated	39
Number of Shifts Operated	99
Average Daily Product (Tons)	5,646
Average Product per Shift (Tons)	2,224
Average Number of Men Employed	48
Product Per Man per Day	111.82

5. OPEN PIT OPERATIONS

a. Stripping

Stripping operations at the Tilden Mine commenced in the extreme southwest portion of the West Pit on July 7th and continued until the industry-wide AFL-CIO strike on July 15th. The portion of the ore body exposed by stripping contained numerous stringers of intrusive, which indicated that

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5. OPEN PIT OPERATIONS (Cont.)

a. Stripping (Cont.)

the large hanging wall intrusives that form the north mining limit of the West Pit may extend further to the southwest than was formerly outlined.

b. Open Pit

Mining during 1959 was concentrated on the lower bench of the West Pit. During the year, a total of 167,652 tons of Silica grade ore was produced from this area. The remaining 38,461 tons of Silica grade ore was mined from the Upper Bench of the East Pit. A total of 14,062 tons of Low Phosphorus grade ore was mined from the Summit Pit during 1959. Most of this ore was made available by constructing a road from the east main haul road to the bottom bench of the Summit Pit.

Three primary production blasts were fired, breaking a total of 169,169 tons in the East and West Pits. All primary blast holes were 9" in diameter and were drilled with a Joy 60BH Rotary drill machine. The drill averaged 91 feet per shift, although mechanical problems reduced the availability of the machine to 51%. It was necessary to spend 22% of the available operating shifts in repair.

A total of 113,025 lbs. of explosive were used during the year, which resulted in a powder factor of 1.50 tons per pound of powder. Of the total amount of explosives consumed, 69% were prilled ammonium nitrate.

Three 34 ton Euclid trucks owned by the Humboldt Mining Company were moved to the Tilden Mine as production units, and two 24 ton International Harvester Payhaulers were moved in for use as stocking trucks. One 22 ton Euclid was utilized as a spare truck.

c. Crushing Plant

During the early part of the operating season, a considerable amount of trouble was encountered in keeping the pocket conveyor belt trained properly. The two belt system, consisting of a drive belt and a load belt, was worn and tended to ride off the idlers during heavy loading. This situation wascorrected by replacing the two belts with a new belt possessing sufficient strength to handle both drive and load stresses.

Some delays were encountered when dumping fine material, as the ore tended to go through the secondary system extremely fast and overload the conveyor. This condition was corrected by replacing the concaves in the east secondary crusher and installing a new mantle in the west secondary crusher.

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5. OPEN PIT OPERATIONS (Cont.)

c. Crushing Plant (Cont.)

The primary crusher spider was turned and re-zinced prior to the 1959 operating season.

d. Stocking Data

Location	Material	Loads	Shifts	Loads Per Shift	Type Truck
Plant to stockpile	Tilden Silica	6,652	72	92.4	24 ton
" "	" Low Phos.	353	5	70.6	24 ton

Truck factor used - 23, 25 and 25.5 tons per load.

6. ESTIMATE OF ORE RESERVES

a. Summary of Estimate of Ore Reserves	Proven	Prospective	Total
Ore reserves as of 1-1-59	3,827,677	2,735,500	6,563,177
Less 1959 production	213,038*	-	213,038*
Ore Reserves as of 12-31-59	3,614,639	2,735,500	6,350,139

* Does not include 7,137 tons of Low Phos. grade ore which were produced from previously blasted material in the Summit Pit below the 1620 elevation.

b. Expected Average Analysis of Ore Reserves

	Tons	Iron	Phos.	Sil.	Mang.	Sul.	Moist
Tilden Proven	3,614,639	39.74	0.028	43.51	0.090	0.009	2.50
Tilden Prospective	2,735,500	36.90	0.026	42.90	0.090	0.009	2.50

c. Proven Ore - Developed

1. West Pit - Above Floor 1430 Ft.
(13 cu.ft. equals one ton)

	Tons
Proven - January 1, 1959	724,440
Mined 1959	167,652
Remaining 12-31-59	556,788

2. East Pit - Above Floor 1440 ft.
(14 cu.ft. equals one ton)

Proven - January 1, 1959	2,810,362
Mined 1959	38,461
Remaining 12-31-59	2,771,901

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6. ESTIMATE OF ORE RESERVES (Cont.)

c. Proven Ore - Developed (Cont.)

3. Summit Pit - Above Floor 1620 Ft.
(14 cu.ft. equals one ton)

	Tons
Proven January 1, 1959	292,875
Mined 1959	6,925*
Remaining 12-31-59	285,950

*7,137 tons of Low Phos. grade ore were produced from previously blasted material in the Summit Pit below the 1620 elevation.

4. Total Proven Ore Dec. 31, 1959

West Pit	556,788
East Pit	2,771,901
Summit Pit	285,950
Total Proven Ore 12-31-59	3,614,639

d. Total Prospective Ore

West Pit	500,000
East & Summit Pits	2,235,500
Total Prospective Ore 12-31-59	2,735,500

e. Guaranteed Grade 1959

Grade	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist
Tilden Silica										
Dried	39.00	0.040	42.30	0.07	0.69	0.25	0.20	0.01	0.35	-
Natural	38.30	0.040	41.54	0.07	0.68	0.25	0.20	0.01	0.34	1.80
Tilden Low Phos.										
Dried	36.00	0.015	46.94	0.07	0.66	0.20	0.20	0.01	0.30	-
Natural	35.50	0.015	46.24	0.07	0.65	0.20	0.20	0.01	0.30	1.40

7. TAXES

	1959		1958	
Tilden Mine, N½,Sec.26,47-27	Valuation	Taxes	Valuation	Taxes
Real Estate	$ 125,000	$4,197.81	$ 125,000	$ 4,123.25
Personal Property	200,000	6,716.50	220,000	7,062.00
Additional Tilden Lands	8,590	288.48	-	-
	$ 333,590	$11,202.79	$ 345,000	$11,185.25

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8. PERSONAL INJURY

Mr. Oliver Grandlund injured a finger while attaching a portable air compressor to a truck. The nature of the injury necessitated that a skin graft be made to restore the finger for normal use. Mr. Grandlund was on compensation for 7-5/6 weeks and the total cost amounted to $352.50.

9. PROPOSED NEW CONSTRUCTION

Deterioration of the conveyor and loading pocket has necessitated a review of past plans to rebuild these structures. The present yearly mining schedule at the Tilden Mine will require this construction work in the immediate future.

10. EQUIPMENT RECEIVED AND PROPOSED NEW EQUIPMENT

None.

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1. GENERAL

Production from the Bunker Hill Group in 1959 totaled 415,955 tons. This is an increase of 28.7% over the 323,287 tons produced in 1958. The increase in production was the result of an increase in the working force. The number of operating days in 1959 was 167 compared to 162 in 1958.

The total shipments for the year were 462,233 tons, which is an increase of 55,810 tons over the 406,423 tons shipped in 1958.

The mine operated on a two-shift per day, four-day per week schedule through January. On February 1st, work was increased to a two-shift per day, five-day per week schedule. The nationwide steel strike idled the mine from July 15th through November 8th. On November 9th, the two-shift per day, five-day per week schedule was resumed. The hoisting schedule was increased from one shift per day to two shifts per day on February 9th and continued on a two shift basis for the balance of the year.

The average natural iron analysis of the ore as hoisted during the year was 52.84% compared to a natural iron of 52.16% in 1958. The average natural iron for the ore shipped was 52.54% compared to 51.65% natural iron in 1958.

The proven ore reserves, as submitted to the State Tax Commission, showed a reduction from the 1958 figures.

Labor relations between the mine management and employees were very good. One formal grievance was submitted and dropped by the Union following a Step 2 meeting.

The only wage increase in 1959 was a $0.01 per hour cost-of-living adjustment made on January 1st.

The surface operations were routine for the year. There was no new construction.

The underground operations were systematically increased during the year to provide for an annual production rate of 800,000 tons in 1960 compared to a 323,287 ton production in 1958. The scheduled production for 1959 was 600,000 tons. This production was not realized because of the 116 day steel strike. There was a marked increase in productivity accompanying the increase in the rate of production. The tons per man per day increased from 8.00 in 1958 to 9.67 in 1959.

The 65 cubic foot rocker dump tram cars of the Bunker Hill Mine were replaced by 130 cubic foot roll over cars as a result of the savings realized in the Maas Mine tramming costs in 1958 by using the larger cars. The tramming costs for the Bunker Hill Group were 32% less in 1959 than in 1958.

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1. GENERAL -contd.

Approximately 96% of the year's production came from block caving and long hole stoping.

The development drilling consisted mainly of outlining ore areas being developed for block caving or long hole stoping.

Pumping of Bunker Hill Group water continued on an automatic basis with very satisfactory results.

There were seven active E&As during 1959, and a total of $132,895.85 was expended as compared with $159,683.67 in 1958.

The total valuation of the Athens showed a decrease from 1958 of $205,000.00; the Bunker Hill a decrease of $135,000.00; and the Maas a decrease of $215,000.00.

There was an increase in the number of lost time accidents. The frequency and severity ratings in 1959 were 52.09 and 8,217 respectively, compared to 22.01 and 1,129 in 1958.

The cost of electric power per kilowatt hour increased from $.00827 in 1958 to $.00889 in 1959.

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2. PRODUCTION:

a. Production by Grades and Months:

Month	Athens	Bunker Hill	Maas	Pioneer-Arctic	Mulvey	Race Course	Total	Rock
January	1,092	12,570	2,740	7,303	5,678	--	29,383	4,032
February	1,483	19,234	6,067	13,018	7,246	--	47,048	8,057
March	234	18,708	9,126	14,394	6,994	--	49,456	7,350
April	159	16,537	15,061	9,248	14,242	--	55,247	5,516
May	2,458	22,028	11,080	9,235	10,960	--	55,761	5,220
June	2,876	25,056	14,797	7,635	12,937	--	63,301	3,156
July	1,730	8,264	5,158	1,995	5,505	--	22,652	720
August	Strike							
September	"							
October	"							
November	540	18,432	9,456	1,428	3,192	--	33,048	2,724
December	4,207	28,007	21,951	5,114	780	--	60,059	4,164
Total:	14,779	168,836	95,436	69,370	67,534	--	415,955	40,939
Stockpile Overrun	--	--	--	--	--	--	--	--
Total 1959	14,779	168,836	95,436	69,370	67,534	--	415,955	40,939
Total 1958	45,875	110,118	51,852	52,365	50,194	12,883	323,287	24,538
Increase		58,718	43,584	17,005	17,340		92,668	16,401
Decrease	31,096					12,883		

b. Shipments:

Grade of Ore:	Pocket Tons	Stockpile Tons	Total 1959	Total 1958
Athens	2,775	51,209	53,984	72,269
Bunker Hill	42,097	156,134	198,231	121,630
Maas	23,902	48,883	72,785	109,212
Pioneer-Arctic	13,838	59,245	73,083	28,047
Mulvey	18,907	45,243	64,150	56,968
Race Course	--	--	--	18,297
Total:	101,519	360,714	462,233	406,423
Total Last Year	13,605	392,818	406,423	---
Increase	87,914		55,810	
Decrease		32,104		

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2. PRODUCTION: -contd.

c. Ore Statement:

	Athens	Bunker Hill	Maas	Pioneer-Arctic	Mulvey	Race Course	Total 1959	Total 1958
On Hand 1/1/59	52,266	123,708	44,853	44,993	39,298	--	305,118	388,256
Product 1959	14,779	168,836	95,436	69,370	67,534	--	415,955	321,314
Stockpile Overrun	--	--	--	--	--	--	--	1,973
Total	67,045	292,544	140,289	114,363	106,832	--	721,073	711,543
Shipments	53,984	198,231	72,785	73,083	64,150	--	462,233	406,425
Balance On Hand	13,061	94,313	67,504	41,280	42,682	--	258,840	305,118
Increased Output	--	58,718	43,584	17,005	17,340	--	92,668	--
Decreased Output	31,096	--	--	--	--	12,883	--	673,042
Increased Ore on Hand	--	--	22,651	--	3,384	--	--	--
Decreased Ore on Hand	39,205	29,395	--	3,713	--	--	46,278	--

Operating Schedule:

Year	Days Per Week Mine Operated
1959	4 days per week in January -- February through December - 5 days per week.
1958	4 days per week through February -- March 1st through September, Mine operated four days per week, three weeks on then off one week -- 4 days October through December.
1957	5 days through November 1st -- 4 days balance of year.
1956	5 days entire year.
1955	4 days through April 17th -- 5 days balance of year.

d. Division of Product by Levels:

	1959 Tons	1959 Percent	1958 Tons	1958 Percent
2nd Level Maas	232,340	55.8	167,294	51.8
10th Level Bunker Hill	79,080	19.0	65,091	20.1
12th Level Bunker Hill	104,535	25.2	90,902	28.1
Total:	415,955	100.0	323,287	100.0

e. Production Delays:

Production was delayed for 11 hours on November 9th due to a fire in the air receiver - 2100 tons lost.

