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8. COST OF OPERATING (Cont.)

b. Detailed Cost Comparison

	1937 Amount	1937 Per Ton	1936 Amount	1936 Per Ton
1. Exploring in Mine	170.67	.000	263.64	.000
3. Development in Rock	669.75	.002	10,853.10	.030
4. Development in Ore	44,247.25	.082	29,023.54	.080
5. Stoping	209,183.51	.384	115,061.46	.316
6. Timbering	121,680.25	.223	63,974.79	.176
7. Tramming	60,134.06	.110	37,142.58	.102
8. Ventilation	1,678.45	.003	909.52	.002
9. Pumping	13,697.99	.025	9,455.99	.026
10. Comp. & Air Pipes	25,923.37	.048	18,895.75	.052
12. U.G.Superintendence	16,288.66	.030	8,748.58	.024
14. Maint.Comp.& P.Drills	1,627.07	.003	2,719.23	.007
15. Scrp. & Mech.Loaders	12,034.46	.022	7,724.85	.022
16. Elec. Tram Equipt.	11,898.23	.022	11,631.24	.032
17. Pumping Machinery	2,970.42	.005	66.29	.000
Total Underground Costs	520,864.64	.955	316,470.56	.869
18. Hoisting	26,324.30	.048	17,888.01	.050
19. Stocking Ore	7,490.93	.014	5,413.96	.015
20. Crushing at Mine	1,655.65	.003	1,192.57	.003
21. Dry House	7,376.84	.014	3,285.26	.009
22. General Surface Expense	7,868.03	.014	4,376.35	.012
23. Maint.Hoisting Equipt.	7,034.21	.013	3,100.64	.009
24. Shaft	5,154.15	.009	1,412.58	.004
25. Top Tram Equipt.	4,088.94	.007	3,751.36	.010
26. Docks,Trestles & Pockets	5,698.42	.011	5,526.14	.015
27. Mine Buildings	3,732.71	.007	6,004.00	.016
Total Surface Costs	76,424.18	.140	51,950.87	.143
28. Insurance	3,435.96	.006	736.46	.003
Vacation Expense	4,787,91	.009	3,182.82	.009
29. Mining Engineering	2,373.79	.004	2,331.50	.006
30. Mech.& Elect. Engr.	1,547.65	.003	1,308.78	.004
31. Analysis & Grading	13,006.71	.024	9,151.09	.025
32. Personal Injury	14,587.58	.027	8,279.03	.023
33. Safety Department	1,582.41	.003	836.98	.003
34. Tel. & Safety Dev.	1,820.75	.003	1,536.07	.004
35. Local & Gen. Welfare	5,917.74	.011	4,576.34	.012
36. Spec.Exp.Pensions & all	5,673.93	.011	5,364.87	.015
37. Ishpeming Office	14,439.00	.026	9,602.70	.026
38. Social Sec. Taxes	13,752.87	.025	2,591.42	.007
39. Mine Office	13,494.07	.025	11,115.61	.029
Total General Mine Expense	96,420.37	.177	60,614.67	.166
Cost of Production	693,709.19	1.272	429,036.12	1.178
40. Taxes	32,159.69	.059	29,004.95	.080
Total Cost	725,868.88	1.331	458,041.07	1.258

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8. COST OF OPERATING (Cont.)

b. Detailed Cost Comparison (Cont.)

The explanation of the detailed accounts that follow include only the comparison of extraordinary or varying costs which are of interest:

3. Development in Rock

These costs were included in the operating costs until the month of December, when they were charged to E&A #752 - development of the 6th Level. Since they also included the plat and pocket charges, the account at the end of the year shows a credit of $669.75. The introduction of two N-72 Ingersoll Rand drifters was largely responsible for lowering the 6th Level rock drifting cost to $14.01 per foot in December as compared to $16.85 for the year.

5. Stoping

The detailed cost comparison for 1937 and 1936 follows. The slight varian ce in the supply cost may be noticed as well as the considerable increase in the labor costs:

	1937		1936	
	Amount	Per Ton	Amount	Per Ton
General Supplies	10,446.90	.020	4,683.57	.014
Iron & Steel	2,319.28	.005	1,790.87	.005
Oils and Greases	281.67	.000	240;00	.001
Machinery Supplies	2,041.42	.004	1,377.65	.004
Explosives	30,479.10	.060	19,136.46	.058
Lumber & Timber	16.81	.000	14.62	.000
Electric Power	393.18	.001	253.32	.001
Sundries	589.02	.001	509.84	.002
Expense Accounts	184.24	.000	-	-
Total Supplies	46,751.62	.091	28,006.33	.085
Payroll Labor	157,765.43	.308	84,663.25	.256
Cliffs Shaft Labor	372.60	.001	611.49	.002
General Shops Labor	1,115.06	.002	940.81	.003
Shops, Labor, etc.	3,178.80	.006	839.78	.002
	162,431.89	.317	87,055.13	.263
GRAND TOTAL	209,183.51	.408	115,061.46	.348
Production, Tons	545,274		364,326	
Avg.Miners rate for stoping		7.20		5.81

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8. COST OF OPERATING (Cont.)

b. Detailed Cost Comparison (Cont.)

6. Timbering
The increase under this heading is due solely to the labor proportion, for the supply cost declined from .0596 to .0528.

7. Tramming
The supply and maintenance expenditure changed but little even though 50% more ore was trammed. Here again the labor charge increased the total as shown in the following table:

Operating	1937	1936
Labor:		
Motormen & Brakemen	31,641.50	25,241.25
Chutemen	17,749.94	2,769.74
Total Labor	49,391.44	28,010.99
Supplies		
General	65.84	242.31
Oil & Grease	170.94	207.28
Electric Power	4,829.63	3,989.92
Total Supplies	5,066.41	4,439.51
Total Operating	54,457.85	32,450.50
Maintenance		
Generator & Dynamo	121.35	130.37
Locomotives	2,953.91	3,083.24
Wiring	1,019.25	1,641.39
Main Line Tracks	3,678.37	4,129.68
Main Line Cars	4,125.35	2,646.56
Total Maintenance	11,898.23	11,631.24
Grand Total Operating and Maintenance	66,356.08	44,081.74

9. Pumping
The Lloyd Mine water continued to be pumped to surface by the Inland Steel Company through the Morris shaft. The charges were again allocated to each company in proportion to the gallons of water as determined by daily weir readings. These readings were checked by monthly pump calculations minus a 3% slippage factor with remarkably close results.

The expense for both companies was higher in 1937 although the Lloyd Mine proportion was lower for the third straight year. The

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8. COST OF OPERATING (Cont.)

b. Detailed Cost Comparison (Cont.)

Morris Mine water increased considerably to an average of 360 gallons per minute. This necessitated pumping during the working shift with a consequent increase in the power cost. The water was pumped from a greater average head in 1937 because the Lloyd mine workings passed below the 4th Level and the Morris increase was largely on the 7th and 8th Levels. Lastly, the purchase of a new motor was necessary for one of the 4th Level pumps and the Lloyd Mine proportion of this extra expense amounted to $1,561.09. The comparative figures for the past five years are shown in the following table:

	Inland Steel			C.C.I.Co.		
	Amount	Per Cent	Avg.Gal. per Min.	Amount	Per Cent	Avg.Gal. per Min.
Total 1937	30,636.14	69.05	360.1	13,731.40	30.95	137.6
1936	14,887.49	61.20	208	9,446.76	38.80	137
1935	8,864.80	51.40		8,384.18	48.60	
1934	7,449.56	44.27		9,378.76	55.73	
1933	8,068.44	49.11		8,361.29	50.89	

Early in 1938, the Lloyd Mine 5th Level relay pump will be installed to lift the growing proportion of water issuing on this Level to the 4th Level. From here it will be handled direct to surface by the Morris pumps at a saving in head of 515'.

11, Compressors and Air Pipes

The cost per ton and the cost per 1000 cu. ft. declined in 1937 due largely to the lower average power rate. The following table gives the comparison:

	1937	1936
Operating compressors	19,284.47	13,986.42
Air Pipes	6,638.90	4,909.33
Total	25,923.37	18,895.75
Cost for 1000 cu. ft.	.038	.048
Cost per ton	.048	.052

12. Underground Superintendence

The two additional bosses for the third shift which started in December 1936, and the salary increases account for the added cost per ton.

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8. COST OF OPERATING (Cont.)

b. Detailed Cost Comparison (Cont.)

14. Maintenance, Compressors & Power Drills
The cost of a new 150 H. P. motor for the small compressor delivered at the end of the year will be charged to capital account. Two new R.B.12 drilling machines were bought in 1937 compared to eight in 1936.

17. Maintenance, Pumping Machinery
The building of the concrete dams between the Morris and Lloyd Mines was responsible for the large increase in this account.

18. 23. Hoisting and Maintenance Hoisting Equipment
The purchase of three hoisting ropes and the cost of erecting the pulley stand in front of the engine house increased the maintenance charges but the operating charge declined from .050 to .048 per ton. The following table lists the detail of this adcount:

	1937	1936
Maintenance	7,034.21	3,100.64
Operating		
Labor:		
Engineers	9,869.61	5,854.14
Other Labor	30.91	0
Total Labor	9,900.52	5,854.14
Supplies		
Oil Waste & Packing	97.38	82.31
Tools & Misc. Supplies	230.07	117.93
Electric Power	15,649.28	10,935.24
Heating Expense	447.05	898.39
Total Supplies	16,423.78	12,033.87
Total Operating Expense	26,324.30	17,888.01
Total Opt. & Maintenance	33,358.51	20,988.65
Tons Rock & Ore Hoisted	559,581	373,353
Average Depth Hoisted	890	880

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8. COST OF OPERATING (Cont.)

b. Detailed Cost Comparison (Cont.)

21. Dry House
The increase from .009 to .014 was due to the full year occupancy of the new combined dry and office building compared to less than two months in 1936.

22. General Surface Expense
The much needed road improvement and landscaping caused the small increase from .012 to .014 per ton.

24. Shaft
The large increase here was occasioned by the necessary replacement of bearer sets in the portion of the shaft above the 4th Level.

25. Top Tram Equipment
The maintenance charge was lower than last year and most of the new equipment had been charged out in 1936.

26. Docks, Trestles & Pockets
The expenditure was changed but little from last year and the larger tonnage reduced the unit cost from .015 to .011.

27. Mine Buildings
The cost of the heating plant, storage building and transformer building were included in E&A Nos. 787,788 and 789 respectively. The remaining expense was largely for improvements to the garage and engine house.

28. Insurance
The large increase here was occasioned by the group insurance plan instituted October 1936, and by the addition of catastrophe insurance.

32. Personal Injury
Although the accident frequency and severity rates were lower in 1937 the continued payments on previously incurred injuries and the larger hospital operating loss increased the total.

36. Special Expense, Pensions & Allowances
The 1936 and 1937 charges were about the same so the unit cost was less in 1937.

38. Social Security Taxes
The inauguration of the 1% unemployment insurance tax on January 1,1937 increased the expenditure from $2591.42 in 1936 to $13752.87 in 1937.

40. Taxes
The small increase in taxes and the large increase in production reduced the unit cost from .080 to .059.

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9. EXPLORATIONS AND FUTURE EXPLORATIONS

Late in the year, a test drift south of #486 raise on the 890' sub level disclosed ore between a dike 10' thick and the south footwall. Further exploration by means of small raises proved the upward extension as high as the floor of the 3rd Level. The deposit is small and rather lean, being contaminated with dike stringers in places. Development for sub level stoping operation was rapidly nearing completion in December.

10. TAXES

The following figures show the taxes paid in Ishpeming Township for the past two years by the Mining Department on the Lloyd Mine, on lots in West Ishpeming, and on property in the North Lake Location.