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3. ANALYSIS:

a. Average Mine Analysis on Output:

Grade:	1959 Tons	Iron	Phos.	Sil.	Sul.	1958 Tons	Iron	Phos.	Sil.	Sul.
Athens-Bunker Hill	183,615	59.94		6.05		155,993	59.34		6.70	
Maas	232,340	60.73		6.69	2.31	154,411	60.88		6.24	.208
Race Course						12,883	60.96		6.08	.211

b. Average Analysis of Shipments:

Grade:	Tons	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
Athens-Bunker Hill:											
Dried	252,215	58.95	.116	7.45	.72	3.35	.55	1.20	.012	1.72	11.74
Natural		52.03	.102	6.58	.64	2.96	.49	1.06	.011	1.52	
Maas:											
Dried	210,018	60.23	.095	7.15	.23	3.30	1.00	.32	.221	2.00	11.75
Natural		53.15	.084	6.31	.20	2.91	.088	.28	.195	1.77	

c. Average Analysis of Ore in Stock:

Grade:	Tons	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
Athens-Bunker Hill:											
Dried	107,374	59.22	.116	6.83	.75	3.35	.55	1.20	.012	1.72	12.25
Natural		51.97	.102	5.99	.66	2.94	.48	1.05	.011	1.51	
Maas:											
Dried	151,466	60.16	.091	7.07	.23	3.20	1.00	.32	.242	2.20	12.00
Natural		52.94	.080	6.22	.20	2.82	.88	.28	.213	1.94	

d. Straight Cargo Shipments:

Grade:	Tons	Iron	Phos.	Sil.	Mang.	Sul.	Moist.
Maas	1,969	58.61	.091	7.76		.260	12.15

4. ESTIMATE AND ANALYSIS OF ORE RESERVES:

Developed Ore:

Athens:

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

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4. ESTIMATE AND ANALYSIS OF ORE RESERVES -contd.

Bunker Hill:

All of the ore reserves above 10th and 12th Levels, with the exception of any ore north of the 3000-S Coordinate, (Boundary Orebody), are considered developed. There are 223,215 tons of developed ore between 12th Level and 14th Level in the North Orebody; all remaining ore is considered undeveloped.

Maas-Mulvey:

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

Pioneer & Arctic:

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

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

	Athens	Bunker Hill	Maas-Mulvey	Pioneer & Arctic	Total
Ore Reserves - 12/31/58	244,258	4,179,110	1,505,412	1,267,593	7,196,373
Ore Production - 1959	14,779	168,836	162,970	69,370	415,955
Ore Reserves - 12/31/59	168,873	3,155,999	1,309,822	477,649	5,112,343
Tonnage Proven in 1959	-60,606	-854,275	-32,620	-720,574	-1,668,075
Above 2nd Level (Formerly Maas 7th)			2,392,350	866,009	3,258,359
8th Level to 10th Level		1,551,204			1,551,204
10th Level to 12th Level	36,425	928,555			964,980
12th Level to 14th Level	137,195	1,119,689			1,256,884
Total Gross to 7/31/58:	173,620	3,599,448	2,392,350	866,009	7,031,427
*Expected Recovery Net Total 7/31/59	173,620	3,202,438	1,345,201	484,191	5,205,450
Less Production 7/31-12/31/59	4,747	46,439	35,379	6,542	93,107
Net Total 12/31/59	168,873	3,155,999	1,309,822	477,649	5,112,343

*Ore which is expected to be recovered. Athens-Bunker Hill 100% Stopes, 0% Pillars (75% Boundary Orebody). Maas, Mulvey, and Pioneer & Arctic - Recovery Estimate.

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4. ESTIMATE AND ANALYSIS OF ORE RESERVES -contd.

Expected Average Natural Analysis of Ore Reserves:

Athens-Bunker Hill:

Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
51.85	.100	6.65	.58	2.75	.45	1.00	.011	1.70	12.50

Maas-Mulvey-Pioneer & Arctic:

Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
52.50	.075	6.75	.21	3.40	.95	.30	.31	2.50	12.25

The reserves remaining in the Athens property are confined to the North Orebody between 10th and 14th Levels. The decrease in reserves is due to the fact that retaining pillars will not be mined and were therefore deducted from the estimate.

The greater portion of the Bunker Hill reserves occur in the South Orebody. The northern and southern boundaries of this orebody are the Athens Dike and intrusive sills cut off from the dike by the Bunker Hill fault. Experience gained in mining by block caving in this orebody has indicated that a "skin of ore" must be left against the intrusive contacts to prevent dilution of the ore while drawing the stope. This fact and the fact that the retaining pillars are unrecoverable account for the decrease in reserves.

A slight decrease in reserves in the Maas property is the result of dilution from an old mining area that necessitated the abandonment of two sub-cave areas. The reserves in the Mulvey property occur in the western extension of the Maas Orebody. The decrease in reserves in the Mulvey occur in an area which will not be mined because of the Brown Avenue sewer line.

A large reduction in the ore reserves for the Pioneer & Arctic property is the result of the presence of a large irregular shaped mass of iron-formation extending down from the hangingwall into the ore section west of the 2400-W Coordinate. The small amount of ore remaining in this area cannot be mined economically because subsidence would affect a high cost surface area. In the vicinity of the 1300-S and 2000-W Coordinates, a tongue of iron-formation protrudes from the hangingwall into the ore section; consequently, the reduction in ore height in this area decreased the reserves appreciably.

A significant tonnage of ore which occurs in the Pioneer & Arctic portion of the Boundary Orebody is not included in the State Tax Commission Estimate because there is no mining agreement outside the Phase I portion of this property.

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5. LABOR & WAGES

Labor Relations:

The labor relations between mine management and employees were very good throughout the year. There was one formal grievance submitted with the Union dropping the case in Step 2. The cooperation received from the Union during the strike with reference to emergency repairs was somewhat erratic. The Union was agreeable to calling out hourly rate people to make repairs in some cases but not in others.

Employment:

The average number of statistical employees was 255¼ as compared with 249½ in 1958.

There were 68 separations during 1959 - 3 quit, 8 retired, 2 died, 1 leave-of-absence, 12 transferred, 42 economic lay-off.

Number of Men Beginning of Year	210
Added During Year	153
Separations	68
Total End of Year:	295

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

Vacations - 1959

	Number of Men	Number of Hours	Amount	Rate Per Hour
1 Week	2	80	$ 260.25	$3.253
1½ Weeks	1	60	176.04	2.934
2 Weeks	-	--	---	---
2½ Weeks	16	1600	5,011.62	3.132
3 Weeks	85	10200	32,118.91	3.149
3½ Weeks	90	12600	39,437.67	3.130
Total:	194	24540	$77,004.49	$3.138

Paid Holidays - 1959 *

	Number of Men	Number of Hours	Amount	Rate Per Hour
New Years Day	192	1536	$ 4,670.89	$3.041
Good Friday	250	2000	6,079.67	3.040
Memorial Day	254	2032	6,254.84	3.078
4th of July	243	1944	5,592.99	2.877
Labor Day	12	96	297.83	3.102
Thanksgiving	269	2152	6,359.76	2.955
Christmas	267	2136	6,341.79	2.969
Total:	212	11896	$35,597.77	$2.992

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5. LABOR & WAGES: -contd.

Statement of Wages:

Average Wages Per Day	1959	1958	Increase	Decrease
Surface	$ 24.47	$ 25.53		$ 1.06
Underground	27.70	30.52		2.82
Total:	$ 26.99	$ 29.26		$ 2.27*

*Large decrease due to smaller vacation pay accrual, from $179,413.37 in 1958 to $105,154.49 in 1959.

Average Wages Per Month				
Surface	$340.50	$344.66		$ 4.16
Underground	385.50	412.02		26.52
Total:	$375.58	$395.01		$19.43

Average Days Worked Per Month
1959 - 13.92
1958 - 13.50

Tons Per Man Per Day				
Surface	43.97	31.60	12.37	
Underground	12.39	10.71	1.68	
Total:	9.67	8.00	1.67	

Labor Cost Per Ton				
Surface	$ .557	$ .808		$ .251
Underground	2.234	2.850		.616
Total:	$2.791	$3.658		$ .867

6. SURFACE

Athens Shaft

The Athens Shaft was inspected periodically during the year and ground conditions adjacent to the shaft seem to have become more stable than in past years. The shaft is presently being used as a second outlet, and for exhaust ventilation for the Athens and Bunker Hill sections of the mine.

Maas Shaft

The Maas Shaft is used as a second outlet and exhaust ventilation shaft for the Maas and Pioneer & Arctic sections of the mine. Periodic inspections of the shaft were made during the year.

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6. SURFACE -contd.

Purchase and Disposal of Dwellings:

Maas House #227, Lot 7, Block 33, Pioneer Plat. Purchased from Henry Hendrickson, October 16, 1959. This house was received in exchange for Maas House #181 which was moved to Lot 31 of the Cliffs Fourth Addition.

Athens House #50 on Lot 1 of Boyer's Plat in Harvey Lot 2 on Ann Street. Purchased from Victor C. Maki, December 30, 1959 - $15,500.00.

Athens House #51 on the Easterly part of Harvey Lot 2 on Ann Street. Purchased from Johanna Renaldi, December 30, 1959 - $11,000.00.

House #50 and #51 will be occupied rent-free until June 30, 1960 and then will be disposed of.

Houses Sold:

Maas House #181 was moved from Lot 11, Block 32, Pioneer Plat, to Lot 31, 4th Addition, and then traded to Henry Hendrickson for Maas House #227 on Lot 7, Block 33, Pioneer Plat.

Maas House #204, Lot 34, Cliffs 4th Addition, was sold under contract to Turri Johnson on May 19, 1959.

Maas House #226 on Lot 1, Block 2, Kirkwood & Kellan's Addition was sold for salvage to Edward Antilla on November 13, 1959 to be removed by June 30, 1960.

The Kellan store building on Lot 3, Block 2, Kirkwood & Kellan's Addition, was sold for salvage to the City of Negaunee on March 18, 1959 and has been removed.

The Kellan brick house on Lot 4, Block 2, Kirkwood & Kellan's Addition, was sold for salvage to Richer Bros. Salvage Company on March 18, 1959 and has been removed. There was no number assigned to this house and store building.

Maas House #227 was sold for salvage to Roland Juchemich on November 13, 1959 and will be removed by June 30, 1960.

Negaunee District Miscellaneous House #12 located on Lot 87, Iron Plat, across from the C.&.N.W. depot at 216 Gold Street, was sold for salvage on March 18, 1959 and has been removed.

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6. SURFACE -contd.

Construction:

There was no new construction during the year.

Equipment:

The headframe skip dump scrolls were completely replaced with new scrolls of a much stronger design.

The two motors for the skip hoist motor generator set were disassembled, cleaned, reinsulated and reassembled.

7. UNDERGROUND

After experiencing a drastic reduction in the size of the underground mining operation during 1958, the year 1959 saw a gradual recovery toward the optimum production rate at the Bunker Hill Group. Starting with a daily production quota in January of 1,550 tons, a stepped-up development program was instituted and by the end of the year, the eventual goal of 3300 tons per day, or an 800,000 ton annual production rate, had practically been reached. As a result of the large increase in the production rate during the year without a corresponding increase in the size of the work force, productivity rose from 8.00 tons per man-day in 1958 to 9.67 in 1959.

The bulk mining methods, long hole stoping and block caving, continued as the prime producers in 1959 with the former accounting for approximately 44% and the latter for 52% of the total mine production. The remaining 4% was mined by the pillar recovery method, which is being used at the Maas Mine to extract the retaining pillars between mined-out long-hole stopes.

Because of the favorable results achieved by the introduction of 130 cubic foot roll-over tram cars in the tramming system at the Maas Mine, the 65 cubic foot rocker-dump cars at the Bunker Hill were replaced at mid-year by the roll-over cars. The efficiencies realized through the use of these cars in the Bunker Hill and Maas tramming systems was responsible for the major portion of the 32% reduction in tramming costs at the Bunker Hill Group from 1958 to 1959.

Mining operations in the Athens Lease were limited to production from one small block cave area on the 12th Level. At the close of the year, development work in the eastern end of the North Orebody on 14th Level was started.

In the Bunker Hill property, development and mining were conducted on the 10th and 12th Levels. Production from both levels was mined by the block caving method, with approximately 47% of the total Bunker Hill tonnage coming from the 10th Level and 53% coming from the 12th Level. With the

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7. UNDERGROUND -contd.

exception of one small block area in the North Orebody, all of the mining in the 10th Level took place in the Upper 10th Level Orebody, while on the 12th Level, all of the Bunker Hill production was mined from the South Orebody. Tramming on the 10th Level was carried on entirely by drag chain and belt conveyors throughout the year. On the 12th Level, the change-over at mid-year from 65 cubic foot rocker dump cars to 130 cubic foot roll-over cars improved the rail haulage system greatly.

Mining and development at the Maas Mine was confined to the 2nd Level and conducted in the Maas, Pioneer & Arctic, and Mulvey Leases. Production in the three leases was mined by the long-hole stoping and pillar recovery methods, with the former producing 92% of the total Maas Mine tonnage. Excellent results in both analysis and mining costs were achieved by the long-hole stoping method at the Maas in 1959 as evidenced by the 60.73% iron analysis of the output tonnage and the low underground costs as compared with previous years. Tramming on the 2nd Level was by the rail haulage system utilizing 130 cubic foot roll-over cars, and as in the previous year, very favorable results were experienced with their use.

The following is a resume of the main level drifting completed in 1959:

Level	Ore Drift	Rock Drift	Total
2nd Level	--	--	--
10th Level	--	--	--
12th Level	--	477	477
14th Level	--	--	--
Total:	--	477	477

Geological Mapping and Development Drilling:

Athens:

Geological mapping incidental with development was the extent of investigation in the Athens property during the year. No significant changes in the expected structural outline were indicated as a result of this mapping.

Bunker Hill:

Diamond drilling conducted at the Bunker Hill Mine consisted of the drilling of two holes for development purposes. A total of 320 feet was drilled. Geological mapping revealed only minor changes in the expected structural outline.

Maas-Mulvey:

Geological mapping of the mining development was the extent of investigation in the Maas and Mulvey properties during the year.

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7. UNDERGROUND -contd.

Geological Mapping and Development Drilling: -contd.

Pioneer & Arctic:

Twelve diamond drill holes, for development purposes, were drilled in the Pioneer & Arctic property during the year. This drilling and geological mapping incidental with mine development further indicates that a large irregular shaped mass of iron-formation extends down from the hangingwall into the previously outlined ore section west of the 2400-W Coordinate and in the vicinity of 1300-S and 2000-W Coordinates.

The following table gives the amount of ore cut and the total footage drilled during 1959:

	Hole Number	First Class Ore	Footage Drilled
Bunker Hill:	94	90'	130'
	95	136'	190'
Maas:	117	30'	60'
	118	35'	85'
	119	101'	155'
	120	105'	160'
	121	80'	130'
	122	80'	135'
	123	125'	150'
	124	52'	80'
	125	0	80'
	126	30'	85'
	127	80'	110'
	128	26'	45'
		970'	1595'

The following is a summary by properties and levels of the 1959 development drilling:

Bunker Hill:

12th Level:

U. H. Numbers 94 and 95 were drilled along the 2979-W Coordinate to determine the position of a dike cutting the ore section, and the position of the hangingwall, for development purposes.

Pioneer & Arctic:

2nd Level:

During development of the 712 Block Area, iron-formation was intersected. U. H. Numbers 117, 118, and 119 were drilled to outline the ore section along the south side, and above the east end of the

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7. UNDERGROUND-contd.

Geological Mapping and Development Drilling: -contd.

712 Block. This drilling indicated that 75 feet of ore occurs above the undercut elevation on the east end of the block, but no mineable ore occurs along the south side above the iron-formation intersected at 35 feet.

U. H. Numbers 120 through 123 were drilled from the vicinity of the 1300-S and 2000-W Coordinates in the 721 Block Area. These holes were drilled to outline the position of the hangingwall, to determine the attitude of Dike #81, and to determine if a mineable amount of ore occurs west of the dike. From this drilling, it was learned that Dike #81 does not trend as far west as expected, and a tongue of iron-formation extends down from the hangingwall into the ore section.

U. H. Numbers 124 and 125 were drilled along the 2500-W and 2540-W Coordinates to further outline the iron-formation intersected in the 710 Block development. Results of this drilling indicate that the irregular shaped mass of iron-formation outlined by earlier drilling extends west of the 2500-W Coordinate. U. H. Numbers 126, 127, and 128 were drilled along the 1817-W and 1920-W Coordinates to outline this tongue of iron-formation in the 721 Block Area.

Statement of Timber Used:

	Amount - 1959	Amount - 1958
Cribbing	$ 7,032.96	$ 2,021.37
Stulls	12,331.58	6,746.83
Lagging	8,295.52	7,774.94
Poles	3,130.88	8,242.49
Steel Beams	57,064.99	47,144.20
Steel Sets	39,012.85	42,827.15
Total:	$126,868.78	$114,756.98

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

Year	Amount	Per Ton
1959	$126,868.78	$.3050
1958	114,756.98	.3550
1957	239,804.94	.2407
1956	184,283.60	.2212
1955	196,013.82	.2340
1954	184,238.54	.2190
1953	238,470.33	.1975
1952	181,991.85	.1828
1951	159,351.37	.1186
1950	142,517.38	.1144

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7. UNDERGROUND -contd.

Explosives:

Statement of Explosives Used During 1959:

	1959		1958	
	Quantity	Amount	Quantity	Amount
Total Powder Used	204,650#	$42,307.89	139,900#	$28,221.12
Total Caps, Fuse, etc.		19,408.07		13,336.75
Total:		$61,715.96		$41,557.87
Product		415,955		323,287
Pounds Powder per ton of ore		.4920		.4327
Tons of ore per pound of powder		2.033		2.311
Cost per ton for powder		.1017		.0873
Cost per ton for fuse, caps, etc.		.0467		.0413
Cost per ton for all explosives		.1484		.1286

Pumping:

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

Month	1959	1958	1957	1956	1955
January	1954	2028	2125	911	1124
February	1925	1999	2130	811	1057
March	1899	2035	2113	923	1023
April	1839	2045	2166	901	1002
May	2042	2142	2229	937	1014
June	1975	2073	2252	914	1053
July	1992	2051	2067	981	1053
August	2040	1956	2118	1020	1011
September	2068	1978	2326	944	999
October	2086	2095	2007	1030	961
November	2183	2145	2046	1020	963
December	2188	2169	2068	1017	880
Average	2016	2060	2137	956	1012

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

Year	Gallons Per Minute
1959	2016
1958	2060
1957*	2137
1956	956
1955	1012
1954	1146
1953	1495
1952	1493
1951	1539
1950	1593

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

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

There were 7 active E&As at the Bunker Hill Group during 1959:

		Prior Year's Expenditures	1959 Expenditure	Total
E&A CC-979	Undg. Development-Bunker Hill	$ 31,871.22	$ 43,960.08	$ 75,831.30
CC-980	Undg. Development - Maas	14,746.57	1,916.93	12,829.64
CC-981	Undg. Development - P&A	8,100.19	8,432.81	16,533.00
CC-994	Underground Cars	---	40,604.74	40,604.74
CC-996	Diamond Drilling - P&A	---	6,003.33	6,003.33
CC-995	Underground Development	---	30,240.94	30,240.94
AM-40	Underground Development	---	5,570.88	5,570.88

Comparative Mining Costs:

	1959	1958	Increase	Decrease
Product	415,955	323,287	92,668	
Underground Cost	3.443	4.032		.589
Surface Cost	.513	.676		.163
General Mine Expense	.602	1.061		.459
Power Adjustment		.006	.006	
Cost of Production	4.558	5.763		1.205
Depreciation	.601	.511	.090	
Taxes	.194	.762		.568
Loading & Shipping	.125	.151		.026
Administration, Cleveland Office, etc.	.074	.132		.058
Total Cost at Mine	5.552	7.319		1.767
Budget: Estimated Cost at Mine	5.179	6.418		1.239
Number of Shifts & Hours	2-1/8 Hr.	2-1/8 Hr.		
	166-2/8 "	161-2/8 "	5	
Number of Days Operated	167	162	5	
Average Daily Product	2490	1996	494	

Proportion of Labor & Supplies:

Cost of Production	1959	Percent	1958	Percent	Increase	Decrease
Labor	2.965	65.05	3.737	64.78		.772
Supplies	1.593	34.95	2.032	35.22		.439
Total:	4.558	100.00	5.769	100.00		1.211

8. COST OF OPENING, EQUIPPING, DEVELOPING & OPERATING -contd.

Cost of Production	1959 Amount	1959 Per Ton	1958 Amount	1958 Per Ton
Underground Costs:				
Development	$ 358,753.80	$ .863	$ 219,639.72	$ .679
Mining	432,263.35	1.039	370,254.64	1.145
Tramming	192,491.84	.463	220,805.63	.683
Ventilation	21,996.83	.053	28,876.65	.089
Pumping	49,198.27	.119	77,662.40	.240
Compressors & Air Lines	26,353.75	.064	37,802.89	.117
Crushing & Screening - UG	22,469.74	.054	16,221.49	.050
Underground Superintendence	71,903.27	.173	84,616.66	.262
Maint: Pockets and Chutes	4,338.81	.010	4,327.25	.013
" Mining Equipment	44,279.18	.107	46,725.85	.145
" Levels and X-Cuts	53,633.92	.128	65,273.49	.202
" Shaft	7,757.80	.018	9,993.49	.031
Telephones & Safety Devices	16,497.05	.039	20,597.59	.064
Holiday Pay	29,722.65	.072	28,756.67	.089
Vacation Pay	62,776.09	.151	72,023.37	.223
Social Security Taxes	37,631.70	.090		
Total Underground Cost	$1,432,068.05	$3.443	$1,303,577.79	$4.032
Surface Costs:				
Hoisting	$ 58,281.36	$ .140	$ 61,923.45	$ .192
Crushing & Screening - Surf.	10,281.24	.025	6,098.29	.019
Stocking	49,158.36	.118	47,532.42	.147
Timber Yard	23,367.03	.057	25,599.63	.079
Dry House	23,595.95	.057	27,558.09	.085
Policing	15,787.08	.038	13,571.28	.042
General Surface	6,756.46	.016	13,657.86	.042
Maint: Headframe Bldg. & Equip.	2,164.99	.005	773.36	.002
" Other Mine Buildings	4,055.44	.010	3,734.10	.012
Telephones & Safety Devices	729.95	.001	611.80	.002
Holiday Pay	5,577.29	.013	6,945.78	.021
Vacation Pay	7,250.00	.017	10,540.00	.033
Social Security Taxes	6,473.46	.016		
Total Surface Cost	$ 213,478.61	$ .513	$ 218,546.06	$ .676
General Mine Expenses:				
Electrical Engineering	$ 2,813.82	$ .007	$ 2,820.10	$ .009
Geological Department	12,972.42	.031	14,939.50	.046
Mining Engineering Department	20,335.56	.050	30,117.54	.093
Mechanical Engineering Department	3,366.20	.008	4,801.46	.015
Safety Department	4,773.49	.011	4,983.38	.015
Research Laboratory	2,609.62	.006	10,478.39	.032
Analysis & Grading - Laboratory	12,729.07	.031	15,448.46	.048
" " " - Shipping	2,886.35	.007	4,305.93	.013
Research Department	245.96		4,779.43	.015
Special Expense - Retirements			4,038.48	.012
" " - Hygiene Clinic	3,243.14	.008	3,514.23	.011
" " - Employment Office			28.00	
Ishpeming Office	63,691.84	.153	60,273.51	.187
Mine Office - Supt. & Clerks	27,323.83	.065	47,996.98	.148
Central Warehouse Overhead	8,791.14	.021	9,317.86	.029
Insurance - Property	3,568.53	.009	5,274.64	.016
" - Group, Health & Life	25,046.97	.060	28,304.18	.088
" - Group Annuity	4,541.21	.011	6,733.39	.021
" - Catastrophe	2,426.83	.006	6,146.50	.019
Personal Injury - Comp. & Doctors	35,675.89	.086	18,728.86	.058
Michigan Sales Tax			2,738.77	.008
Employees Insurance & Comp.			3,755.78	.012
Supply Inventory Adjustment	505.94	.001	485.91	.002
Taxes - Unemployment Insurance			12,146.64	.038
" - Old Age Benefit			23,064.43	.071
Supplemental Unemployment Benefits	16,873.80	.041	18,057.65	.056
MSESC Rental	100.00		75.00	
Sale of Scrap	75.00		300.00	.001
Barasa Flowage Rights	1,837.30	.004		
Total General Mine Expenses	$ 250,218.37	$ .602	$ 342,849.00	$1.061
Power Adjustment			1,882.42	.006
COST OF PRODUCTION	$1,895,765.03	$4.558	$1,863,090.43	$5.763