	1937		1936	
Lloyd & Section 6	Valuation	Taxes	Valuation	Taxes
S½ of NW¼ of Sec.6-47-27 - 81 A.)	1,400			
S½ except SE¼ of SE¼ " - 282.93 A.)	1,335,000	21,027.46	1,125,000	19,425.71
Personal, Supplies & Equipment	680,000	10,699.96	525,000	9,065.74
S½ of NE¼ of Sec.6,47-27 - 80 A.	320	5.04	320	5.56
SE¼ of SE¼ of " - 40 A	575	9.06	575	9.91
Total	2,017,295	31,741.52	1,650,895	28,506.92
Collection Fees		317.40		285.08
Total Lloyd		32,058.92		28,792.00
Lots in West Ishpeming	385	2.66	425	7.50
Accounts Receivable Negaunee Land Dept.		3.50		
North Lake Dwellings				
Houses on Section 6, The C.C.I.Co.	40,500	637.56	40,500	699.35
Collection Fees		6.37		7.00
Total Dwellings		643.93		706.35
Total Ishpeming Township	2,058,180	32,709.01	1,691,820	29,505.85
Rate		1.573		1.730

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10. TAXES (Cont.)

In each of the last two years the tax rate has decreased but the total taxes paid have been larger because of the increased valuation.

The comparative tax payments, based on an increasing production and shipment cycle, are interesting, The following table shows the figures for the last three years:

		1937	1936	1935
Tax paid per ton produced	$	.059	.079	.1137
Tax paid per ton shipped		.0497	.0815	.1401

11. ACCIDENTS AND PERSONAL INJURY

The 1937 accident record showed an improvement over the previous year with respect to both the frequency and severity rates. It is a real pleasure to be able to report this improvement, for the third shift of more or less inexperienced men added in December, 1936, and the 24 hour working schedule were additional hazards that were overcome to a large extent. The mining captain and bosses deserve a great deal of credit for their leadership and efficient enforeement of the safety standards, and the large majority of the men for their willing cooperation.

There were eight lost time accidents in each of the years 1936 and 1937. There was one accident for every 6633 days worked in 1936 and 9490 days worked in 1937. The severity rate, or the days lost in 1936 were 11.25 per 1000 days worked and this figure dropped to 6.90 in 1937.

Six of the 1937 accidents resulted in leg injuries and four of these were caused by falls of ground. Two were blasting accidents where the men overstayed their allotted time in lighting a round of holes, and it is extremely fortunate that their injuries were slight. The detailed list follows:

Accident #785 - George Niemi, No. 5 contract. Injured Feb. 19th. A chunk of ore fell from the back and struck him on left leg. Still home.

Accident #786 - Frank Gelmi, No. 16 contract. Injured April 13. Fell and injured left ankle. Time lost April 13 to June 1st.

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11. ACCIDENTS AND PERSONAL INJURY (Cont.)

Accident #787 - David Bussone, No.10 Contract. Injured June 28. First holes went off before the men were through lighting all holes. Time lost, June 28 to July 5.

Accident #788 - George Hedstrom, No.10 Contract. Injured June 28. Same as accident #787. Time lost, June 28 to July 19,

Accident #789 - Corell Peppin, No. 7 contract. Injured Aug. 16. Leg struck by fall of broken ore from mill raise. Time lost, Aug. 16 to Nov. 8.

Accident #790 - Gordon Vercoe, No. 7 Contract. Transfer drift. Injured Aug. 16. Legs struck by fall of broken ore from mill raise. Time lost, Aug. 16 to Nov. 12.

Accident #791 - Arley Fisk, Timber Hoister. Injured Aug. 28. Snatch block fell on right foot. Time lost, Aug. 28 to Sept. 27.

Accident #792 - Axel Carlson, No. 14 contract. Injured Nov. 27. Chunk of ore rolled from pile and struck left ankle. Still home.

12. NEW CONSTRUCTION AND PROPOSED NEW CONSTRUCTION

New construction on surface included the erection of a storage and transfer building south of the Lloyd shaft, a central switch and transformer building west of the shaft, and a stoker fired heating plant for the headframe. Other items which were completed in 1937 were the new top tram control room and the new motor drive units located on the surface under the west permanent trestle; the concrete extension and double door entrance to the timber tunnel; the painting of the hradframe enclosure; the improved engine house ventilation system, etc. All of these items have been described more in detail under the heading of "Surface".

	Total Authorized	Expended To Date	Completed
No.787, Headframe heating plant	$ 2,621.51	3,684.17	12-31-37
No.788, Storage Building	603.80	514.90	12-31-37
No.789, Central Switch & Transformer building	1,855.00	1,964.37	12-31-37

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12. NEW CONSTRUCTION AND
PROPOSED NEW CONSTRUCTION (Cont.)

The variation under E&A #787 is explained by the purchase and installation of one additional large unit heater to discharge warm air into the skip roads.

The underground work included construction of the concrete dams between the Morris and Lloyd Mines on the 4th and 7th Levels, and concrete fire door frames on the 5th and 4th Levels; the cutting of a sump on the 5th Level for the relay pump which will raise this water to the Morris 4th Level pumps; and the completion of the new 6th Level pocket and plat with the drift underway toward the ore body at the end of the year. The E&A information is listed in the table below:

	Total Authorized	Expended To Date
No. 752 - Development of 6th Level	$ 80,819.00	15,485.65
No. 776 - Fifth Level Relay Pump	1,337.60	1,645.96

13. EQUIPMENT AND
PROPOSED EQUIPMENT

The purchase of additional mining equipment such as drilling machines, scraper hoists, etc., was about completed early in the year. Twelve 4 ton rocker dump cars were received for use on the new 6th Level development and they are covered under that E&A. The same is true of the Ingersoll-Rand motor pump and starter for the 5th Level pump station. The purchase of a new 5 ton Cletrac tractor at a cost of $1850 was covered under E&A #769. The skip hoist drum was replaced by one transferred from the Barnes-Hecker Mine, and this was accounted for by E&A #745. The E&A of the switch and transformer building covered an extensive list of electrical equipment necessary for the proper rewiring of the surface structures, and the heating plant included a new stoker, boiler and the unit heaters. Other more important additions or replacements are listed below:

10 Additional electric cap lamps (total 220)
18 Electric trip lamps for underground cars
2 Holcomb-Westeeco scrapers
1 Ingersoll-Rand 20 H.P. double drum scraper hoist
2 Ingersoll-Rand RB 12 drill machines
7 Timber trucks

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13. EQUIPMENT AND
PROPOSED EQUIPMENT (Cont.)

1 Set of dies for #3 pipe machine
1 Power hacksaw for shops
1 Bench grinder for shops
1 New 150 H.P. motor to replace 100 H.P. motor driving Ingersoll-Rand compressor.
3 Plungers, glands and crossheads for 2nd Level water supply pump.
1 Armored 3 conductor electric cable 720' long
1 Second hand cage to be used as a spare
1 Cage hoisting cable, plow steel $1\frac{1}{4}$ dia. 1700' long
1 Skip " " " " $1\frac{1}{4}$ dia. 1480' "
2 " " " cast steel, $1\frac{1}{4}$ dia. 1480' long

One of the skip ropes had not yet been placed in service at the end of the year, but the heavy replacement necessary under the accelerated mining schedule is here particularly well illustrated.

14. MAINTENANCE
AND REPAIRS

a. Mine

Rotted supports under the 4th Level storage pocket were replaced in January. During the next several months, shaft timber bearing sets were replaced on the upper levels, for the settlement of timber on the new portion of the shaft below the 4th Level had placed a strain on these sets. To correct this, new bearers extended to solid rock were placed on the cage side of the shaft on the 1st, 2nd and 4th Levels and on the skip side from the 1st to 4th Levels. As an additional precaution, 58 tamarack props were placed on the south wall plates from the 1st to 4th Levels to assure support between levels. During the summer months, worn skip runners were replaced and a number of dividers between the 5th and 6th Levels which had been cut away by spillage.

The worn skip hoist drum was replaced by one transferred from the Barnes Hecker Mine at the end of May, the work being done over the Labor Day week-end. The skip ropes were lengthened to the new 6th Level at the same time.

The second level water supply pump was completely overhauled by the installation of new plungers, guides and crossheads. Repairs to the crushing plant included replacement of the pinion and level gear in the gyratory crusher, and a new 220 volt motor is on hand

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14. MAINTENANCE AND REPAIRS (Cont.)

a. Mine (Cont.)

to replace the present one of 2300 volt rating. The small Ingersoll-Rand compressor 100 H.P. motor has been carrying too heavy a load for the past several years, and the additional strain of the Butler loaders and the two drilling machines in the rock drift caused the burning out of three coils early in December. A new 150 H.P. motor was ordered immediately and it will be installed early in the new year. This will allow full time operation of the small compressor and ease the load on the larger Sullivan machine. The purchase of this new motor was covered by E&A #793 in the amount of $1224.42.

The old style counterweight head sheave was replaced by a steel lined sheave in October. All four head sheaves are now of the new type. The changed skip hoist drum necessitated the addition of a third pulley stand to eliminate vibration of the ropes. The stand was fabricated at the central shops, erected in front of the engine house wall and it immediately corrected the trouble. Six of the new type rubber lined idler sheaves have been ordered to further reduce the wear on the skip ropes.

b. Location

1. General Maintenance

The following table lists the detailed cost of maintaining the mine location in 1937, and the comparison with former years:

	Labor	Supplym	Total
Proportion of Policemen's Time	2,318.80		2,318.80
Cleaning streets and alleys	1,348.00	71.45	1,419.45
Repairing Water mains	30.23	2.80	33.03
Water		1,162.90	1,162.90
Removing Snow and Ice	35.33	1.73	37.06
Repairing Water Tank		6.00	6.00
Fencing	713.60	405.98	1,119.58
Sewers and Cess Pools	1000	3.00	13.00
Total Cost 1937	4,455.96	1,653.86	6,109.82
" " 1936			5,952.21
" " 1935			3,248.22
" " 1934			2,600.78
" " 1933			625.68

Costs in 1936 and 1937 nearly equalled one another, but there was some variation under the different headings. Repairs to the concrete water tank in 1936 cost $1,055.15 and in 1937 $6.00. This was offset by increases in the policemen's time, cleaning streets and alleys, and repairing fences.

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14. MAINTENANCE AND REPAIRS (Cont.)

b. Location (Cont.)

2. Rented Buildings

An unusually large amount of repair work was done on the North Lake Location houses in 1937. This work was necessary to halt further deterioration, for many of the houses have not been painted since 1922, and the outside woodwork was in very poor shape. Another factor which is becoming increasingly troublesome is the rotting of the post and sill foundations. The worst of these were taken care of, but there are many more which will need attention during the next few years.

Interior decorating in 1937 did not form as large a proportion as usual, and most of this work was the placing of sheetrock on cracked plaster walls. Many of the tenants were quite anxious to have rear outside storm porches added, and most of these were allowed for an increase in the rent of 50¢ per month which will return the cost within a few years. Another item which can be partly taken care of in this manner is the installation of bath and toilet facilities. A sewer system must be provided in the location within a very short time for things have reached a point where there will soon be no more space available in which to dig cesspools. A cost estimate and report on this situation is being prepared and will be presented early in 1938.

Roof repairs and changes in electrical wiring to meet code requirements used up the balance of the 1937 expenditure. The roof repairs consisted of placing sheet metal strips extending above the eaves, and the work has been successful in preventing the ice from lifting the shingles and spoiling interior decoration on 15 of the houses.

The total expenditure and comparison with 1936 was as follows:

	Labor	Supplies	Total
1937	$ 19,245.31	10,025.94	29,271.25
1936	5,614.54	4,345.20	9,959.74
Increase			19,311.51

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14. MAINTENANCE AND REPAIRS (Cont.)

b. Location (Cont.)