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

Underground Costs:	Strike Expense
Development	$ 1,541.65
Mining	4,160.54
Tramming	8,880.39
Ventilation	2,888.73
Pumping	34,109.23
Compressors and Air Lines	3,677.29
Crushing and Screening - UG	1,268.16
Underground Superintendence	40,519.98
Maint: Pockets and Chutes	117.84
" Mining Equipment	3,032.59
" Levels and X-Cuts	2,406.46
" Shaft	170.97
Telephones & Safety Devices	216.48
Holiday Pay	36.53
Vacation Pay	31,728.40
Social Security Taxes	1,300.88
Total Underground Cost	$136,056.12
Surface Costs:	
Hoisting	$ 16,546.72
Crushing and Screening - Surf.	128.79
Stocking	685.93
Timber Yard	1,228.12
Dry House	6,042.57
Policing	5,224.96
General Surface	1,861.23
Maint: Other Mine Buildings	253.17
Telephones & Safety Devices	7.80
Holiday Pay	261.30
Vacation Pay	3,400.00
Social Security Taxes	242.53
Total Surface Cost	$ 35,883.12
General Mine Expenses:	
Electrical Engineering	1,364.37
Geological Department	5,670.56
Mining Engineering Department	9,886.39
Mechanical Engineering Department	1,143.96
Safety Department	2,223.79
Research Laboratory	796.91
Analysis & Grading - Laboratory	3,479.88
" " - Shipping	1,344.65
Research Department	---
Hygiene Clinic - Special Expense	1,526.84
Ishpeming Office	29,671.70
Mine Office - Supt. & Clerks	11,006.09
Central Warehouse Overhead	4,962.59
Insurance - Property	1,294.82
" - Group, Health & Life	1,512.72
" - Group Annuity	2,055.03
" - Catastrophe	612.36
Personal Injury - Comp. & Doctors	3,874.66
Supplemental Unemployment Benefits	126.81
Barasa Flowage Rights	809.68
Total General Mine Expenses	$ 83,363.81
TOTAL:	$255,303.05

BUNKER HILL GROUP
ANNUAL REPORT
YEAR 1959

9. TAXES:

DESCRIPTION	1959 Valuation	1959 Taxes	1958 Valuation	1958 Taxes
ATHENS MINE				
Personal Property	$ 450,000	$ 22,497.75	$ 655,000	$ 30,001.29
Rented Buildings	3,540	176.98	3,540	162.15
TOTAL ATHENS IRON MINING COMPANY:	$ 453,540	$ 22,674.73	$ 658,540	$ 30,163.44
BUNKER HILL MINE				
Real Estate	$1,150,000	$ 57,494.25	$1,065,000	$ 48,780.73
Stockpiles, Supplies & Equipment (Personal Property)	1,310,000	65,493.45	1,530,000	70,079.36
TOTAL BUNKER HILL MINE:	$2,460,000	$122,987.70	$2,595,000	$118,860.09
MAAS MINE				
Maas (Includes Maas, Mulvey, Pioneer & Arctic and Race Course)	$1,240,000	$ 61,993.81	$1,135,000	$ 51,986.97
Personal	1,130,000	56,494.35	1,450,000	66,415.07
TOTAL MAAS MINE:	$2,370,000	$118,488.16	$2,585,000	$118,402.04
OTHER LANDS				
Lucy Mine Area	$ 9,200	$ 459.95	$ 9,200	$ 421.39
TOTAL BUNKER HILL OPERATING UNIT:	$4,839,200	$241,935.81	$5,189,200	$237,683.52

Note: The above figures include the 1% collection fee collected by the City of Negaunee. The 1959 tax rate was $49.50 per thousand, and the 1958 rate was $45.35 per thousand.

TAXES ON RENTED BUILDINGS				
Maas Houses	$ 105,860	$ 5,292.50	$ 108,110	$ 5,951.86
Negaunee District Miscellaneous Houses	17,950	897.42	19,650	900.05

BUNKER HILL GROUP
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10. ACCIDENTS AND PERSONAL INJURY:

There were a total of 14 lost time accidents during 1959 as compared to 6 in 1958.

Fatal	None
Time lost over 4 Months	2
Time lost 1 to 4 Months	7
Time lost less than 1 Month	5
Total:	14

Date of Accident			Days Lost
2/10/59	James Piper	Bruised left leg and foot.	53
2/12/59	John Cleven	Contusion of left hip and abrasions.	43
2/16/59	Charles K. Ahola	Nails off two fingers, right hand, and fracture of end of fingers.	20
2/20/59	Arthur Rivers	Traumatic bursitis left knee and infection.	12
3/ 5/59	Theodore L. Peterson	Amputation left foot above ankle.	2400
3/ 9/59	Edner W. Pelto	Fracture right foot.	58
3/ 9/59	Robert Anderson	Laceration third and fourth fingers, left hand.	7
4/ 1/59	Carl S. Luoma	Fracture left elbow.	129
5/18/59	Raymond C. Anderson	Broken bone right hand.	70
6/ 8/59	Victor Karvela	Lacerated little finger, right hand, and fracture middle phalanx.	10
6/ 2/59	Mark Roberts	Bruised left foot.	30
8/ 7/59	Tony Arrieri	Broken thumb.	22
10/15/59	William Nicholas	Fracture 5th metatarsal.	70
11/20/59	William Helmsdorfer	Contusions, abrasions of both arms, neck and head.	60
	Total Days Lost:		2984

BUNKER HILL GROUP
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11. POWER:

The Cleveland-Cliffs Iron Company Electric Power Department generates the power and the U. P. Power Company distributes it over their transmission lines. The average cost per kilowatt hour in 1959 was .00889, as compared to .00827 in 1958.

The following table lists the costs of power for 1959:

Hoisting	$ 18,731.91
Dry House	815.25
Shops	589.85
Crushing & Screening - UG	6,487.38
Electric Haulage	11,031.14
Ventilation	4,450.61
Heating Plant	589.86
Compressors	23,052.89
Stocking	1,170.91
Pumping	73,728.75
Office	398.69
Crushing & Screening - Surf.	585.78
Skip Tending	3,860.57
Mining	5,072.73
Development	154.48
Loading by Shovel	767.42
Total:	$151,488.22

CAMBRIA-JACKSON MINE
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1. GENERAL:

The mine did not operate for the year. A few men worked on a drainage drift to connect with a raise from the Mather Mine "B" Shaft. Underground equipment was salvaged and the shaft was covered over at ledge elevation. The area was fenced, and the work of closing down was completed March 15th.

The stockpile was loaded out with the shipments totaling 50,176 tons.

No mineable ore reserves were reported to the tax commission on December 31, 1959.

2. ORE STATEMENT:

	1959	1958
On Hand January 1, 1959	49,468	15,474
Output for Year	-	89,130
Stockpile Overrun	708	-
Total	50,176	104,604
Shipments	50,176	55,136
Balance on Hand	-	49,468

3. ANALYSIS:

Average Analysis of Shipments

Grade	Iron	Phos.	Silica	Sulphur	Moisture	Iron Natural
Jackson	59.55	.085	8.44	.053	11.78	52.54

CAMBRIA-JACKSON MINE
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4. COST OF ABANDONING MINE:

	Labor	Supplies	Total
Underground & Surface Costs			
Abandoning Mine	$23,692.36	$ 8,427.28	$32,119.64
Vacation Pay	773.18		773.18
Holiday Allowance	331.40		331.40
Social Security Taxes		2,235.65	2,235.65
Total UG & Surface Costs	$24,796.94	$10,662.93	$35,459.87
General Mine Expenses			
Mining Engineering Department	$ 687.09	$ 172.68	$ 859.77
Mechanical Engineering Dept.	518.38	138.37	656.75
Safety Department	119.14	50.61	169.75
Analysis & Grading - Laboratory	210.78	47.68	258.46
" " " - Shipping	360.25	87.05	447.30
Hygiene Clinic		306.84	306.84
Ishpeming Office	1,184.43	1,080.26	2,264.69
Mine Office - Supt. & Clerks	1,685.84	139.63	1,825.47
Central Warehouse Overhead	50.79	23.09	73.88
Insurance - Property		139.06	139.06
" - Group, Health & Life		1.41	1.41
" - Group Annuity		69.24	69.24
" - Catastrophe		83.00	83.00
Supplemental Unemployment Benefit		353.00	353.00
Total General Mine Expenses	$ 4,816.70	$ 2,689.10	$ 7,505.80
COST OF ABANDONING MINE	$29,613.64	$13,352.03	$42,965.67
Taxes		$ 3,135.62	$ 3,135.62
Loading and Shipping	$ 1,822.71	$ 3,757.79	$ 5,580.50
Rental of Shaft Facilities		$36,000.00	$36,000.00
TOTAL COST AT MINE	$31,436.35	$56,245.44	$87,681.79

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MATHER MINE "B" SHAFT
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YEAR 1959

1. GENERAL:

The USA-CIO Strike resulted in a loss of 82 operating days. The Strike commenced on July 15th and ended on November 7th after a length of 116 days. As a result, the production was 23.1% less than that of 1958.

For 1959, the production amounted to 654,574 tons. The production of tonnage by levels was: 99,522 tons from the 7th Level, 314,518 tons from the 8th Level, 233,088 tons from the 9th Level, and 7,446 tons from the 10th Level.

The production analysis improved in 1959.

Average Mine Analysis on Output (Including Stockpile)

Grade	Iron	Phos.	Silica	Sulphur
Mather Standard	59.76	-	8.14	.020

The first shipment to the Ore Improvement Plant started on April 5th while the lake shipments began on April 25th. Although ore movement stopped during the Strike, the total pocket and stockpile loading amounted to 908,676 tons. By the end of December, the Ore Improvement Plant received 584,601 tons. The final dock shipment occurred on December 13th. A total of 324,075 tons were sent for direct lake transport.

Average Analysis On Shipments (Total Average)

Grade	Iron	Phos.	Silica	Sulphur	Iron Natural
Mather Standard	59.95	.094	7.75	.020	54.09
Mather Special	57.34	.095	8.03	.901	51.36

The cost of production was $0.261 per ton less than that of the previous year. An increased productivity of 0.24 tons per man has aided in lowering the costs. Another favorable variance occurs in the general mine expense because of the reduction of departmental labor and supplies.

Labor relations remained on a satisfactory basis. The Union initiated two grievances concerning holiday pay. Both grievants received pay adjustments by the Company.

The dewatering of the overburden in the Partridge Creek area continued during the year. This section is located above the mining area. Due to pump failures, the water table rose 3 feet as compared to 1958.

This year the daily microseismic counts were 35% lower which indicates that the caving activity over the mining block is decreasing. From the monthly seismic time interval shots, the information shows the fracturing is within 500 feet of the surface.

On the 9th Level, the main level drifting comprised of completing the 9700, 9800, and 9910 Cross-cuts. A total of 262 feet of drift was driven with steel supports.

MATHER MINE "B" SHAFT
ANNUAL REPORT
YEAR 1959

1. GENERAL: (Cont'd.)

The 10th Level main line drift was advanced 545 feet and a connection was effected with the Mather "A" heading. Except for 51 feet, the drift required steel sets as supports.

East of the 10th Level crusher station, the 10000 Cross-cut was completed after drifting 1,409 feet. Only 270 feet of this cross-cut was driven naked.

In the second quarter of 1959, development work started on the 10th Level mining conveyor belt system. The North gathering belt drift was completed. Development work began for the East belt drift. The system will consist of North, East, and West conveyor belts. The latter two belts will convey the ore from the stoping areas and discharge onto the North gathering belt. In turn, the North belt will transfer the ore to the 10th Level crusher-conveyor system.

Another application of industrial television enabled one man to perform the work of two men. An attendant is able to control a chain conveyor on the -1225 sub and another on the -1325 sub. The latter discharges onto the 9th Level East conveyor belt.

Plans to consolidate the Mather "A" and "B" steel fabrication were undertaken. In the first quarter of 1960, the shop will be situated at the Mather "A". A more efficient and productive installation is expected.

As a result of the diamond drilling program, the ore reserves were increased moderately.

MATHER MINE "B" SHAFT
ANNUAL REPORT
YEAR 1959

2. PRODUCTION, SHIPMENTS & INVENTORIES:

a. Production by Grade and Months:

	Standard	Rock
January	65,675	7,224
February	79,789	8,064
March	77,554	11,064
April	86,186	6,660
May	78,463	5,064
June	84,118	5,100
July	34,136	1,848
August	-	-
September	-	-
October	-	-
November	58,581	5,100
December	90,072	7,116
Total	654,574	57,240

b. Shipments:

	Pocket Tons	Stockpile Tons	Total Tons	Total 1958	Increase or Decrease
Mather Standard	320,557	544,773	865,330	519,583	345,747
Mather Special	-	43,346	43,346	65,762	22,416
Total	320,557	588,119	908,676	585,345	323,331

c. Ore Statement:

	1959	1958
On Hand January 1, 1959	526,639	260,602
Output for Year	654,574	851,382
Total	1,181,213	1,111,984
Shipments	908,676	585,345
Balance on Hand	272,537	526,639
Increase or Decrease in Output	196,808	445,117
Increase or Decrease in Ore on Hand	254,102	266,037

MATHER MINE "B" SHAFT
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YEAR 1959

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

Working Schedules:

1959 - Four 2-8 hr. shifts from January 1, 1959 to January 31, 1959. Five 2-8 hr. Shifts from February 1, 1959 to July 14, 1959. Five 2-8 hr. shifts from November 9, 1959 to December 31, 1959.

1958 - Four 3-8 hr. shifts from January 1, 1958 to October 4, 1958. Four 2-8 hr. shifts from October 5, 1958 to December 31, 1958, with a tramming crew on the third shift.

Commencing in March, the Mine operated on a reduced schedule of four days per week for three weeks, with the fourth week idle. This schedule prevailed throughout the month of September.

1957 - Five 3-8 hr. shifts from January 1, 1957 to November 3, 1957. Four 3-8 hr. shifts from November 4, 1957 to December 31, 1957.

1956 - Five 2-8 hr. shifts from January 1, 1956 to September 9, 1956. Five 3-8 hr. shifts from September 10, 1956 to December 31, 1956.

1955 - Four 2-8 hr. shifts from January 1, 1955 to April 14, 1955. Five 2-8 hr. shifts from April 15, 1955 to December 31, 1955.

d. Division of Product by Levels and by Months:

	7th Level Standard	8th Level Standard	9th Level Standard	10th Level Standard	Total
January	10,035	29,482	26,158		65,675
February	14,195	42,080	23,514		79,789
March	11,827	42,849	22,878		77,554
April	13,258	44,422	26,979	1,527	86,186
May	9,729	43,939	21,970	2,825	78,463
June	14,721	41,234	25,740	2,423	84,118
July	5,120	14,337	14,679		34,136
August					
September					
October					
November	9,959	25,190	23,432		58,581
December	10,678	30,985	47,738	671	90,072
Total	99,522	314,518	233,088	7,446	654,574

e. Production Delays:

Outside the strike, There were no major production delays during the year; however, one hoisting shift and two tramming shifts were lost due to a bearing failure on the hold down sheave for the east skip in November.

MATHER MINE "B" SHAFT
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YEAR 1959

3. ANALYSIS:

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

Grade	Iron	Phos.	Silica	Sulphur
Mather Standard	59.76	-	8.14	.020

b. Average Anylsis of Shipments: (Total Average)

Grade	Iron	Phos.	Silica	Sulphur	Moist.	Iron Nat'l.
Mather Standard	59.95	.094	7.75	.020	9.77	54.09
Mather Special	57.34	.095	8.03	.901	10.43	51.36

c. Average Analysis of Ore in Stock:

Grade	Tons	Iron	Phos.	Silica	Mang.	Alum.	Lime	Mag.	Sulph.	Loss	Moist.
Math. Std.	189,383	59.14	.095	8.48	.34	2.85	.50	.73	.032	2.04	9.70
Math. Spec.	83,154	57.27	.095	8.02	.30	2.35	1.65	.46	.868	2.78	9.40

MATHER MINE "B" SHAFT
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YEAR 1959

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

a. Comparative Mining Costs:

	1959	1958
Product	654,574	851,382
Underground Costs	$3.165	$3.230
Surface Costs	.501	.467
General Mine Expense	.546	.776
Cost of Production	$4.212	$4.473
Amortization of Defense Facilities	.001	.095
Current Years Development	.546	.494
Depreciation:		
Plant & Equipment	.255	.256
Development after 12/31/44	.104	.104
Pre-Production Development	.016	.016
Movable Equipment	.012	.012
Taxes	.481	.721
Administration	.050	.053
Loading and Shipping	.092	.055
Total Cost at Mine	$5.769	$6.279
Budget - Estimated Cost at Mine	5.431*	5.728*
Number of Shifts and Hours	167 2-8 hr.	29 1-8 hr. 75 2-8 hr. 90 3-8 hr.
Total 8 Hr. Operating Shifts	334	447
Number of Operating Days	167	165-2/3

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

Proportion of Labor and Supplies

	Amount	Per Ton	Per Cent
Labor	$1,845,557.24	$2.819	54%
Supplies	1,572,795.08	2.403	46%
Total Cost at Mine	$3,418,352.32	$5.222*	100%

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

MATHER MINE "B" SHAFT
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YEAR 1959

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

b. Detailed Cost Comparison:

	1959		1958	
	Amount	Per Ton	Amount	Per Ton
Development	$ 415,744.07	$ .635		
Mining	820,250.36	1.253		
Tramming	301,140.43	.459		
Ventilation	24,075.51	.037		
Pumping	27,005.39	.040		
Compressors and Air Lines	18,911.11	.029		
Crushing and Screening -- UG	20,251.95	.031		
Underground Superintendence	121,196.82	.185		
Maint: Pockets and Chutes	6,634.35	.010		
" Mining Equipment	30,590.64	.047		
" Levels and X-cuts	20,946.06	.033		
" Shaft	10,285.20	.016		
Telephones & Safety Devices	37,055.87	.057		
Vacation Pay	96,881.85	.148		
Holiday Allowance	47,707.07	.073		
Social Security Taxes	73,522.48	.112		
Total Underground Cost	$2,072,199.16	$3.165	$2,749,835.91	$3.230
Hoisting	121,415.33	.186		
Crushing and Screening -- Surf.	23,730.70	.036		
Stocking	30,823.20	.048		
Timber Yard	46,318.08	.071		
Dry House	46,072.05	.070		
Policing	10,026.60	.015		
General Surface	13,049.44	.020		
Maint: Headframe Bldg. & Equip.	17.06			
" Other Mine Buildings	171.97			
Telephones & Safety Devices	1,757.78	.003		
Vacation Pay	14,464.76	.022		
Holiday Allowance	8,665.15	.013		
Social Security Taxes	10,986.12	.017		
Total Surface Cost	$ 327,498.24	$ .501	$ 397,314.32	$ .467
Geological Department	7,859.95	.012		
Mining Engineering Department	23,485.28	.035		
Mech. Eng. Dept.	3,713.34	.006		
Safety Department	7,439.59	.012		
Research Laboratory	9,956.49	.015		
Analysis & Grading -- Laboratory	29,607.00	.045		
" " " -- Shipping	6,235.73	.010		
Special Expense -- Hygiene Clinic	4,482.60	.007		
Ishpeming Office	99,596.94	.152		
Mine Office -- Supt. & Clerks	36,147.06	.055		
Central Warehouse Overhead	9,863.16	.015		
Insurance -- Property	3,712.91	.006		
" -- Group, Health & Life	40,974.54	.063		
" -- Group Annuity	6,518.05	.010		
" -- Catastrophe	1,498.16	.002		
Personal Injury -- Comp. & Doctors	38,327.95	.059		
Electrical Eng. Dept.	1,581.57	.002		
S.U.B.	26,449.07	.040		
Total General Mine Expenses	$ 357,449.39	$ .546	$ 661,215.20	$ .776
COST OF PRODUCTION	$2,757,146.79	$4.212	$3,808.365.43	$4.473

MATHER MINE "B" SHAFT
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4. COST OF OPENING, EQUIPPING, DEVELOPING AND OPERATING: (Cont'd.)

c. Cost of Strike Expense for the Year 1959:

Development	$ 1,654.06
Mining	74.29
Tramming	4,485.22
Ventilation	10,571.49
Pumping	15,319.14
Compressors and Air Lines	2,118.20
Crushing and Screening -- UG	99.67
Underground Superintendence	63,212.69
Maint: Pockets and Chutes	17.94
" Mining Equipment	714.16
" Levels and X-cuts	152.63
" Shaft	315.73
Telephones & Safety Devices	10,672.00
Vacation Pay	40,594.70
Holiday Allowance	48.94
Social Security Taxes	583.74
Total Underground Cost	$150,634.60
Hoisting	10,976.14
Crushing and Screening -- Surf.	118.23
Stocking	534.05
Timber Yard	211.91
Dry House	7,875.80
Policing	3,712.85
General Surface	3,548.29
Telephones & Safety Devices	23.13
Vacation Pay	6,058.52
Holiday Allowance	211.08
Social Security Taxes	87.23
Total Surface Cost	$ 33,357.23
Geological Department	3,623.37
Mining Engineering Department	11,060.11
Mechanical Engineering Department	2,128.02
Safety Department	3,476.57
Research Laboratory	3,040.91
Analysis & Grading -- Laboratory	7,017.76
" " " -- Shipping	2,905.00
Special Expense -- Hygiene Clinic	1,521.59
Ishpeming Office	46,398.57
Mine Office -- Supt. & Clerks	14,492.73
Central Warehouse Overhead	4,785.06
Insurance -- Property	1,828.01
" -- Group, Health & Life	2,189.70
" -- Group Annuity	4,579.16
" -- Catastrophe	1,885.52
Personal Injury -- Comp. & Doctors	2,333.20
Electrical Engineering Dept.	671.88
Total General Mine Expenses	$113,937.16
	$297,928.99

MATHER MINE "B" SHAFT
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4. COST OF OPENING, EQUIPPING, DEVELOPING AND OPERATING: (Cont'd.)

c. Cost of Strike Expense for the Year 1959: (Cont'd.)

Total Underground, Surface & General Mine Expenses	$297,928.99
Total Taxes	148,387.00
Total Depletion & Depreciation	2,890.68
Total Loading and Shipping	657.08
Total Strike Expense	$449,863.75

MATHER MINE "B" SHAFT
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YEAR 1959

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

Capital account expenditures for the year amounted to $332,392.64, which brings the cumulative expenditures in E&A to $18,255,079.24.

Capital Expenditures for Year:

E&A NM-159	Mining Conveyors - 10th Level	$ 36,473.82
E&A NM-160	Incline Conv. Drift 11th-12th Levels	2,304.63
E&A NM-161	Diamond Drilling	79,104.98
E&A NM-162	Main Level Development	202,195.21
E&A NM-163	Model 422 Loader	12,314.00
		$332,392.64

MATHER MINE "B" SHAFT
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5. ESTIMATE AND ANALYSIS OF ORE RESERVES:

The net ore reserves reported to the Tax Commission on December 31, 1959, were 11,199,197 tons. This is an increase of 296,655 tons from the previous year.