The 1937 expense was divided approximately as follows:

Painting		$ 11,108.75
Carpenters:		
Storm Sheds	$3,800.00	
Foundations	3,000.00	
Roof Repairs	1,050.00	
Siding & Sheetrock	7,907.86	15,757.86
Masons		1,520.76
Plumbing		483.08
Wiring		400.80
Total		29,271.25

15. POWER

The consumption of electric power in 1937 increased nearly in proportion to the larger production. The more constant load under the three shift schedule reduced the cost per K.W.H. to 1.367¢ from 1.438¢ in 1936. The comparative figures follow:

	K.W.H.	Cost
1937	3,035,200	41,504.24
1936	2,120,592	30,507.89
Increase	914,608	10,996.35
Percent Increase	43.1%	36%

16. WATER SUPPLY

The water supply for the Lloyd Mine and the North Lake Location consists of a pump on the 2nd Level south of the Lloyd shaft piped to a concrete reservoir 50' in diameter and 20' high on the hill west of Section 6 shaft. The pump was overhauled early in the year, and repair parts costing $426.00 were installed. The concrete reservoir had been reinforced in 1936 and needed little attention this year. Mining operations in their westward course have approached to within 200' of the water main south of the reservoir so that a rerouting of this pipe will be necessary in the near future.

17. CONDITION OF PREMISES

The appearance of the mine surface was greatly improved by the removal of the old rotted frame structures and construction of

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17. CONDITION OF PREMISES (Cont.)

new buildings similar to the steel and concrete main building. The construction of parking grounds and resurfacing and widening of roads was a second contributing factor. The main improvement, however, was the landscaping of the slope between the headframe and main builting. This area in the center of the mine surface was plowed, graded and rolled. A border of shrubbery was planted in the fall, and an inner border of flowers and a lawn will be added in the spring. A new 3 strand fence was constructed and the enclosure with its natural contour, surrounded on all sides with the new buildings and roads, is expected to present a most attractive appearance.

The Marquette County Road Commission in October improved the road between the mine and the location by adding 2 heavy gravel courses on the previously widened and graded road bed. The road was in very poor shape in the spring of 1937 and this condition has now been corrected.

The condition of the location premises was naturally much improved by the painting of all of the houses within the last two years. The repaired fences, the storm sheds built by the company, and the glassed in porches constructed by a few of the tenants, were added improvements. Taken with the natural setting of well grown trees, tended shrubbery and lawns, it seems safe to say that the location presented a more attractive appearance in the fall of 1937 than at any time in the past.

18. NATIONALITY OF EMPLOYEES

American	181
Finnish	45
Italian	36
French	2
Scandinavian	5
English	5
Austrian	1
	275

The high proportion of American born employees may be noted in the table above. If the parentage or nationality extraction is taken into account, the comparison with last year is as follows:

	1937	1936
Finnish	114	90
Italians	51	40
French	47	99
Scandinavians	32	29
English	26	23
German	1	2
Austrian	2	1
Irish	1	1
Belgian	1	
	275	225

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1. GENERAL

Production for 1937 was the largest since the Inland Steel Company took over the property. With the exception of the first and last two months, the average monthly hoist totalled about 40,000 tons. The last two months of the year the product was down due partially to delays but mostly because so many mining gangs were taken off of ore production and put to work sinking the Morris Shaft.

Operations were conducted on a two-shift basis, half the crew working from 8 to 5 by day and half 8 to 5 by night. The men came up for dinner and supper. No man was allowed to work over 40 hours per week. In the late Fall when shaft sinking was started, the men in the shaft worked on a three 8-hour shift basis.

Underground, the major improvements were the laying of 50-lb. rail on the main lines; completion of the 8th level dam, and the installation of the new 800 g.p.m. Prescott pump on the 8th level.

On the surface the new air pre-heating plant over the top of the air shaft was built and put into operation in November.

The Layne-Northwest Company successfully completed No. 1 well and also got No. 2 well down to ledge. The pump in No. 1 well was pumping 1900 g.p.m. during December and No. 2 well was draining the surface at the rate of 250 g.p.m.

The ore estimate shows a loss of about 157,000 tons of ore, exclusive of the 1937 product. The reductions in ore area occur in both the main deposit and "B" deposit. "B" deposit cut off on the East end and the West end on the subs above the 8th level and the main deposit did not run over onto Chase Lease No. 24 as far as estimated in 1936.

2. PRODUCTION, SHIPMENTS & INVENTORIES

a. Production

Grade	Tons
Morris Standard	316,353
Morris Siliceous	109,605
Total	425,958

This tonnage is divided between fee and leased lands as shown, viz:

	Leased Tons	Fee Tons	Total Tons
Morris Standard	188,297	128,056	316,353
Morris Siliceous	73,171	36,434	109,605
Total	261,468	164,490	425,958
Percentage of Total	61.4	38.6	100.0

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Tonnage and percentage of product from fee and leased lands for past five years follows:

	Leased Lands		Fee Lands	
Year	Tons	% of Total	Tons	% of Total
1933	103,487	82.0	22,709	18.0
1934	129,284	74.6	43,985	25.4
1935	187,679	76.5	57,781	23.5
1936	180,647	51.9	166,742	48.1
1937	261,468	61.4	164,490	38.6
Grand Total	862,565	65.4	455,707	34.6

The product from the mine for the same five-year period follows:

	Standard Ore		Siliceous Ore		
Year	Tons	% of Total	Tons	% of Total	Total
1937	316,353	74.4	109,605	25.6	425,958
1936	289,421	83.4	57,978	16.6	347,399
1935	202,296	82.5	43,164	17.5	245,460
1934	125,634	72.8	47,635	27.2	173,269
1933	105,441	83.6	20,755	16.4	126,196
Total	1,039,145		279,137		1,318,282

b. Shipments

Ores shipped from stockpile and pockets for 1937 follow:

Grade	Pocket Tons	Stockpile Tons	Total Tons
Morris Standard	192,406	58,062	250,468
" Siliceous	75,375	13,203	88,578
Total	267,781	71,265	339,046

Shipments for past five years follow:

Year	Standard Ore	Siliceous Ore	Total
1937	250,468 tons	88,578 tons	339,046 tons
1936	236,512 "	64,373 "	300,885 "
1935	181,233 "	36,624 "	217,857 "
1934	110,956 "	45,565 "	156,521 "
1933	63,255 "	13,300 "	76,555 "
Total	842,424 "	248,440 "	1,090,864 "

Shipments have been climbing gradually with 1937 at the peak.

c. Ore in Stock

On December 31, 1937, stockpile balances were as follows:

Morris Standard Ore	199,806	tons
" Siliceous Ore	27,568	"
Total	227,374	"

The ore carried over from previous years was less than the total in stock on Dec. 31, 1937.

On Dec. 31,	1933	- ore	left	at	mine	-	49,641 tons
" "	1934	- "	"	"		-	66,389 "
" "	1935	- "	"	"		-	93,993 "
" "	1936	- "	"	"		-	140,459 "
" "	1937	- "	"	"		-	227,374 "

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e. Production by Months

Month	Shifts Operated	Morris Standard	Morris Siliceous	Total Tons
January	20	29,289	4,541	33,830
February	20	23,493	11,566	35,059
March	23	29,266	10,248	39,514
April	22	30,135	9,354	39,489
May	21	28,153	10,130	38,283
June	22	24,140	13,215	37,355
July	21	25,451	9,067	34,518
August	24	31,296	8,196	39,492
September	22	31,115	9,427	40,542
October	21	26,471	13,159	39,630
November	16	16,579	5,418	21,997
December	21	20,965	5,284	26,249
Total	253	316,353	109,605	425,958

f. Delays

There were three bad delays during the year. In February the hoisting rope on the skip hoist broke because the engineer was coming into the dump too fast and the loaded skip dropped 1400 feet to the bottom, demolishing the two bottom sets. It took four days to clean up the wreckage, make repairs, and resume production.

In October the main 8th level pumps became blocked with mud and the pumps had to be shut down and the 8th level dam closed to prevent flooding of the shaft and lower levels. Operations were suspended for a day and a half.

In November, however, the most serious delay occurred. All production was stopped from November 17th until Thanksgiving Day because of the failure of the motors driving the 8th level pumps. The 8th level dam was again closed and the installation of the new Prescott pump rushed before operations could be resumed. The trouble was caused by the failure to keep the sumps clean.

3. ANALYSIS

Following are detailed and compositive results on shipments of Morris Standard Ore:

Month	Tons	Iron Dried	Moisture	Iron Natural
March - 1937	12,567	59.21	10.28	53.13
April - "	34,888	58.75	10.21	52.76
May - "	40,042	58.22	10.45	52.13
June - "	10,684	58.44	10.08	52.55
July - "	40,265	58.79	10.13	52.84
August- "	29,455	59.04	10.29	52.97
Sept. - "	27,332	59.69	10.28	53.55
Oct. - "	19,848	59.21	10.38	53.06
Nov. - "	27,367	58.89	10.47	52.92
Dec. - "	35	59.10	10.27	53.03
	247483			
Natural Iron Average				53.01

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Analysis of Siliceous Shipments were as follows:

Month	Tons	Iron Dried	Moisture	Iron Natural
January - 1937	1,425	51.84	9.45	46.95
February- "	723	51.97	9.81	46.87
March - "	3,763	51.82	9.12	47.10
April - "	9,354	51.93	9.90	46.79
May - "	8,399	50.84	9.93	45.79
June - "	13,742	50.72	9.75	45.78
July - "	10,917	51.35	9.50	46.47
August - "	11,710	51.89	9.46	46.48
Sept. - "	15,028	52.99	9.47	47.97
October - "	8,300	52.26	9.89	47.09
Nov. - "	4,459	50.57	9.60	45.70
Dec. - "	507	50.39	9.06	45.82
	88727			
Average Natural Iron for 1937				46.44

The accumulated analysis of the ore as stocked follows:

	Standard Ore			
Month	Tons	Iron Dried	Phos.	Moisture
January - 1937	163,210	58.76	.070	
February - "	186,701	58.76	.068	
March - "	203,400	58.82	.069	
April - "	194,097	58.82	.069	
May - "	182,208	58.82	.069	
June - "	195,663	58.82	.069	
July - "	181,352	58.82	.069	
August - "	182,690	58.82	.069	
Sept. - "	186,473	58.84	.067	
October - "	193,096	58.89	.066	
November - "	182,358	58.89	.066	
December - "	199,806	58.89	.065	10.55

	Siliceous Ore			
Month	Tons	Iron Dried	Phos.	Moisture
January - 1937	9,654	50.70	.058	
February - "	20,501	50.78	.052	
March - "	26,986	51.48	.053	
April - "	26,486	51.48	.053	
May - "	28,217	51.48	.053	
June - "	27,691	51.48	.053	
July - "	27,041	51.48	.053	
August - "	22,327	51.48	.053	
Sept. - "	16,726	51.41	.047	
Oct.. - "	21,585	51.47	.048	
Nov. - "	22,793	51.41	.049	
Dec. - "	27,568	51.14	.051	9.80

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4. ESTIMATE OF ORE RESERVES:

	Ore Reserves as of Dec.31, 1937	Ore Reserves as of Dec.31, 1936	Difference
Chase Lease #26	26,140 tons	26,140 tons	None
" " #25	33,273 "	33,273 "	"
" " #24	86,634 "	92,310 "	5,676 tons
" " # 9	1,539,461 "	1,912,071 "	372,610 "
C. C. I. Co. Lands	571,322 "	656,470 "	85,148 "
Total	2,256,830 "	2,720,264 "	463,434 "
1937 Production of Standard Ore		316,353 "	
Net tons left		2,403,911 "	
1937 - Dec. 31st estimate		2,256,830 "	
Net loss during 1937		147,081 "	

SUMMARY OF RESERVE ORE ESTIMATE FOR THE YEAR 1937

Description	Estimate Dec. 31, 1936	Estimated 1937 Production Standard	Siliceous	Estimate by Deducting Production	Actual Engineer's Estimate	Difference
Above 7th Level #66	8,910	-	-	8,910	8,910	None
7th-8th Level #66	9,281	-	-	9,281	9,281	"
Above 7th Level #74	777	-	-	777	777	"
7th-8th Level #74	7,172	-	-	7,172	7,172	"
Total Chase Lease #26	26,140	-	-	26,140	26,140	"
Above 7th Level #36	1,328	-	-	1,328	1,328	"
D. D. Hole #90	6,627	-	-	6,627	6,627	"
D. D. Hole #93	1,988	-	-	1,988	1,988	"
Above 7th Level #74	12,994	-	-	12,994	12,994	"
7th-8th Level #74	10,336	"	-	10,336	10,336	"
Total Chase Lease #25	33,273	-	-	33,273	33,273	"
Above 7th Level #35	1,477	-	-	1,477	1,477	"
Above 7th Level "Y"	4,939	-	-	4,939	4,939	"
Above 7th Level #62	1,114	-	-	1,114	1,114	"
East of Division Line	3,999	-	-	3,999	3,999	"
West of Division Line	979	-	-	979	979	"
7th-8th Level #62	8,353	-	-	8,353	8,353	"
Above 7th Level #63	5,503	-	-	5,503	5,503	"
7th-8th Level #63	10,041	-	-	10,041	10,041	"
Ore Above 8th Level #33	55,905	14,849	2,391	38,665	25,919	12,746
Ore Below 8th Level #33	-	-	-	-	24,310	24,310
Total Chase Lease #24	92,310	14,849	2,391	75,070	86,634	11,564

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Description	Estimate Dec. 31, 1936	Estimated 1937 Production Standard	Estimated 1937 Production Siliceous	Estimate by Deducting Production	Actual Engineer's Estimate	Difference
Above 7th Level #21	3,151	117	279	2,755	3,156	401
7th-8th Level #21	-	-	-	-	-	None
Above 7th Level #61	52,307	16,581	6,618	29,108	31,480	2,372
7th-8th Level #61	14,690	-	-	14,690	14,781	91
Above 7th Level West Dep.	5,250	-	-	5,250	5,250	None
7th-8th Level West Dep.	8,672	-	-	8,672	8,672	"
Above 7th Level "B"	198,343	43,470	29,593	125,280	103,751	21,529
7th-8th Level "B"	474,243	33,729	10,656	429,858	310,552	119,306
Below 8th Level "B"	58,365	-	-	58,365	62,498	4,133
7th-8th Level "C"	29,719	-	-	29,719	32,197	2,478
Below 8th Level "C"	31,406	-	-	31,406	33,938	2,532
Above 7th Level #33	1,042	-	-	1,042	1,123	81
7th-8th Level #33	729,776	76,389	22,495	630,892	608,206	22,686
Below 8th Level #33	305,107	-	-	305,107	323,857	18,750
Total Chase Lease #9	1,912,071	170,286	69,641	1,672,144	1,539,461	132,683
Above 7th Level #21	53,650	23,319	3,331	27,000	35,112	8,112
7th-8th Level #21	8,022	-	-	8,022	8,033	11
Above 7th Level #33	26,921	20,656	3,212	3,053	6,927	3,874
7th-8th Level East #33	221,676	-	-	221,676	247,889	26,213
7th-8th Level S. #33	227,836	87,243	31,030	109,563	160,781	51,218
Below 8th Level E. #33	28,467	-	-	28,467	28,085	382
Below 8th Level S. #33	73,360	-	-	73,360	67,957	5,403
7th-8th Level "C"	8,100	-	-	8,100	8,100	None
Below 8th Level "C"	8,438	-	-	8,438	8,438	"
Total C.C.I.Co.Lands	656,470	131,218	37,573	487,679	571,322	83,643
Summary						
Chase Lease #9	1,912,071	170,286	69,641	1,672,144	1,539,461	132,683
" " #24	92,310	14,849	2,391	75,070	86,634	11,564
" " #25	33,273	None	None	33,273	33,273	None
" " #26	26,140	None	None	26,140	26,140	None
Total Lease Lands	2,063,794	185,135	72,032	1,806,627	1,685,508	121,119
C.C.I.Co. Fee Lands	656,470	131,218	37,573	487,679	571,322	83,643
Total	2,720,264	316,353	109,605	2,294,306	2,256,830	37,476
Ore in Stockpile Dec. 31, 1937	140,459	199,806	27,568	227,374	227,374	
Total	2,860,723	516,159	137,173	2,521,680	2,484,204	37,476

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6. SURFACE

The Layne-Northwest Company successfully completed two deep wells, No. 1 and No. 2. No. 1 deep well is located over on the West side of the surface area very close to test drill hole #509. No. 2,bottomed at a depth of 138 feet, is located over to the South of the area that may cave. A temporary pump was placed on top of Well #1 and the pump gradually speeded up to 1,000 gallons per minute as the water cleared and was free from all mud and sediment. A month later the pump was handling 1150 gallons per minute. By September 1500 gallons was being pumped and on September 25th the pump was pulled out for repairs. A new 2400 g.p.m. capacity pump had been ordered by the Inland Company and as that was expected to arrive early in October the original test pump was not put back after repairing. By November the new pump was placed and started pumping at the rate of 1750 g.p.m. Later this was speeded up to 2,000 g.p.m. but tests showed that the pump did not operate satisfactorily at speeds in excess of 1900 g.p.m. Too much air is tapped at higher speeds causing the pump to vibrate and run wild. The pump over Well No. 2 located 100 ft. South of Test Hole #505 was pulling 250 g.p.m. by the end of 1937 and it was planned to place a 500 g.p.m. unit over this well. The last information from this well is that it is making 650 g.p.m.

By the end of the year the water level had dropped as much as 27½ feet near Well #1 and 15 feet at points located 500 ft. away. The following tabulation gives the figures for each test hole:

Test Hole		Drop of Water Level Since Aug. 21, 1937
501 -	1770' from #1 Well	3' 6"
502 -	950' " " "	1' 5"
503 -	500' " " "	15' 8"
504 -	550' " " "	16' 0"
505 -	100' North of Well No. 2	6' 4"
506 -	1430' from #1 Well	3' 4"
507 -	730' " " "	5' 0"
508 -	940' " " "	1' 3"
509 -	25' North of Well No. 1	27' 5"

The above indicates that the project intended to drain a portion of the surface that may cave in the near future is meeting with considerable success.

The water from the pumps is led by flume to the South into the old drainage ditch The C. C. I. Co. dug to divert the water from Gold Mine Creek to the South of the Morris Mine.

Another project intended to remedy the trouble experienced with ice in the ventilation shaft was the construction of a heating plant for pre-heating the downcast air going into the mine. The plan followed was a combination of those suggested by the Grinnel Company and the Morgan-Gerrish Company. The air is heated by four "Trane" unit heaters combined capacity of 21,600 cu. ft. of air per minute. Thermostats in the shaft regulate the operation of these units, the idea being to prevent the air in the shaft from getting any colder than 34°. The boiler plant is equipped with an automatic "NoKol" stoker. The building housing the equipment by the end of the year was made fairly fireproof by using galvanized sheets on the outside and by the use of rock wool and reinforced plaster on the inside.

Changes were also made in the office building. A vault was construc ted outside to the East of the building and the offices formerly occupied by the Lloyd Mine office crew were revamped for use by Mr. Wahl and Mr. Satterley.

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7. UNDERGROUND

Pump House & Dams

During the early summer months the water coming into the mine began to increase rapidly. This is made clearer by referring to the following table:

	Gallons Per Minute			
Month	1937	1936	1935	1934
January	233	225	130	124
February	255	201	130	142
March	270	202	134	120
April	294	204	133	126
May	328	202	181	127
June	393	202	169	117
July	406	206	161	123
August	432	207	163	118
September	405	203	172	118
October	382	210	172	123
November	466	233	187	113
December	458	201	163	81
Average	360	208	158	119

Both the Inland and C. C. I. Co. managements immediately took steps to try and find out whether the increased flowage was coming from the back over the various stopes or was it caused by draining new territory opened up in the course of development work. After making a thorough inspection of the old workings and examining the records showing the depth of the water level in the various drill holes and inspecting the drainage ditches, we concluded that there were no breaks in the back allowing surface water to enter the mine which would be preliminary to a probable cave-in on the surface. Instead it seemed more logical to attribute the increased flow to development work and the releasing of water trapped behind the dikes along the South side of the main deposit. Eventually the surface will cave and it is to be hoped that by that time the two deep wells will have removed most of the water from the overburden, that all the concrete dams will be complete and the new 8" water line installed from the 8th level to surface. The dam on the 8th level was used twice during the year but the 6th and 7th level dams are not as yet finished. We have dams on the 4th and 6th level Lloyd Mine so that we can isolate our property if necessary. To date though our new 300 g.p.m. pump on the Lloyd 5th level is not operating but we had hopes of getting it going by February 1st.

When the Inland Company took over the Morris Mine there were two 500 g.p.m. pumps on the 7th and two Triplex pumps on the 8th. As the water began increasing the new 800 g.p.m. Prescott pump good for a 2,000 ft. head was ordered. In the meantime one of the 500 g.p.m. units was moved from the 7th to the 8th levels. In October when the bottom of the Morris Shaft was being cleaned up all the mud and silt was pumped directly into the suction sump on the 8th. In a short time both Triplex pumps became plugged, the centrifugal pump refused to function, and the 8th level dam had to be closed so that a part of the sump could be cleaned. Later in November, as a result of the strain put on the motors while the pumps were attempting to handle mud, motors on the Aldrich Triplex and centrifugal burned out. A spare motor was hurriedly installed which ran

for twenty minutes and then shorted and refused to run. The fire pump was then temporarily installed on the 8th level and managed to keep the water down behind the dam so that none of the haulage motors were damaged. In the meantime the new Prescott pump was being assembled and after nine days it was ready to take the load. Operations were resumed on Thanksgiving Day.

Developing Contracts

All of the development work done in 1937 was confined to the bottom 125 ft. of the mine. On the -10 ft. sub level a drift 300 ft. long was run parallel with the 3600 South coordinate line from the 1800 East to the 2100 East coordinate line. The primary purpose was to provide a new timber and travelling road from the 7th level to the subs below the -10 ft. elevation in the lower half of the ore body between the 7th and 8th levels. On the same sub a crosscut was driven North for ventilation.

On the -40 ft. sub level a short crosscut went due South from the footwall raise along the 2100 East coordinate line. This drift not only explored the area between the dikes on our lands to the South of Chase Lease No. 9 but it also drained off some of the water trapped between the dikes.

On the -90 ft. sub level in the extreme Southwest corner of the 8th level territory about 500 ft. of ore formation was explored by drifting and diamong drilling. The idea behind this work was to determine what ore was left here so that it could be mined out soon and retreat back towards the shaft. This development work proved that neither "B" deposit or the Main Deposit extended as far West as shown on the 1936 maps for the State Tax Commission.

The biggest project undertaken during the year with the exception of the sinking of the shaft was the driving of two main level drifts on the 8th level. A new motor drift 800 ft. long was put in under "B" deposit between the old footwall and hanging wall drifts. This drift started near the intersection 3500 South and 1500 West and ended at 3700 South and 2100 West. This work also proved that "B" deposit did not extend as far to the East as previously estimated. The main drift on the 8th level in the Southwest corner of Chase Lease No. 9 was extended West in ore over onto Chase Lease No. 24 where the ore stopped 100 ft. over the line. Crosscuts driven North and South for a distance of 350 ft. could find no additional ore. The North crosscut, however, will be extended 400 ft. further North in 1938 to check up on the formation as far North as our old footwall drift in the slate.

Shaft sinking was started late in the year by sinking in the ladder road, leaving a pentice below the cage and skip compartment. By the end of the year the shaft was down 60 ft. below the pentice. Steel sets are being installed and the new 9th level will be located 200 ft. below the 8th. Miners were taken from the ore contracts to work in the shaft.

Stoping

C. C. I. Co's Lands

Lands East of Chase Lease No. 9

In #21 deposit contract #12 stoped onto the extreme East end and a pillar in the central portion from the 170 ft. down to the 150 ft. sub level. On the 130 ft. elevation the Eastern half of the deposit was worked out from foot to hanging. On the 110 ft. sub level slicing was started because the stope became quite wet and because the ore was becoming mixed with horses of jasper. At the latter elevation #1 joined #12 in taking out the ore.