	Mather Standard	Sulphurous	Total Tons
Above 5th Level		1,449,789	1,449,789
Between 5th & 6th Levels		345,509	345,509
Between 6th & 7th Levels	558,962		558,962
Between 7th & 8th Levels	1,032,411		1,032,411
Between 8th & 9th Levels	2,731,193		2,731,193
Between 9th & 10th Levels	3,784,243		3,784,243
Below 10th Level	2,495,834		2,495,834
Sec. 1 Diamond Drill Hole Estimate	248,710		248,710
Total Gross as of June 30, 1959	10,851,353	1,795,298	12,646,651
Less 10% for Mining Loss & Rock	1,085,135	179,530	1,264,665
Net Total as of June 30, 1959	9,766,218	1,615,768	11,381,986
Less Production June 30 - Dec. 31, 1959	182,789		182,789
Net Total as of December 31, 1959	9,583,429	1,615,768	11,199,197

Expected Average Analysis of Ore Reserves as of December 31, 1959: (Natural)

Grade	Total Tons	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sulph.	Loss	Moist.
By Surface Diamond Drilling	223,839	54.40	.081	5.08	.10	2.62	.58	.60	.017	2.20	11.50
By Underground Development	10,975,358	51.50	.090	8.85	.45	2.62	2.50	.50	.300	2.00	10.50
	11,199,197										

MATHER MINE "B" SHAFT
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6. LABOR AND WAGES:

a. Employment:

At the end of the year 451 men were employed at the mine.

Number of Men 1/1/59.....	451
Added to Roll During the Year.....	50
Total.....	501
Separations.....	50
Total on Payroll 12/31/59.....	451
Average Number of Men as per December Labor Statement.....	448

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

Laid Off	4
Transferred Out	33
Died Natural Causes	2
Quit	2
Retired	6
Disability Pension	3
Total Separations	50
Transferred In	48
Rehired	2
Total Additions	50

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

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

Average Wages Per Day:	1959	1958	Increase or Decrease
Surface	$ 23.88	$ 23.38	$ .50
Underground	27.51	27.34	.17
Total	$ 26.78	$ 26.55	$ .23

Wages Per Month of 14 Days: (1958 based on 13¾ Days)

Surface	$334.32	$322.78	$11.54
Underground	385.14	377.45	7.69
Total	$374.92	$366.54	$ 8.38

Tons Per Man Per Day:

Surface	52.07	50.16	1.91
Underground	12.82	12.52	.30
Total	10.26	10.02	.24

Labor Cost Per Ton:

Surface	$ .465	$ .466	$ .001
Underground	2.146	2.184	.038
Total	$ 2.611	$ 2.650	$ .039

c. Labor Relations:

Only two grievances were filed during the year. Both of them involved the computation of Holiday Allowance. In each case, the grievants received an adjustment.

There was no scheduled vacation period due to the Strike.

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

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7. SURFACE:

Buildings:

Only a small amount of maintenance was necessary to retain the buildings in excellent condition.

New Equipment:

A Pettibone Fork Lift Truck with a 180° boom swing enabled safer and faster handling of long items, such as rails, pipes, runners, etc.

Because of the late shipping season, the freezing of the ore to the sides of the railroad cars became a problem. To facilitate unloading, oil sprayers were constructed so that the interior of the ore cars were coated with a solution of fuel oil and Cemkote.

Engine House:

In September, the compressor tank was cleaned and the water line valves were repaired.

Headframe and Stocking:

A new deck and punch plate was installed on the shaker feeder in February. Additional repairs were required to the apron feeder in July.

Two hoist ropes were replaced this year. On April 4th, the East skip rope was changed after hoisting 1,402,896 tons. The cage rope was removed and installed on the West skip on May 2nd. It had been in service since August 20, 1955. The former West skip rope had hoisted 1,397,157 tons.

During April, the West skip was replaced.

On November 16th, the bearing failed on the hold-down sheave for the East skip. Production was halted until the next morning.

Pumping:

Throughout the year, the underground portion of the North Jackson Mine was being pumped. As in the previous two years, the average rate of pumping amounted to 240 G.P.M.

At Partridge Creek, one pump operated at approximately 250 G.P.M. The water table was at 27'-3" in December. The loss of draw down as compared to 1958 is 3'-0". Three pumps operated simultaneously for a portion of the year. Up to 700 G.P.M. were being pumped; however, repeated pump failures resulted in a loss of pumping capacity. At least two additional low-volume pumps are needed to lower the water table.

7. SURFACE: (Cont'd.)

Pumping: (Cont'd.)

This year, a pipeline was installed by the City of Negaunee. All of the water pumped at Partridge Creek and the North Jackson Stope is being discharged into Teal Lake by this pipe line.

Subsidence:

In Holes #153, #167, and #168 microseismic counts were recorded daily. The total count for 1959 was about 35% lower than in 1958, which indicates a reduced amount of caving activity.

Time interval-velocity tests were conducted on a monthly basis between Holes #153 and #167. The upper travel path showed a change from increasing velocities in 1958 to decreasing velocities in 1959. The lower travel path continued to demonstrate decreasing velocities. This information indicates fracturing above the +900 elevation, which is 500 feet from the surface. Holes #153 and #168 located over the mined-out areas still retain water.

Iron Pin Surveys were conducted during the year. There were no indications of subsidence.

Steel Fabrication Shop:

To increase the output and efficiency of steel fabrication at the Mather Mine, plans for a centralized shop were initiated. The consolidation will be effected during the first quarter of 1960. The shop will be located at the Mather "A".

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8. UNDERGROUND:

a. General:

Total ore production was 654,574 tons. The tonnage distribution by levels was 15% or 99,522 tons from 7th Level, 48% or 314,518 tons from 8th Level, 36% or 233,088 tons from 9th Level, and 1% or 7,446 tons from 10th Level.

Mining on the 6th Level was stopped temporarily because of the sulphur content of the orebody. Production will be resumed depending on the market conditions.

A total of 12 chain conveyors were in operation on the various levels at the Mather "B" throughout the year. The main application of the chain conveyor was in a transfer drift which cross-hauls the ore from the slusher drifts to a storage raise or sub-level mining conveyors. The chain conveyors have definitely increased the productivity of the various blocks, thereby reducing the number of active mining areas underground.

6th Level:

There was no development or mining on this level during 1959.

7th Level:

All of the 99,522 tons produced from the 7th Level was conveyed by the 1225' mining conveyor. The ore was dropped to the 8th Level crusher trench by means of an ore pass and then crushed. The ore was conveyed from the crusher station to the shaft by a 483' conveyor. The block-cave system of mining was used in all the standard ore blocks on the 7th Level.

Area Between 7100 and 7200 Cross-cut:

Block 72-C: Block-cave mining produced 30,534 tons during 1959. This orebody is situated on the north side of Dike #22 and consisted of three 250' slusher drifts developed along the footwall.

Block 72-C Pillar: Development of a transfer drift and slusher drift at the -875 sub elevation and along the south side of Dike #22 was completed at the end of the year. To date, 2,358 tons have been mined.

Area Between 7300 and 7400 Cross-cuts:

Block 74-C: Block-cave mining continued in this 135,000 ton block which consists of three 265' slusher drifts located along the north side of Dike #22. During 1959, 63,364 tons were mined.

8th Level:

All of the standard ore was adaptable to the block-cave system of mining and was trammed to the crusher station 465' from the shaft. At this point, the ore was crushed to -4½" and conveyed to the storage trench at shaft.

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8. UNDERGROUND: (Cont'd.)

8th Level: (Cont'd.)

Area Above 8000 Cross-cut:

Block 80-A: Block caving produced 48,115 tons from this area below the 7000 Cross-cut pillar.

Area Between 8400 and 8500 Cross-cuts:

Block 84-F: A single slusher drift at the -1025 elevation was undercut. To date, 15,796 tons were mined.

Block 85-C: Block caving produced 24,347 tons during the year in this standard orebody located 75' above the cross-cut.

Block 85-E Pillar: One crew was in the process of developing a single slusher drift eastward at the -1025 elevation at the end of 1959.

Area Between 8600 and 8700 Cross-cuts:

Block 86-D: Development of the south slusher drift in this 95,000 ton standard orebody located along the footwall and on the north side of Dike #22 was completed during December.

Area Between 8700 and 8800 Cross-cuts:

Block 87-B: Block caving produced 16,325 tons from this area.

Block 87-D: During the year, 46,217 tons of standard ore were block caved in this area located at the south end of the 8700 Cross-cut and at top timber elevation.

Block 88-C North: A single slusher drift at the -1025 sub elevation was undercut and produced 41,689 tons of standard ore during 1959.

Block 88-C North Pillar: Development work continued in this single slusher drift 50' below the 7th Level and along the footwall.

Block 88-E: In this standard orebody located at top timber elevation and south of Dike #22, 49,728 tons were produced.

Block 89-C: Two slusher drifts at the -1050 sub elevation were undercut this year. To date, 50,162 tons have been mined.

Block 89-C North: A single slusher drift was driven eastward along the footwall and at the -1025 sub elevation during the latter part of the year.

Area West of 8900 Cross-cut:

Block 89-A: Block caving from this area amounted to 12,132 tons during the year.

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8. UNDERGROUND: (Cont'd.)

9th Level:

A total of 233,088 tons was block caved during the year from this level. The 1160' west mining conveyor was put into operation during the year. All of the 9th Level ore is discharged through a 200' ore pass raise to the 10th Level crusher.

Area Between 9000 and 9100 Cross-cuts:

Block 90-C: Three slusher drifts were developed along the west side of the 7600-W Coordinate shaft pillar and at top timber elevation. All of the 65,734 tons were chain-conveyed to the 9th Level East mining conveyor.

Block 91-A: Block caving from this area amounted to 99,892 tons during the year.

Block 91-A South: One crew developed a single slusher drift in this 18,000 ton standard orebody along the south side of the Jackson Fault Zone.

Block 91-B: Block caving amounted to 47,404 tons from four slusher drifts developed at the -1225 sub elevation. The material was chain conveyed and discharged onto the East mining conveyor.

Area Between 9500 and 9700 Cross-cuts:

Block 95-A: Three slusher drifts were developed at top timber elevation along the south side of the Jackson Fault. The north drift was undercut at the end of the year.

Block 96-A: One crew developed the main transfer drift southward and a single slusher drift to the 9700 Cross-cut during the year.

Area Between 9800 and 9900 Cross-cuts:

Block 98-A: Two slusher drifts were driven and a drilling sub developed in this 114,000-ton standard orebody located at top timber elevation. Production for the year totaled 5,462 tons.

Block 99-A: Preparations to undercut this block were made at the end of the year. Development work consisted of three slusher drifts driven eastward at top timber elevation.

Block 99-D: Two cribbed raises were advanced 165' to the -1175 sub elevation and preparations to drive the main transfer drift northward were made at the end of the year.

10th Level:

On the 10th Level, the main-level development work consisted of three phases: Completion of the 10000 Cross-cut, the Mather "A" Winze Drift, and the main-level heading.

8. UNDERGROUND: (Cont'd.)

10th Level: (Cont'd.)

The 10000 Cross-cut was advanced 1,409 feet. With the exception of 270 feet, the cross-cut was driven with steel sets as supports.

The entire length of the Mather "A" winze drift required steel supports. During the first quarter, this drift was extended 260 feet.

On the "A" Shaft side of the boundary, the 10th Level main line was driven 545 feet. A connection was made with the Mather "A" heading on June 30th. The headings met with excellent line and grade.

Work commenced on the 10th Level sub-level conveyor system during April. The intersection and discharge point for the East and West sub-level conveyor belts was cut. During December, the North conveyor belt drift was finished, the length of which is 150 feet. The initial drifting for the East conveyor belt started in November.