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In the main deposit, sometimes called #33 deposit, #2 and #13 sliced out all the available ore left in place from 1936 East of the East line of Chase Lease #9 on the 100 ft. sub level. On the next sub 10 ft. below #13 took out all of the triangular shaped ore body South of the main dike which process was repeated on the main 7th level. Contract #2 also mined about half the available ore area in the Northeast corner of the main deposit on the 7th level.

Lands South of Chase Lease #9

The top subs mined out in the main deposit South of Chase Lease #9 were at the 50 ft. elevation between 2000 West and 2200 West. Contract #8 stoped out a narrow lens between two dikes from the 50 ft. down to the 10 ft. elevation. They also took out a pillar left between the dike located 50 ft. South of the South line of Chase Lease #9 and the dike that runs along and parallel to the South line.

From the 20 ft. sub level to the 10 ft. sub #26 stoped out a pillar between the 2200 West and 2300 West coordinate lines. At the latter elevation five pillars left over from the year before in the South-central portion of the deposit were taken out.

In the extreme Southwest corner of the main deposit two very large sub level stopes were kept active during the entire year. The area mined out on the -10 ft. sub level, -20, -30, -40, -50, -70, and -80 ft. subs was located between 2400 West and 2600 West and 3900 South and 4000 South. Slicing was also started on the -80 ft. sub between 2200 West and 2400 West under the old sub level stope up over.

Chase Lease #9 - "B" Deposit

Stoping was in progress from the 200 ft. sub down to the 110 ft. sub level in the central portion of the deposit. Slicing underneath the stopes was started on the 100 ft. sub level between 1900 West and 2000 West.

In the South portion of the old stoped out area to the South of the horse or rather seam of Jasper a new stope was begun at the 90 ft. elevation and continued down to the 000 ft. sub level.

In #61 deposit in the central part of Chase Lease #9 slicing was continued from the 160 ft. sub level and the 150 ft. subs. This work was done by #6 and #7. Late in the year #6 lost its raise and had to start a new one from the 7th level. Contract #7 also finished slicing up against the limit of mining on the 120 and 110 ft. sub levels.

In the main deposit #13 took out a small triangular shaped piece of ore to the South of the main dike in the Southeast corner of Chase Lease #9. In the Northeast end of the same deposit #3 sliced out all the ore from foot to hanging for a distance of 150 ft. along the strike of the ore body on the 60 ft. sub level. On the 000 ft. elevation two areas were sliced, one in the North-central portion of #33 deposit under the hanging from 1800 West to 2000 West and another area 200 ft. farther West. The mining of duplicate areas on the -10 ft. sub was also done in 1937.

Another new sub level stope was started in the Southwest corner of Chase Lease #9 running from the -20 ft. sub down to the -60 ft. sub level. This mining was done from raises put up from the new scraping drift driven on the -80 ft. sub level parallel and alongside of the 3800 South coordinate line.

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Chase Lease #24

One gang stoped what little ore existed in the main deposit in the extreme Southwest corner of the 8th level territory from the -10 to the -90 ft. elevation. The ore did not run over 100 ft. across the line from our lands to the South of Chase Lease #9. On the new or 9th level the ore body will undoubtedly be quite extensive on this particular one of the Moore and Chase Leases.

19. PUMPING

Following is a detail of the 1937 pumping cost showing division between Morris and Lloyd Mine:-

Month	Inland Steel Co. Amount	%	The C. C. I. Co. Amount	%
January - 1937	$ 1627.20	65.84	$ 844.09	34.16
February - "	1491.15	70.90	611.88	29.10
March - "	1962.63	71.87	775.56	28.13
April - "	1829.63	56.81	1814.01	43.19
May - "	1924.37	58.00	1547.30	42.00
June - "	2374.37	69.00	1079.94	31.00
July - "	2716.84	74.11	960.10	25.89
August - "	2950.71	78.19	1040.31	21.81
September - "	3134.93	79.31	826.15	20.69
October - "	2935.40	79.49	866.09	20.51
November - "	3848.02	81.53	879.60	18.47
December - "	3603.67	79.74	924.28	20.26
Total	$30398.92	71.41	$12169.31	28.59
Year 1936	14887.49	61.20	9446.76	38.80
" 1935	8864.80	51.40	8384.18	48.60
" 1934	7449.56	44.27	9378.76	55.73
" 1933	8068.44	49.11	8361.29	50.89

It will be noted how the Morris Mine pumping costs are increasing and despite the fact that the Lloyd Mine percentage is decreasing the costs are increasing.

The amount of water pumped from the Lloyd Mine workings was measured at 70,811,089 gallons in 1936 compared with 72,600,568 gallons in 1937. The flow into the Morris Mine increased 73% while the Lloyd Mine showed only a 2% increase. Part of the increased cost for the Lloyd Mine can be explained by an increase in rate for electric power because the main pumps now have to be run during the hoisting period. Formerly all pumping with the exception of two months during the heavy run-off in the Spring could be done between shifts. Another reason for the larger cost was due to repairs incident to the burning out of four large pump motors and the installation of the new Prescott pump. It might be well to point out, however, that the Lloyd Mine was not charged with a proportion of all the costs incident to the trouble and delays with the pumping equipment in November. The Lloyd Mine, however, did pay its portion of the cost of the new 4th level motor.

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1. GENERAL

Production at this property was started on April 7th and continued throughout the year with one shovel in the East pit and two in the West. The total product of 305,418 tons was an increase of 14,077 over 1936. Loading was somewhat intermittent, particularly in June and July. Operations were on a single shift schedule until October, when production was increased to a point where a double shift program was necessary for the greater portion of the month. Production and shipments were completed on November 3rd, after which winter repairs and stripping operations were begun. The following tonnages were produced in the various pits: West - 217,586, East - 87,832, Summit - 0, total - 305,418. Of the East pit product, 469 tons were actually mined as low Phos. ore and 23,668 as Tilden Silica #1, of which 11,557 were separated as low Phos. ore by selective grading.

Churn drilling was carried on in both the East and West pits well in advance of blasting and loading operations. The loading schedule was in general not heavy enough to keep the drills running continuously. Exploration drilling by Diamond Drill under E. & A. #680 was continued during the first 3 months and brought to a close at the end of March with the completion of incline hole #54 on the floor of the West pit. A considerable amount of stripping was done during the year, in the East pit under contract and in both the East and West pits by Company crews and equipment. A total of 6 blasts were made during the year, three in each pit. The estimated tonnage broken was 128,000 in the East and 160,000 in the West a total of 288,000 tons. Both 6" and 9" blast holes were used, the former producing 123,400 tons and the latter 164,600 tons. From the results obtained with the large size holes it is probable that in the future the bulk of drilling and blasting will be done with this larger, more efficient equipment. A second 9" 29-T Bucyrus-Armstrong Drill was purchased and delivered in July, after a lengthy delay due to labor difficulties at the South Milwaukee Plant of Bucyrus-Erie Co. In addition to the new drill, two new oil-burning bit furnaces were purchased and installed.

A ventilating fan and the necessary discharge pipe was installed in the crusher building and equipped with a dust filtering bag which was designed in the Engineering Department and built by company carpenters.

2. PRODUCTION SHIPMENTS & INVENTORIES

a. Production by Grades

	Tilden Silica	Tilden Silica #1	Low Phos.	Total
West Pit	217,586	0	0	217,586
East Pit	63,695	12,091	12,046	87,832
Summit Pit	0	0	0	0
	281,281	12,091	12,046	305,418

The low Phos. ore during 1937 was produced in the following manner: During ordinary loading operations, the products from both pits were combined to make Tilden Silica Grade. When low Phos. ore was called for, the East pit product was handled separately as Tilden Silica #1, from which were selected the cars containing low Phos. ore, the remainder being combined with the West pit product.

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2. PRODUCTION SHIPMENTS & INVENTORIES (CONT.)

b. Shipments

Shipments from the Tilden Mine for 1937 were the same as the production figures of 305,418 tons.

c. Stockpile Inventories

There is no ore stocked at the Tilden Mine. The following are the book figures of the broken ore reserves in the several pits:

West Pit*	0 Tons.
East Pit	51,128 "
Summit Pit	7,032 "
Total Broken Ore Dec. 31, 1937	58,160 "

The above book figures compare with 37,087 tons at the end of 1936, an increase of 21,073 tons, These broken ore reserves will be available for the early season shipping in 1938.

*The above figures are book figures of broken ore reserves. These are obtained by subtracting actual shipments from the estimated tonnages broken in the previous blasts. The figures given for the East and Summit Pits very closely approximate the actual reserves in these pits. Since the opening of the West Pit there has been a constantly increasing overrun, 39,499 tons of which were actually loaded out during 1937. There still remains a considerable quantity which has been estimated roughly at 50,000 tons.

c. Product by Months

Month	Days Operated	Average Daily Tonnage.	Total Tons
April	21 (1-8 hr.)	1708	35,871
May	21 (1-8 hr.)	2102	44,146
June	18 (1-8 hr.)	2041	36,756
July	8 (1-8 hr.)	1960	15,687
August	17 (1-8 hr.)	2145	36,470
September	21 (1-8 hr.)	2167	45,523
October	7 (1-8 hr.) 17 (2-8 hr.)	1944	79,762
November	3 (2-8 hr.)	1866	11,203
Total	153 (1-8 hr.)	1996**	305,418

**See next page

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2. PRODUCTION
SHIPMENTS &
INVENTORIES (CONT.)

e. Product by Months. (Cont.)

**The average output per 8-hour shift of 1996 tons during the current year, compares with 1525 tons per shift during 1936, an increase of 471 tons. This increase was due in part to the fact that the third electric shovel was in operation throughout 1937, and was in operation only the last three months of 1936. Increased efficiency and closer supervision also had considerable bearing on this improvement. During 1936, 291,341 tons were produced in 191 - 8-hour days, while in 1937, 305,418 tons were produced in 153 - 8-hour days.

f. Ore Statement

	1937 Tons	1936 Tons
On hand January 1, 1937	-	-
Output for year	305,418	291,341
Total	305,418	291,341
Shipments	305,418	291,341
Balance on hand	-	-
Increase in output	14,077	
Increase in shipments	14,077	

1936 - 77 - 1-8 hr. shifts and 57, 2-8 hr. shifts, total: 191 - 1-8 hr. shifts.

1937 - 113 - 1-8 hr. shifts and 20, 2-8 hr. shifts, total: 153 - 1-8 hr. shifts.

g. Delays

There were no serious delays during 1937, although the total lost time due to necessary minor repairs, aggregated 114½ hours for the shovels as compared with 55½ during 1936. The following table shows the time lost by the three individual machines:

#29	#31	#46 (Marion)	Total
26½	28¼	59¾	114½

The small Marion shovel was the chief offender, accounting for more than 50% of the total lost time. This is due largely to the fact that the construction of this machine is rather light as compared to the other two, while the power developed is great enough to cause failure at the points of weakness while attempting to root out or break up large chunks. To offset this, the Marion is much faster than the larger shovels, and has proved invaluable when loading from a low, well broken pile, or while engaged in stripping operations. Further delays were as follows:

Crushing Plant	Lack of Electric Power.	Transportation Equipment.	Total Misc.
8-hours.	1¾-hours.	3½-hours.	13¼-hours.

The estimated loss of product due to shovel delays was 12,300 and due to the above miscellaneous delays 2850, a total of 15,150 tons.

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2. PRODUCTION SHIPMENTS & INVENTORIES (CONT.)

h. Delays from Lack of Current

In the report for 1936, we discussed a condition which existed at the Tilden, which was responsible for innumerable small annoying delays. We believed that this condition was caused by the distance between the mine transformers and the nearest sub-station, which was several miles away. Under our working conditions it frequently happened that the volume of available power transmitted to the mine from this distant sub-station was temporarily insufficient to maintain the correct voltage. This drop in line voltage was large enough to stall the motors while working under a heavy load, and affected power shovels, churn drills, crushing plant, bit dressing machine, and practically all other electrically operated equipment. We subsequently recommended that this property be furnished with its own sub-station from the main power line which passed very close to the mine. This installation was completed in March, but it was not until May, after new transformers had replaced those originally installed in this sub-station, that any improvement was seen. This improvement became more apparent during the operating months, and we now feel safe in saying that the original diagnosis was correct, and power delays due to a drop in line voltage have now been eliminated.