8. UNDERGROUND: (Cont'd.)

b. Diamond Drilling:

A total of 8,032' of diamond drilling was completed in 1959. This footage represents 28 holes -- 12 on 9th Level and 16 on 10th Level. The main objectives of the drilling program were:

1. Detailing Ore Above 9th Level.

2. Outlining Ore On 10th Level.

3. Locating Ore And Structure Below 10th Level.

9th Level:

Two holes were drilled to determine the height of the ore on the Jackson Fault in the area extending between the 7900-W to the 8000-W Coordinates. The ore was found to extend as high as the -1125 elevation. A sub level was cut at -1225 elevation to mine this section.

Three holes were drilled downward from the 9800 Cross-cut to outline 10th Level ore and to locate the footwall below this area. The footwall leaves the Jackson Fault at -1430' elevation and dips southward at 22°. There is 80' of ore lying on the footwall, but it pinches out very quickly to the south.

One hole was drilled downward from the 9400 Cross-cut to outline ore above the 10400 Cross-cut. This hole showed some lean material lying along the Jackson Fault and on the footwall near the fault.

Three holes were drilled downward from the 9th Level mining areas to determine the dip of the Jackson Fault between 9th and 10th Levels. The dip was found to be between 55 and 60 degrees, which means a sub-level will be needed between 9th and 10th Levels to mine the ore directly below 9th Level on the Jackson Fault.

Three holes were drilled from the 9 W 1 transfer drift to outline the ore above 9th Level southeast of the junction of the Cambria and Jackson Faults. It was found that although there was very little ore directly above the level, the ore blossomed out considerably above the -1200' elevation and extends at least to the -1100' elevation.

10th Level:

Three holes were drilled downward from the 10200 Cross-cut to outline the ore and locate the footwall below the Cross-cut. The footwall was found to lie almost flat at the -1670' elevation with ore extending up to 10th Level and southward to about the 2700-South Coordinate.

Six holes were drilled from a cut-out on the 8300-W Coordinate to outline ore and structure. A large body of ore was outlined between the Jackson Fault and Dike 27. This ore extends from 9th Level to the -1640 elevation and is cut by at least six E-W dikes. The footwall leaves the Jackson Fault at -1590' and

8. UNDERGROUND: (Cont'd.)

b. Diamond Drilling: (Cont'd.)

dips southward at 10°, contacting the Dike 27 fault at 1670'. On the south side of Dike 27 fault, the footwall drops to -1870' and 180' of ore is indicated on the footwall immediately south of Dike 27.

Three holes were drilled from the 10400 Cross-cut at 2700-S in a radial pattern to outline ore and to determine the course of the dikes cut by the drilling on the 8300-West Coordinate. These holes indicated that the large orebody in the 10400 Cross-cut area does not extend very far south of the drill station and decreases in size to the west. The majority of the dikes run in an E-W direction and most pinch out before reaching the 10400 Cross-cut. Dike 27 swings south as it progresses westward.

One hole was drilled due south from the end of the 10400 Cross-cut to attempt to cut the Main Athens Dike and thus help to correlate Bunker Hill-Athens structure with Mather structure. This hole cut four large intrusives, none of which could definitely be labeled as the Athens Dike.

One hole was drilled from the 10th Level cut-out at 8300-W - 3200-S to outline ore and locate the footwall. The footwall was encountered at -1850' elevation, 100' higher than expected. Very little mineable ore was cut. Two more holes will be drilled in this area in 1960.

One hole was drilled from the 10400 Cross-cut to detail ore over the north end of the Cross-cut. This hole showed the ore height to be greater than expected.

One hole was drilled from the cut-out at the end of the 10700 Cross-cut. Drilling here has indicated a dike-fault in the 3500-S area with the footwall at about the -2050' elevation. No mineable ore was cut south of this dike.

The following table shows the drilling for the year:

Holes Drilled From 9th Level		Ore Drilled	Depth
Hole Number:	499	110	117
	505	71	117
	507	83	208
	511	--	329
	513	70	160
	522	203	315
	523	135	155
	525	45	91
	526	70	92
	528	91	257
	533	63	320
	535	146	326

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8. UNDERGROUND: (Cont'd.)

b. Diamond Drilling: (Cont'd.)

Holes Drilled From 10th Level		Ore Drilled	Depth
Hole Number:	489	40	137
	494	17	1,065
	495	83	160
	498	109	220
	500	245	439
	503	130	175
	510	60	290
	514	143	353
	515	130	241
	517	291	409
	518	71	244
	520	246	260
	521	295	515
	529	15	252
	532	146	415
	537	276	370
Total	28	3,384'	8,032'

Percent Ore Cut - 42.1%

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8. UNDERGROUND: (Cont'd.)

c. Timbering:

Statement of Ground Support Material Used Under Development and Mining Accounts

Item	Amount	Cost Per Ton
Cribbing	$ 6,554.87	$.01002
Stull Timber	351.61	.00054
Lagging	12,706.10	.01941
Poles	5,906.51	.00902
Steel	109,182.33	.16679
Total 1959	$134,701.42	$.20578
Total 1958	$187,458.29	$.22018
Total 1957	$299,980.23	$.23135
Total 1956	$231,672.76	$.17984
Total 1955	$142,941.88	$.11591

d. Explosives:

Explosives Used In Breaking 654,574 Tons of Ore In Development And Mining Accounts

	Amount	Cost Per Ton
Total Powder	$ 64,379.75	$.09835
Blasting Supplies	47,596.51	.07271
Grand Total Powder & Blasting Supplies	$111,976.26	$.17106

Pounds of Powder Per Ton of Ore	.46138
Tons of Ore Per Pound of Powder	2.16737
Cost Per Ton For Powder	$.09835
Cost Per Ton For Fuse, Caps, etc.	$.07271
Cost Per Ton For All Explosives	$.17106

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8. UNDERGROUND: (Cont'd)

e. Pumping:

As compared to 1958, the pumping increased on the 6th and 8th Levels during the year. The flow of water decreased on the 7th, 9th, and 10th Levels. The total gallonage decreased by 43.3 G.P.M. during 1959.

Level	1959 G.P.M.	1958 G.P.M.
6th	44.3	40.7
7th	14.1	20.9
8th	38.1	30.3
9th	12.9	16.4
10th	87.2	131.6
Total	196.6	239.9

9. TAXES:

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

	1959			1958		
	Valuation	Rate	Taxes	Valuation	Rate	Taxes
Section 1, 47-27						
Real	$ 5,660,000		$282,971.70	$ 7,665,000		$351,083.83
Personal	5,175,000		258,724.13	2,680,000		122,753.38
Total Mather Mine "B" Shaft (Sec. 1 City of Negaunee)	$10,835,000	49.9950	$541,695.83	$10,345,000	45.8035	$473,837.21

	1959		
	Taxes	Per Ton Produced	Per Ton Shipped
Operating	$352,102.29	$0.538	$0.387
Idle Expense	189,593.54	0.290	0.209
Total	$541,695.83	$0.828	$0.596

	1958		
	Taxes	Per Ton Produced	Per Ton Shipped
Operating	$473,837.21	$0.557	$0.810
Idle Expense	-	-	-
Total	$473,837.21	$0.557	$0.810

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10. ACCIDENTS AND PERSONAL INJURY:

There were twenty compensable accidents during 1959. These injuries amounted to 752 days of lost time while 35 days were lost as a result of thirteen non-compensable accidents. The lost time totaled 787 days.

Year	Total Hours Worked	Days Lost	Severity (Days Lost x 1 Million / Man Hrs. Worked)	Frequency (Injuries / Million Man Hrs. Worked)
1959	581,087	787	1,354	56.79
1958	747,280	7,120	9,528	37.47

Date	Name	Nature of Injury	Days Lost
1- 9-59	Nestor Korpi	Chip fracture, left small finger	31
2-11-59	Louis Vallier	Fracture, left metatarsal	25
2-17-59	Samuel Carilli	Contusion of forehead	9
3- 6-59	John Vercoe	Laceration, left thumb	7
4-23-59	Frank Guizzetti	Laceration, left thumb	11
4-23-59	Matt Larson	Contusion, back and legs	125
4-24-59	Edward Ecklid	Contusion, right leg	10
4-28-59	Arne Kauppinen	Oil wound, right middle finger	23
4-28-59	Gunnar Anderson	Laceration, right middle finger	11
4-30-59	Reino Lepisto	Fracture, 5th left toe	52
4-30-59	Charles Asmund	Lumbo sacral strain	12
5-12-59	Leonard Maki	Contusion, chest	8
5-13-59	Walfred Luoma	Hematoma and contusion, right foot	23
5-18-59	Arthur Baldini	Sprain, left ankle	7
5-22-59	Toivo Lahti	Amputation, 2nd joint small right finger	100
6-29-59	Arthur Moore	Hemotoma, right shoulder blade	35
7-10-59	Henry Isabelle	Chipped, right knee cap	45
11-14-59	John Marietti	Bruised back; Fracture, right ankle	130
11-18-59	Charles Gravedoni	Laceration, right little finger	8
11-23-59	John Mongait	Fracture, right arm	80
			752

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11. POWER:

	CONSUMPTION K.W. HOURS	AVERAGE MAX. DEMAND	AVERAGE DEM. FACTOR	COST OF CURRENT	AVERAGE PRICE PER K.W. HOUR
1959 -	13,151,034	3,728 K.W.	39.3%	$208,896.28	$.01588
1958 -	15,584,943	4,248 K.W.	42.3%	$205,552.04	$.01319
1957 -	19,263,481	4,219 K.W.	53.1%	$214,657.24	$.01114
1956 -	17,699,459	3,532 K.W.	57.8%	$157,953.08	$.00892
1955 -	15,193,755	3,300 K.W.	53.1%	$140,408.83	$.00924

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GENERAL

The year 1959 was closed with an optimistic view towards making substantial cuts in the operating costs and further increasing the overall production rates in 1960. Realization of the 1959 goals was not possible due to the strike action taken by The United Steelworkers of America (CIO). The discontinuance of all operations between July 14 and November 8 encompassed over three months of the best operating weather conditions for the year.

In spite of the prolonged strike a marked improvement was noted in the production rates, pellet quality and cost per ton of pellets produced. In reviewing 1959 costs consideration was given to two very important factors; namely, the inability to take advantage of the overrun in the remaining 1959 stockpile plus the loss of four summer operating months with low cost potentials. The 1959 production of 428,633 LT for an approximate 8 month period signifies the annual potential of more than 600,000 tons for a 12 month year. The quality of the pellets produced in 1959 showed an improvement of 1½% over that of 1958. This improvement was measured in terms of percent of minus 28 mesh after tumble.

The highlight of the year relative to testing programs was the installation and operation of a balling drum, reroll drum and green pellet screen. The various phases of the balling study were written up in individual Metallurgical Research Memorandums.

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I. PRODUCTION, SHIPMENT, AND INVENTORIES

A. Operating Schedule

The plant operated on a 3 shift per day, 7 day per week schedule during the year except for the strike period. The plant was shut down by the strike at the end of the afternoon shift on July 14. Operation was resumed on November 8 after the Taft-Hartley Act was invoked sending the strikers back to work.

One or more shifts were scheduled each week for repairs. There was no shut-down for major repairs in 1959. The operating schedule, by months, is shown in Table No. 1 below.

TABLE NO. 1

Month	Days Operated	Days/Week	Total Shifts	Total Hours
January	27.65	7	82.95	663.29
February	26.20	7	78.60	628.55
March	27.98	7	83.94	671.29
April	27.59	7	82.77	662.05
May	28.19	7	84.57	676.38
June	28.25	7	84.75	677.57
July	11.99	7	35.97	287.46
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-
November	18.50	7	55.50	444.08
December	26.86	7	80.58	644.44
Totals	223.21		669.63	5357.11

B. Production and Production Rates

The production and production rates for 1959 were as shown in Table No. 2 below.

TABLE NO. 2

	Concentrate Regrinding Section			Pellet Firing Section		
Month	Tonnage	LTPH		Tonnage	LTPH	
		Gross	Net		Gross	Net
January	68,500	103.55	104.20	46,447	70.00	74.89
February	66,399	106.94	107.13	48,254	76.73	80.19
March	69,179	102.63	102.93	50,970	75.91	79.77
April	68,293	105.51	105.51	52,697	79.59	86.32
May	74,392	110.61	111.50	62,197	91.92	100.34
June	75,840	111.85	112.33	60,153	88.73	94.71
July	31,028	108.10	103.30	24,350	84.60	90.90
August	-			-		
September	-			-		
October	-			-		
November	47,400	106.4	106.7	33,106	74.54	79.93
December	69,015	106.8	107.80	50,928	78.99	82.26
Totals & Averages	570,046	106.9	107.4	428,633	80.0	85.3

A more detailed description of production rates of the various sections may be found in the tables in Section XI.