3. ANALYSIS

a. Average Mine Analysis on Output

Grade	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss on Ignition
Tilden Silica	39.69	.038	41.53	.09	.60	.28	.20	.013	.25
Tilden Silica#1	38.21	.017	44.19	.09	.45	.30	.15	.011	.20
Tilden Low Phos	38.28	.013	43.82	.09	.45	.30	.15	.011	.20

b. Average Analysis on Straight Cargoes

	Mine			Lake Erie	
	Iron	Phos.	Sil.	Iron	Moist.
Tilden Silica	39.83	.037	41.55	39.95	2.00
Tilden Low Phos.	38.26	.013	44.01	38.85	1.84

c. High Sulphur Ore

The high sulphur ore in the area stripped in the East end of the West Pit was successfully added to and mixed with the West Pit product throughout the loading season. The inclusion of this material did not increase the average sulphur content to any great extent. Exploration drilling results were upheld in actual mining operations in that some small areas averaged nearly .200 sulphur; but loading was so regulated that only minimum amounts of this ore were included in any one cargo. Throughout the season, the presence of three shovels was vitally necessary to perform successful grading and still maintain production.

4. ESTIMATE OF ORE RESERVES

a. Developed Ore

1. West Pit

During 1937, it became apparent that the reserves in the upper bench were becoming depleted to the point where it would soon be necessary to open the lower bench for mining.

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4. ESTIMATE OF ORE RESERVES (CONT.)

a. Developed Ore (Cont.)

Accordingly, new estimates were made and reported by letter of November 23, 1937. This letter was written in connection with the request for an authorization for stripping the lower bench. Without regard to the estimate of reserves as reported last year, we are submitting the new estimate as being the most accurate and up to date.

Assumption: 13.5 cu. ft. equal 1 ton.

Grade: Tilden Silica

West portion of West Pit, Upper Bench	280,000 tons
East " " " " "	195,000 "
Total Unbroken Reserves "	475,000 tons.
Broken Ore Reserves "	50,000 "
Total Upper Bench	525,000 tons.
Reserves Lower Bench. (60' deep)	2,000,000 "
Total Developed Ore, Jan. 1, 1938, West Pit.	2,525,000 tons.

As a check on our former figures:
2,525,000 tons reserves plus production of 305,418 tons gives a total of 2,830,418 tons as compared with a figure of 2,835,747 tons reported as of January 1, 1937.

2. East Pit including Summit Pit

Assumption: 14 cu. ft. equals 1 ton
10% deduction for rock
Tonnage above 1500' Elevation
(Track grade from Crushing Plant)

Total ore in sight Jan. 1, 1937	5,325,830 tons
Ore mined in 1937	87,832 "
Total Developed Ore Jan. 1, 1938	5,237,998 tons.

Of this total of 5,237,998 tons, approximately 2/5 is expected to grade above .015 Phos. and 3/5 below .015 Phos. These figures, based on 1930 diamond drill exploration, have so far not been proved by the small tonnage mined at the base of the hill. The tonnage explored covers so large an area that it will be years before much of it is actually developed by mining. Until such time as results prove otherwise, the available ore at the East Pit can conservatively be estimated as analyzing .026 in Phos. which by selective mining and grading, can be made to yield a product of which approximately 25% would run .015 Phos or lower.

As discussed in the report for 1936, operations at Summit Pit have been abandoned as such, although it is probable that these reserves will ultimately be mined from the present floor of the East Pit.

3. Developed Ore as of January 1, 1938:

West Pit	2, 525,000
East Pit (Including Summit)	5, 237,998
Total Tilden Mine	7, 762,998

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4. ESTIMATE OF ORE RESERVES (CONT.)

b. Prospective Ore

In addition to the developed ore, there is probably a considerable tonnage to the North and East of the area developed by drilling at the East and Summit Pits. The reserves in the West Pit are definitely limited by dikes, over-burden and lean material as explained in the letter regarding E. & A. #786 for stripping and opening the lower bench. Under present conditions, there is no further prospective ore in this portion of the property. The ultimate expansion of operations will probably be a continuation of the East Pit which will extend to the North and East, eventually including Summit Pit. The recovery of the ore above the lower bench in the West Pit will be accomplished by mining with the present floor as the top of the face, and a plane 10' below the elevation of the L. S. & I. tracks as the new floor. The total height of face will be approximately 60'

c. Estimated Analysis of Reserves

1. West Pit	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Ign.	Moist.
Dried	39.25	.038	42.20	.09	.60	.28	.20	.013	.25	--
Natural	38.50	.037	41.40	.09	.59	.27	.20	.013	.25	1.90

The above analyses have been changed from those reported previously due to the fact that the figures based on the original diamond drill exploration have not been born out in the production to date of well over a million tons. This is due largely to lean spots and small dikes that were not considered in the original estimate.

2. East Pit	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Ign.	Moist.
Dried	37.00	.020	46.50	.120	.67	.48	.31	.014	.90	--
Natural	36.25	.020	45.40	.118	.65	.47	.30	.013	.88	2.50

f. Estimate of Production

The following tables show the estimated productions and analyses that can be produced during the coming year. The first table shows the tonnages obtainable by mining and shipping without selective loading from the East Pit. The 7,000 tons of broken ore in Summit Pit have been omitted from the tables, since it would be highly impractical to attempt to load this ore at the present time.

The figures in the second table are based on the assumption that any low Phos. ore desired will be produced by selective loading in the East Pit.

1. - ESTIMATE OF 1938 PRODUCTION AS TO PITS

Grade	Tonnage	Iron	Phos.	Sil.	Sul.	Moist.	Iron Natl.
Tilden Silica West Pit	350,000	39.50	.040	42.20	.014	1.90	38.50
Tilden Silica #1 East Pit	100,000	37.00	.020	46.50	.011	2.00	36.25
Total	450,000						

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4. ESTIMATE OF ORE RESERVES (CONT.)

f. Estimate of Production (Cont.)

2. ESTIMATE OF PRODUCTION BY GRADING EAST PIT ORE

Grade	Tonnage	Iron	Phos.	Sil.	Sul.	Moist.	Iron Natl.
Tilden Silica (Includes West Pit and 50,000 tons from East Pit)	400,000	39.00	.040	42.50	.014	2.00	38.20
Tilden Low Phos. (Selected from East Pit shipments)	50,000	37.00	.015	46.50	.011	2.00	36.25
Total	450,000						

From the above tables it will be noted that the Low Phosphorus ore can be obtained only by analyzing each car and segregating those that contain the proper material. Using this method, a cargo can be obtained only by accumulating a sufficient number of cars and holding them for shipment. This arrangement, though not ideal, has proved more satisfactory than the old method of handling the product from Summit.

5. LABOR AND WAGES

a. Comments
1. Labor

Labor conditions during 1937 were satisfactory, and at no time was there a shortage of men. Of necessity, employment was rather intermittent due to the extreme irregularities in the production schedule. The average number of employees was decreased from 40 in 1936 to 37 in 1937. This decrease was made possible by close supervision in spite of a heavier production schedule.

Six men from the Gwinn district were employed during the period from Oct., 3rd to Nov., 10th. This was done in an attempt to take care of some of our old employees who were temporarily without work due to the curtailment of the operations at the Gardner-Mackinaw Mine.

Company Group Insurance was continued by the entire force with the exception of one man.

N.R.A. regulations were officially discontinued in July but were strictly adhered to with the exception of a few instances when over-time was necessary. Time and a half was paid for all over-time work in excess of 40 hours in any one week or 8 hours in any one day.

As was previously mentioned there were two substantial wage increases which affected the 1937 costs. As is seen in the following comparative statement the average increase was $1.62 per day or 38.4%

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5. LABOR AND WAGES (CONT.)

b. Comparative Statement of Wages & Product

	1937	1936	Increase	Decrease
Product	305,418	291,341	14,077	
No. shifts and hours	113-1-8-hr.	77-1-8-hr.	36	
	20-2-8-hr.	57-2-8-hr.		37
Average No. Men working	37	40		3
Average daily wage	$5.84	$4.22	$1.62	
Tons per man per day	45.50	45.84		.34
Labor cost per ton (Labor Stmt.)	.129	.099	.030	
Labor cost per ton (Cost Sheet)	.142	.110	.032	
Total number of Days	6712.50	6837.25		124.75
Amount paid for labor as per Labor Statement	39,246.99	28,838.14	10,408.85	
Amount paid for labor as per Cost Sheet	43,400.98	32,032.56	11,368.42	

In spite of the above increase in the labor cost per ton of ore produced, the total cost at the mine was held down to a figure which compared very favorably with that for the preceding year.

6. SURFACE

Routine repairs were made to equipment and buildings as necessary.

7. OPEN PIT OPERATIONS

a. Stripping

There were four distinct stripping operations carried on during the year, one under E. & A. #749, and the other three under E. & A. #786. The former was done on the East side of the East Pit by Lindberg and Sons, under contract, which included earth excavation, haulage and washing, at a contract unit price of $0.50 per cu. yd. Before the original estimate was made, the area to be stripped was explored by test pits at a cost of $108.58. This testing, which was completed in Feb., furnished the information for the original estimate of 5,000 cu. yds. After work had been begun, it was decided to extend the area to include the earth fill under the tracks running down from Summit. This increase was estimated at 2,000 cu. yds., bringing the total to 7,000. The equipment used was a 1 cu. yd. gas shovel, equipped with both a dipper and dragline, and several 1½ ton dump trucks. The total amount of over-burden removed and paid for was 7,420 cu. yds., at a cost of $3,710, and made available a total of 227,000 tons of ore at the rate of $0.016 per ton. In addition to the above expenditure of $3,710 spent under E. & A. #749, an additional $712.39 was subsequently carried into this account by the Cleveland office. This additional money was actually expended in removing over-burden from the lower Bench in the West Pit and was done during the slack periods in June, July, and August, without an E. & A.

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7. OPEN PIT
OPERATIONS (CONT.)

a. Stripping (Cont.)

The work consisted of casting with #46 Marion Shovel, and was done to facilitate subsequent stripping operations. Since the material handled was merely cast over the bank, the cost was very low, a total of 22,950 cu. yds., being removed for $712.39, or $0.031 per cu. yd. This represents a considerable saving since the lowest contractor's bid obtainable was $0.25 per cu. yd. The following is a tabular record of the above stripping operation in the East Pit:

Cu. Yds.	Unit Price	Total Amount	Tons Made Available	Cost Per Ton
7,420	$0.50	$3,710	227,000	$0.016

Stripping under E. & A. #786 was started at the close of the shipping season and carried on during November and December until severe, freezing weather made it expedient to postpone further work until Spring. As set up in the estimate, there were three distinct stripping jobs, as well as a number of miscellaneous items incidental to preparing the lower bench for mining.

The several operations and items are listed below as well as the expenditures and quantities completed up to the end of 1937:

ORIGINAL ESTIMATE		WORK ACCOMPLISHED	TOTAL EXPENDITURE TO DATE	COST
Moving Power Line	$1,000	Completed	$638.95	-
Stripping 30,000 cu. yds. @ $0.40	12,000	26,640	4,759.11	$0.178 per yd.
220 lineal ft. C.M.P. @ $5.00 in place.	1,100	210' in place.	1,014.28	4.83 per ft.
Clearing & Grubbing.	500	Completed	528.43	-
Washing.	1,000	Pipe Line Moved.	166.67	-
Casting.(L.S.&I.Tracks)	250	Nearly Completed	766.44	"
Surfacing 3,000 yds @.50	1,500	Nothing	-	-
Miscellaneous Material	400	-	-	-
Total	$17,750			
Plus 10%	1,775			
Total Lower Bench	$19,525			
Stripping 3,000 cu. yds. on West side of West Pit @ $0.50	1,500	2700 cu. yds.	350.59	$0.126 per cu.yd.
Stripping 2,000 cu. yds. on West side of East Pit @ $0.50	1,000	2375 " "	784.02	.33 " " "
GRAND TOTAL	$22,025		$9,008.49	

The above items listed under E. & A. 786 are discussed below in the order in which they appear in the table.