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C. Production Costs

The cost of producing the 428,633 long tons of pellets averaged 5.291 dollars per ton. A brief description of the operating costs is shown below:

TABLE NO. 3

Raw Materials - Unloading & Storage	.114
Material Preparation	2.929
Pellet Firing	1.310
Product Screening & Loading	.269
Water Supply	.012
Control & Analysis	.040
Other Direct Plant Expense	.455
Allocated Expense	.162
Total Processing Costs	5.291

A detailed monthly cost analysis may be found in the tables in Section VI.

D. Tonnage and Analysis of Pellets Produced and Shipped

During the year 398825 long tons of pellets were shipped. The chemical analysis of the pellets produced and shipped is presented below.

TABLE NO. 4

Pellets Produced:

	Fe.	Phos.	Silica	Sulphur	Moisture
January	63.36	-	9.01	-	2.50
February	63.13	-	9.17	-	2.50
March	63.43	-	9.32	-	3.10
April	63.09	.033	9.07	.006	2.98
May	62.48	.034	9.39	.006	3.45
June	62.94	.033	9.35	.006	3.27
July	63.10	.034	9.22	.006	3.49
August	-	-	-	-	-
September	-	-	-	-	-
October	-	-	-	-	-
November	62.69	.027	8.59	.006	2.78
December	63.08	.032	8.53	.005	2.84
Yearly Average	63.02		9.09		2.99

TABLE NO. 5

Pellets Shipped:

Pocket	62.89	.034	9.20	.005	3.50
Stockpile	63.08	.034	9.01	.006	6.60

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E. Estimated Production and Analysis

The estimated tonnage and chemical analysis of pellets for 1960 is as follows:

TABLE NO. 6

Estimated Tonnage 650,000 Long Tons

Estimated Analysis	Fe.	Phos.	Silica	Sulphur	Moisture
Pellets Dry	63.25	.031	9.10	.006	-
Pellets Natural	60.72	.030	8.74	.005	4.00

The Pellet analysis is based on Republic's 1960 expected concentrate analysis.

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II. LABOR AND WAGES

A. Report of Men Hired, Transferred, and Separated

TABLE NO. 7

	First of Month	Hires	Trans. From Other Mines	Separations	End of Month
January	113		1		114
February	114				114
March	114		1	7	108
April	108			6	102
May	102	3	1	2	104
June	104	2	4	3	107
July	107		1	2	106
August	106				106
September	106			1	105
October	105			1	104
November	104	3		3	104
December	104	1		1	104

B. Annual Statement of Labor

TABLE NO. 8

	Stat. Men	Hours	Amount	Average Rate
Hourly Employees				
Straight Time - Classified	79½	152,604½	402,729.18	2.639
Overtime - Classified		(16,946¾)	22,698.18	1.339
Shift Differential - Aftn		(34,349¼)	2,961.96	.086
- Night		(30,414¾)	4,083.81	.134
Holiday Allowance		(3,651½)	9,433.78	2.584
Holiday Worked - Prem. Time Only		(1,175)	3,889.38	3.324
Sunday Premium Pay		(16,040)	10,471.12	.653
Sub Total	79½	152,604½	456,267.41	2.990
Vacation Pay			28,042.74	
Other		(144)	369.99	2.569
Total Hourly Employees	79½	152,604½	484,680.14	3.176
Average Job Class				9.597
Salaried Employees				
Mine Payroll - Straight Time	5¾	10,985½	39,933.50	3.635
Total Mine Payroll	85¼	163,590	524,613.64	3.207
General Payroll				
Salaries - Straight Time	4¼	8,304	23,688.00	2.853
Labor From Other Mines	10¾	20,605½	80,734.16	3.918
Total Labor	100¼	192,499½	629,035.80	3.268
Distributed As Follows:				
Operating Mine	92¾	178,348¾	570,935.64	3.201
Strike Expense	3¼	6,193½	30,006.04	4.844
Uncompleted Construction	3	5,804	20,907.20	3.602
Other Mines	¼	285¾	996.61	3.488
Other Accounts	1	1,867½	6,190.31	3.315
Total As Above	100¼	192,499½	629,035.80	3.268

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C. Labor Breakdown

At the close of 1959 the crew included 99 hourly rate and 5 salaried people.

TABLE NO. 9

	Number of Men
Pelletizing Plant	
Operating - Metallurgical Engineer	1
Mechanical - Maintenance Engineer	1
Plant Foremen	2
Maintenance Foreman	1
Shift Leaders	4
Raw Materials Unloading & Storage	
Car Dumpmen	1
Car Dumpmen Helpers	4
Material Preparation	
Pulverizer Operators	3
Ball Mill Operators	4
Disc Operators	8
Feedermen	4
Ball Mill - Pulverizer Helpers	4
Pellet Firing	
Hardening Furnace Operators	4
Hardening Furnace Assistants	4
Spill Conveyor Attendants	4
Product Screening & Loading	
Pocketmen	4
Discharge Screen Attendants	4
Plant Laboratory & Sampling	
Plant Analyst	1
Plant Sampler	1
Truck, Tractor & Payloaders	
Service Truck	1
Tractor	1
Payloaders	4
Hydrocrane Operator	1
Janitors	2
Plant Laborers	3
Plant Maintenance	
Electrician Leader	1
Electricians	7
Assistant Mill Foreman	1
Mechanical Leader	1
Plant Repairmen	7
Plant Repairmen Helpers	5
Welder Standard	5
Welder Intermediate	1
Welder Starter	2
Plant Oilers	2
Automotive Mechanic	1
	104

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III. PLANT OPERATION

A. Introduction

The Pelletizing Plant operated continuously in 1959 with the exception of the shut-down from July 15 to November 9 due to the strike. Operating time increased to a new high of 96.0% in December. The yearly average was 93.85%.

Pellet production reached a monthly high of 62,197 LT in May and was in excess of 60,000 LT for the month of June. The production rate on a net time basis reached a monthly high in May of 100.3 LTPH.

The use of No. 2 Buckwheat as ignition coal was established and resulted in reduced consumption as well as improved ignition. The total heat consumption dropped to 2.403 M Btu/LT for the year.

The balling study tests were run intermittently from January until the first week in May. A testing program was begun to determine the feasibility of grinding limestone in the 6x10 Returns Ball Mill. A test was begun on the use of Ni-Hard grinding balls in the $10\frac{1}{2}'$ x $14'$ Allis-Chalmers ball mill. Numerous other tests were run during the year on individual phases of the operation.

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B. Concentrate Balance with Pellet Production

TABLE NO. 10

Republic Concentrate Shipped			467,605 LT (Nat'l)
Eagle Mills Pellets Produced			428,633
			38,972 LT (Nat'l)
Plus: Material Recovered from Tailings Pond			22,604
Material Unaccounted For			61,576 LT (Nat'l)
Unaccounted For Material			
Process Losses			
Moisture Difference			
Concentrate Moisture	27,980 LT		
Tailings Moisture	2,514		
	30,494		
Product Moisture	12,816		
		17,678 LT	
Oxygen Loss - Reduction of Hematite to Magnetite		8,580	
			26,258 LT
Inventory Adjustment			
Concentrate In Transit, Balance		2,981	
Concentrate in Storage at Eagle Mills, Balance		-3,839	
			- 858
Unrecoverable Material Losses			
In Transit Losses - Republic to Eagle Mills		4,714	
Rotoclone Dust Losses - To Atmosphere		3,478	
			8,192
Possible Recoverable Material			
Estimated Overrun		7,143	
Other Losses (including loss in thickener overflow, spillage, etc.)		20,841	
			27,984
			61,576 LT

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C. Monthly Hourly Operating Rates

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

TABLE NO. 11

	Ball Mills & Filters LTPH	Pulverizer Process Coal	Pulverizer Process Limestone	Average No. Discs Operating	Grate Machine LTPH
January	104.2	6.85	15.35	3.97	74.9
February	107.1	7.43	10.89	3.91	80.2
March	102.9	4.53	12.60	3.92	79.8
April	105.5	5.16	-	3.95	86.3
May	111.5	6.63	10.20	3.98	100.3
June	112.3	5.50	-	3.98	94.7
July	103.3	5.53	-	3.99	90.9
August	-	-	-	-	-
September	-	-	-	-	-
October	-	-	-	-	-
November	106.7	6.00	-	3.96	79.9
December	107.8	6.09	-	3.97	82.3
Total Year	107.4				85.3

A complete description of the operating rates of these pieces of equipment may be found in Section XI.

D. Major Delay Time

The operating time varied from a monthly low of 91.6% to a high of 96.0%. The operating time for the entire year was 93.9%. A specific piece of equipment was not charged with delay time unless the production of the plant was halted because of the piece of equipment. Some of the major delays are listed below.

TABLE NO. 12

Piece of Equipment

Grate Machine Pallet Cars - replace, caught in machine, or repairs
Pulverizer
Grate Machine Sump Pumps - sanded, plugged, or repairs
Balling Study Equipment - jackpots, repairs, or loss of pellet firing
No. 1 Process Air Fan - motor failures
Simplicity Vibrating Conveyor

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E. Fuel and Raw Material Consumption

The raw materials consumption during 1959 is presented below. These are divided into total consumption and consumption per ton of pellets produced.

TABLE NO. 13

Raw Material	Amount Used	Amount/Ton of Pellets
Concentrate	471,320 LT	1.100 LT
Bentonite	2,802 LT	14.64 lbs
Limestone	5,318 LT	27.79 lbs
Process Coal	27,095 LT	141.60 lbs
Ignition Coal	7,799 LT	40.76 lbs
Propane	816,571 Gals	1.905 Gal.
Grinding Balls	1,135 NT	-

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

TABLE NO. 14

	Consumption - Million BTU/LT			
	Propane	Ignition Coal	Process Coal	Total
January	0.098	0.746	2.186	3.030
February	.090	.593	2.123	2.806
March	.088	.682	1.752	2.522
April	.079	.469	1.828	2.376
May	.067	.465	1.594	2.126
June	.076	.452	1.659	2.187
July	.061	.484	2.143	2.688
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-
November	.061	.569	1.830	2.460
December	.065	.541	1.755	2.361
Total Year	.075	.537	1.790	2.402

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IV. REPAIRS AND CHANGES

A. Raw Material Unloading and Storage

The thaw shed extension started late in 1958 was completed. Anticipated results were realized in the winter operations.

The Link Belt car shaker drive was changed from a chain to a V-belt drive. Maintenance costs on this unit should be reduced as a result of the change.

B. Material Preparation

The 6' x 10' Allis Chalmers ball mill on the returns circuit was equipped with a complete new set of Ni-Hard shell liners in December.

New feed and discharge end liners were installed on the 10½' x 14' A.C. ball mill subsequent to the return to work following the strike.

A program to test 7/8 inch Ni-Hard grinding balls in the 10½' x 14' A.C. ball mill was started just prior to the July 14 strike.

Motor ventilation was installed on the Hardinge ball mill motor and the motor on the vacuum pump.

New bearings were installed on the west roll of the coal-limestone pulverizer.

Installation of the exhaust coal dust collector was partially completed.

A new micarta trunion bearing shell was installed on the discharge end of the Hardinge ball mill.

The feed and discharge end liners of the Hardinge ball mill were replaced in February.

A new conveyor belt was installed on No. 12 conveyor. A lighter weight belt with more flexibility was used to decrease the spill problem at feed and mixing points.

The air drying furnace, in connection with the pulverizer, was relined with new fire brick during the strike period.

Four of the table feeders under the concentrate silos were faced with expanded metal. Concentrate was allowed to build up on the expanded metal and used as a wearing surface. A similar type installation was made on one of the coal table feeders.

C. Pellet Firing

Motor ventilation was installed on the drive motors of No. 1 and No. 2 Process air fans.

Installation of revised windbox legs were 90% completed. The new type legs facilitate cleaning of the windbox proper. Clean windboxes are necessary for optimum operating conditions.