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7. OPEN PIT
OPERATIONS (CONT.)

a. Stripping(Cont.)

Moving Power Line: This work was necessary since the power line in its original position ran down the north side of the L. S. & I. right-away immediately south of the stripping operations for the Lower Bench. The line was moved completely clear of the L. S. & I. track, and all future operations, and was completed at a cost of $638.95.

Stripping 30,000 Cubic Yards: The original estimate for this item was set up at a unit cost of $0.40 per cu. yd., which was considered conservative in view of the past record of stripping operations. To date 26,640 yards or 89% of the total have been removed at an average cost of 17.8 cents. While this figure will probably be somewhat greater when the job is finally completed, the average cost for the whole operation will probably not exceed $0.20 per cu. yd., or ½ the estimated cost. This cost of $0.20 is 60% lower than the best price bid by local contractors and was made possible by the fact that loading conditions were almost ideal for the use of our large electric power shovel, which can be operated very cheaply under suitable conditions. A small portion of the material removed to date was cast over the banks and later cleaned up and removed from the L. S. & I. right-away. The remainder was loaded into 1½ ton dump trucks, which were hired locally at the current rate of $1.25 an hour, including driver and fuel.

The material thus hauled away was used to widen several of the mine roads and also to construct a new road leading from the crushing plant to the lower bench, where we are now drilling in preparation for mine operations next summer. Earth unsuitable for road building purposes was disposed of in a stripping dump south of the L. S. & I. tracks. The small portion of this work still unfinished will probably be completed as soon as the spring break up permits the continuation of the work.

Placing Culvert Pipe: In order to build the new road from the crushing plant to the entrance of the lower bench, it was necessary to extend the culvert that provided drainage under the railroad fill in the West Pit. It was also necessary in providing drainage for the pit, to place a culvert underneath the L. S. & I. main line and side track directly south of the lower bench. 220' ft., of 24" corrugated metal pipe were estimated at a cost of $5.00 per ft., including the original purchase price and placing of the pipe. The culvert under the new road has been completely installed and the one under the L. S. & I. tracks is complete, except for one 10' length, which has not yet been placed. The cost of the operation to date including the purchase price on the 10' length not yet installed was $4.83 per ft.

Clearing and Grubbing: The clearing of the area over which the new road to the lower bench was to be built, and the removal of the stumps prior to the placing of the earth fill, was estimated at $500 plus 10% for contingencies. This work was actually completed early in November at a total cost of $528.43.

Washing: This item which has been estimated at $1,000, including the placing of the pipe line and the actual washing operations, will not be done for the most part until next spring or summer. To date, the pipe line has been brought down from Summit Pit, and partially installed at a cost of $166.67.

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7. OPEN PIT
OPERATIONS (CONT.)

a. Stripping (Cont.)

Casting (L. S. & I. Tracks): This item which consisted of removing the material that had been cast over the banks on to the L. S. & I. tracks, was originally estimated as 10 shovel days, at $25.00 per day, including operator, oiler and power. This operation took considerably longer than this, due in part to the fact that a portion of the material was badly frozen before it could be removed. The job was nearly completed at a cost of $766.44, including shovel expenses plus the services of a miner and explosives for blasting the frozen material, and was being continued at the end of the year.

Surfacing: This item has been estimated as requiring 3,000 cu. yds., of crushed ore at an average cost of $0.50 per cu. yd., at the mine pocket, and can be produced and put in place during slack times at the pit. None of this has been done to date.

Stripping 3,000 cu. yds., on the west side of the West Pit: As far as concerns our present plans, this is the last stripping operation that will be done to uncover the ore lying above the present floor of the West Pit. For a number of reasons which are discussed in other portions of this report, it is impractical to attempt to recover any more ore at this elevation. The original estimated cost of $0.50 per cu. yd., including washing was set up, based on previous experience with small jobs where the material to be removed averages 5 or 6 feet in depth. However, instead of removing this over-burden by the usual method of power shovels and trucks, we were fortunate in that we were able to hire an R D-6 Diesel operated Caterpillar Tractor, equipped with a LeTourneau Angle-Dozzer. This machine with an operator, was rented from Emil Railo, a lumber operator at Gwinn. This piece of equipment spent a total of 6 operating days in this area, during which it moved 2,700 cu. yds., or an average of 450 yds., per day. The total cost which included rental, operator's wages, fuel, several minor repairs and transportation from Gwinn and back, was $350.59, or an average of 12.6 cents per cu. yd. This cost is about $\frac{1}{4}$ as much as it would have been had the job been done on contract with the power shovel and trucks. As soon as the upper bench stripping had been completed, the tractor was moved to the present floor of the West Pit, where several days were spent pushing earth over the edge to a position where the power shovel could reach it. An additional half day was spent in levelling off the road grade, and another half day in digging a ditch south from the end of the culvert pipe to the swamp. In all of these operations this piece of equipment tended to bear out the contention of its builders, that at least one unit of this type is almost indispensable in modern open-pit mining.

Stripping 2,000 cu. yds., on the west side of the East Pit: This estimate, which was a rough guess as to the amount of cleaning up necessary to the north of the present East Pit, will prove to be considerably greater than the original quantity set up. This area which has been already partially stripped, will be included by the northerly extension of the East Pit in the next 2 or 3 years. In order to round out our drilling campaign for the winter of 1937 and 1938, it was absolutely necessary that a portion of this over-burden be removed this fall and winter.

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7. OPEN PIT
OPERATIONS(CONT.)

a. Stripping (Cont.)

The work was done with a 50 H.P. hoist and scraper, which is a very slow, but rather inexpensive method under the proper conditions. A total of 2,375 cu. yds., were removed up to the end of the year at an average cost of $0.33, and a considerable amount remains to be done during the coming winter and spring.

At this point it might be well to point out, that any unamortized portion of the West Pit stripping account should be set up against the reserves of 2,525,000 tons, which are all that remain in both benches of the West Pit whether prospective or developed.

b. Development

There was little or no development at the mine during 1937, in spite of the fact that there was a considerable amount of stripping done in both pits. No new ore was developed in the East Pit, as the reserves uncovered in this vicinity had already been outlined and estimated by test drilling.

The development in the West Pit is of little or no importance, since the small area uncovered in the West portion had already been partly stripped, and the reserves in the lower bench have been carried as developed ore for a number of years. The total available ore remaining in this area has been re-estimated at 2,525,000 tons as described in paragraph 4-a of this report.

f. Drilling, Blasting & Explosives

1. Drilling

The churn drill footage for 1937 totaled 9,055' as compared to 12,209' in 1936, a decrease of more than 3,100'. One 80' hole was lost in 1937 as compared with 446' lost in 1936. The effective drilling in 1937 was 8,975' as compared with 11,110' during 1936, a decrease of 2,135' or 19.2%. The amount of footage lost during the current year was only 18% of the total lost in 1936.

The above very favorable comparison is due almost entirely to the fact that the 29-T, 9" Bucyrus drill was in use throughout the year and a second was purchased in the middle of the season and worked the remainder of the year. 4,732' or 53% of the total was drilled by the new machines. These drills not only drill faster and more cheaply, but their increased size allows the holes to be spread farther apart, thus making it unnecessary to drill as many holes for a given amount of burden. In addition to the above advantages, holes are less likely to be lost, since the heavier tools do not permit them to "wander" as was all too often the case with the 6" machines.

The cost of the net footage drilled averaged $1.88 per foot as compared with $1.86 during 1936. In other words, the advantage gained by the more efficient new drills was offset by two wage increases which affected the 1937 drilling; one effective 11/16/36 of 10%, and the other 3/16/37 of 10% in general and more for common labor.

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7. OPEN PIT OPERATIONS (CONT.)

f. Drilling, Blasting & Explosives (Cont.)

1. Drilling(Cont.)

Cost of Operating 9" Churn Drills in West Pit, 1937

Total footage of holes drilled	2,882
Total footage of holes lost	80
Net Available Footage	2,802

Operating	Labor	Supplies	Total	Cost Per Foot
Drilling at Mine	$2,309.32	$ 297.47	$2,606.79	.940
Sharpening Bits	545.13	179.60	724.73	.258
Pipe & Fittings	35.35	92.57	127.92	.045
Rope		130.16	130.16	.046
Drilling Tools		492.67	492.67	.172
Electric Power		255.13	255.13	.091
Truck and Tractor	543.05	182.73	725.78	.259
Total Operating	$3,432.85	$1,630.33	$5,063.18	1.811
Maintenance				
Drill Sharpener Equipt.	42.87	84.53	127.40	.045
" Maintenance	56.39	54.84	111.23	.036
Total Maintenance	$ 99.26	139.37	238.63	.081
Total Maintenance & Operating.	$3,532.11	$1,769.70	$5,301.81	1.892

Cost of Operating 6" Churn Drills in East Pit, 1937

Total footage of holes drilled	824
Total footage of holes lost	0
Net Available Footage	824

Operating	Labor	Supplies	Total	Cost Per Ft.
Drilling at Mine	$1,014.26	$ 39.14	$1,053.40	1.278
Sharpening Bits	111.47	38.60	150.07	.182
Pipe & Fittings		32.99	32.99	.040
Rope		144.80	144.80	.176
Drilling Tools		162.00	162.00	.196
Electric Power		119.35	119.35	.145
Truck and Tractor	132.16	26.76	158.92	.193
Total	$1,257.89	$563.64	$1,821.53	2.210
Maintenance				
Drill Maintenance	59.75	2.23	61.98	.075
Total Maintenance & Operating	$1,317.64	$565.87	$1,883.51	2.285

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7. OPEN PIT
OPERATIONS (CONT.)

f. Drilling, Blasting & Explosives (Cont.)

1. Drilling(Cont.)

Costs varied from $1.70 per foot in the West Pit with 6" drills, to $2.29 per foot in the East Pit with the same size machines. The cost of 6" drilling in the West Pit was lower than the 9" due to the fact that the 6" machines were purposely placed when the material was softer and easier to drill.

Cost of Operating 6" Churn Drills in West Pit, 1937

Total footage of holes drilled	3,419
Total footage of holes lost	0
Net Available Footage	3,419

Operating	Labor	Supplies	Total	Cost Per Foot
Drilling at Mine	$2,986.30	$ 573.97	$3,560.27	1.041
Sharpening Bits	339.48	165.67	505.15	.147
Pipe & Fittings	6.90	178.80	185.70	.054
Rope		225.00	225.00	.066
Drilling Tools		468.00	468.00	.136
Electric Power		370.38	370.38	.109
Truck and Tractor	250.20	127.08	377.28	.110
Total	$3,582.88	$2,108.90	$5,691.78	1.663
Maintenance				
Drills	74.55	20.01	94.56	.029
Drill Sharpener	16.88		16.88	.005
Total	$ 91.43	$ 20.01	$ 111.44	.034
Total Maintenance and Operating	$3,674.31	$2,128.91	$5,803.22	1.697

TILDEN MINE
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YEAR 1937

7. OPEN PIT
OPERATIONS (CONT.)

f. Drilling, Blasting & Explosives (Cont.)

1. Drilling (Cont.)

Cost of Operating 9" Churn Drills in East Pit, 1937

Total footage drilled	1930
Total footage lost	0
Net Available Footage	1930

Operating	Labor	Supplies	Total	Cost Per Foot
Drilling at Mine	$1,727.49	$ 41.87	$1,769.36	.917
Sharpening Bits	377.48	186.43	563.91	.292
Pipe & Fittings	1.85	79.60	81.45	.043
Rope		122.80	122.80	.065
Drilling Tools		438.89	438.89	.223
Electric Power		207.31	207.31	.108
Truck and Tractor	387.51	87.73	475.24	.247
Total	$2,494.33	$1,164.63	$3,658.96	1.895
Maintenance				
Drills	38.55	54.81	93.36	.049
Drill Sharpener Equipt.	52.88	78.80	131.68	.068
Total	91.43	133.61	225.04	.117
Total Maintenance & Operating.	$2,585.76	$1,298.24	$3,884.00	2.012

Combined Cost of Operating Churn Drills, 1937

	Total Net Footage	Total Cost	Cost Per Foot
West Pit, 6" holes	3,419	$ 5,803.22	1.697
West Pit, 9" holes	2,802	5,301.81	1.892
East Pit, 6" holes	824	1,883.51	2.285
East Pit, 9" holes	1,930	3,884.00	2.012
Total	8,975	$16,872.54	1.88

The results obtained by the use of the new 9" drills, were extremely satisfactory as evidenced by the above tables. However, we have not as yet reached the peak of efficiency that will ultimately be attained by these machines. As was to be expected, the drill sharpening crew experienced considerable difficulty during the "breaking in period" while learning to operate the new bit dressing machines and oil burning furnaces. As a result the standard of the bits turned out at the shop was rather low as compared to what can ordinarily be accomplished with this new equipment. As a result of the poor bits, drilling speeds were reduced and costs increased. Toward the end of the year, most of these operating difficulties had been ironed out, and we feel quite safe in predicting that all conditions remaining the same, that the 1938 record will show a substantial improvement in both drilling speeds and costs.

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7. OPEN PIT OPERATIONS (CONT.)

f. Drilling, Blasting & Explosives (Cont.)

1. Drilling (Cont.)

The following tables show a comparison between the drilling speeds of the different size machines in the two pits, and the average footage drilled per bit. In every case, the superiority of the 9" machines is apparent.

Drilling Speeds, Year 1937

Location, Drill No.	Shifts Worked	Footage Drilled	Average Footage Per 8 Hour Shift.
West Pit (6") 5	89	1,396	15.69
" " (6") 6	142	2,023	14.25
Total West Pit 6" Holes	231	3,419	14.80
West Pit (9") 7	84	1,501	17.85
West Pit (9") 8	86	1,381	16.05
Total West Pit 9" Holes	170	2,882	16.35
East Pit (6") 3	18	220	12.22
" " (6") 4	26	423	16.26
" " (6") 6	15	181	12.06
Total East Pit 6" Holes	59	824	13.96
East Pit (9") 7	128	1,930	15.08
Total East Pit 9" Holes	128	1,930	15.08

East Pit		Bits Used		Footage Obtained	Footage Per Bit
6"	-	191	-	824	4.32
9"	-	424	-	1,930	4.55

West Pit		Bits Used		Footage Obtained	Footage Per Bit
6"	-	899	-	3,419	3.80
9"	-	660	-	2,882	4.36

Average Both Pits

6" - 3.89' per bit.
9" - 4.43' " "

2 Blasting

Late in the season of 1936, due to the results of a drilling test by the Bucyrus-Erie Company, we purchased a new 29-T 9" drill and a new electrically operated bit dresser. This new equipment was purchased in order to decrease the cost of both primary and secondary drilling and blasting. A rather lengthy discussion of the test drilling and our conclusions can be found in the report for 1936.

7. OPEN PIT
OPERATIONS (CONT.)

f. Drilling, Blasting & Explosives (Cont.)

2. Blasting (Cont.)

This new drill, and the results obtained with it proved so satisfactory that a second machine was purchased in the middle of the loading season. Subsequently, two new oil burning furnaces were also purchased, since we believed that this new modern equipment would give better results in the heat treating of the bits.

As reported at the end of 1936, the results obtained by the new drills were entirely satisfactory with the exception that we had had no opportunity to test the results obtained in the primary blast. During 1937, a number of blasts were made with the 9" holes, and we now feel safe in stating that the results obtained are fully as good, if not somewhat better than those obtained by the 6" blasts. The material broken at this property is not at all uniform as to texture and hardness, and there has always been necessary a considerable amount of secondary drilling and blasting due to the fact that all primary shots produce a considerable number of large chunks. These large chunks, together with portions of the pit floor, must be re-drilled and blasted before loading can be completed. During the current year, a considerable amount of experimental work was done with rearranging the powder loads for the primary blasts. The results obtained by these experiments tend to indicate that in the future, a slight increase in the primary blasting charge will decrease secondary work sufficiently to repay the additional powder cost. Also loading conditions are benefited considerably when the necessary secondary work is held to a minimum.

The 3rd and 4th of the following tables clearly indicate the decrease in primary drilling and blasting costs, when the 9" machines are used. Using the 9" holes, 164,600 tons of ore were drilled and blasted at an average cost of $0.089 per ton. As a comparison, 123,400 tons were drilled and blasted with the 6" holes at an average cost of $0.147 per ton. The above difference of nearly $0.06 per ton, represents a saving of almost $10,000 during the past year alone.

In the future, the old 6" machines will be used only in places where the use of the large machine is not practical, or in the event that a large production schedule would require ore at a greater rate than could be produced with the two 9" drills. A case in point is the drilling of the entrance to the lower bench, which was started in the last week of December. The 6" machines are being used in this territory since in this type of blast the holes must be placed so close together that the larger size would be a distinct disadvantage instead of an advantage.

Six primary blasts were made during the year, three in each pit. Of these six, four were made using both size holes with the 9" holes predominating, and the other two were made with 6" holes only.

TILDEN MINE
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7. OPEN PIT OPERATIONS (CONT.)

f. Drilling, Blasting & Explosives (Cont.)

2. Blasting (Cont.)

A total of 288,000 tons were broken, 128,000 in the East, and 160,000 in the West. A division as to tonnage produced with the two different size holes, shows 123,400 with the 6" machine, and 164,600 with the 9". As was mentioned above, the results obtained were quite satisfactory as to fragmentation, particularly toward the end of the year, when a larger amount of powder was used per ton of burden. Following is a tabulation of blast results:

EAST PIT

Blast Number	Date	No. of Holes	Footage	Pounds Powder	Estimated Tons	Tons Ore per Pound Powder
1	4-16-37 (6")	10	818	5400	17,000	3.1
"	" (9")	3	304	3880	12,000	3.1
	Total	13	1122	9280	29,000	3.1
2	7-3-37 (6")	10	765	4500	14,000	3.1
"	" (9")	6	636	6690	21,000	3.1
	Total	16	1401	11190	35,000	3.1
3	10-19-37 (6")	1	53	500	1,400	2.8
"	" (9")	15	1253	22270	62,600	2.8
	Total	16	1306	22770	64,000	2.8
Total East Pit	(6")	21	1636	10400	32,400	
" " "	(9")	24	2193	32840	95,600	
Grand Total East Pit		45	3829	43240	128,000	

WEST PIT

Blast Number	Date	No. of Holes	Footage	Pounds Powder	Estimated Tons	Tons Ore per Pound Powder
1	4-29-37 (6")	14	1416	9300	28,000	3.0
"	" (9")	16	1533	23040	69,000	3.0
	Total	30	2949	32340	97,000	3.0
2	7-1-37 (6")	42	2147	13800	43,000	3.1
3	10-15-37 (6")	14	867	7050	20,000	2.8
Total West Pit	(6")	70	4430	30150	91,000	
" " "	(9")	16	1533	23040	69,000	
Grand Total West Pit		86	5963	53190	160,000	
Grand Total (6") Holes East & West Pits		91	6066	40550	123,400	
Grand Total (9") Holes East & West Pits		40	3726	55880	164,600	
Grand Total Both Sizes in Both Pits		131	9792	96430	288,000	

TILDEN MINE
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YEAR 1937

7. OPEN PIT
OPERATIONS (CONT.)

f. Drilling, Blasting & Explosives (Cont.)

2. Blasting (Cont.)

Secondary drilling and blasting caused the usual expense and trouble during the 1937 season. This work was somewhat less than during the previous years due to a number of reasons. In the first place, there were no missed holes in either primary or secondary blasting. This gave us a considerable advantage over previous years, since it quite often happened that one or more holes would fail to explode, subsequently causing tremendous difficulty and a certain amount of hazard during loading operations. The absence of missed holes was due at least to a great extent to the fact that we have used Wire Countered Cordeau-Bickford fuse almost exclusively in the blast holes, instead of Double Countered, which was extensively used in former years. This Wire Countered fuse, practically eliminates miss-fires if carefully and properly handled, and is much more satisfactory than the Double Countered, which is occasionally severed in the hole by a sharp projection or otherwise damaged to the point where a miss-fire occurs. Secondary drilling was considerably speeded up by the introduction of water heads on the jack-hammers.

Pressure was obtained by the use of a battery of tanks, placed in a high point near the face of the pit. This wet drilling was rather simply arranged, and is a distinct advantage over the previous dry method, since speeds are somewhat faster, the wear on bits considerably less, and the resulting dust kept at an absolute minimum.

Tripod drifting machines were introduced with considerable success. In drilling long holes into an unbroken projection in the toe of the face, these machines are a distinct advantage over the jack-hammers in that they have a force feed, and drill much faster and easier, with much less punishment to the operator. Drilling with this equipment was also done wet.

After the loading was finished for the season, several weeks were spent in casting accumulated ore from the northern toe of the East Pit in preparation for extending the pit in that direction in 1938. This was necessary to insure good primary blasting results. After all of the removed ore had been cast away, mining crews spent several weeks drilling long holes into unbroken projections at the toe. The material subsequently broken by blasting these holes, was also cast away from the face. This work was greatly facilitated by the use of the above mentioned tripod drill machines. While this operation was actually a phase of secondary drilling, and blasting, the expense is being carried in the deferred drilling account. Severe freezing weather put a temporary stop to this work late in December, and it will be continued next spring, as soon as the weather permits.

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7. OPEN PIT OPERATIONS (CONT.)

f. Drilling, Blasting & Explosives (Cont.)

2. Blasting (Cont.)

STATEMENT OF COST OF EXPLOSIVES USED FOR THE YEAR ENDING DECEMBER 31, 1937

Primary Blasting

Kind	Quantity	Price	Amount
Gelamite #2	49,750 lbs.	$11.46	$ 5,702.26
40% LF Gelatine	3,000 "	10.00	300.00
60% LF "	150 "	13.00	19.50
80% LF "	34,830 "	15.00	5,225.13
90% LF "	9,000 "	17.50	1,575.00
Total Powder	96,730 lbs.	$13.25	$12,821.89

Blasting Supplies	Quantity	Price	Amount
#2 Wire Countered C. B. Fuse	9,301 ft.	$65.00	$ 604.56
Plain C. Bickford Fuse	2,011 "	42.00	84.45
Double C. Bickford Fuse	1,694 "	47.75	80.66
Cord. Couplings	100		.90
Cap Crimper	1		.50
Total Blasting Supplies	13,006 ft. fuse.		$ 771.07
Total all Explosives			12,821.89
TOTAL COST			$13,592.96

Total Ore Blasted in 1937	288,000 tons
Pounds of Powder per Ton of Ore	.33
Cost per Ton for Powder	.045
Cost per Ton for Fuse, Caps, etc	.002
Cost per Ton for all Explosives	.047
Average price per Pound for Powder	.1325

Secondary Blasting

Kind	Quantity	Price	Amount
60% Gelatine	7,150 lbs.	$12.69	$907.95

Blasting Supplies			
Hot Wire Lighters - 7"	1,000	6.76 (M)	6.76
Crescent Fuse	22,000 ft.	.56 (C)	123.28
#6 Blasting Caps	3,000	1.22 (C)	36.60
Total			$166.64
Total Explosives			907.95
Total Cost			$1,074.59

Product	305,418 tons
Pounds of Powder per Ton of Ore	.023
Cost per Ton for Powder	.003
Cost per Ton for Fuse, Caps, etc	.001
Average price per Pound for Powder	.1269

TILDEN MINE
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YEAR 1937

7. OPEN PIT
OPERATIONS (CONT.)

f. Drilling, Blasting & Explosives (Cont.)

2. Blasting (Cont.)

COMBINED TOTAL BLASTING COST

Kind	Quantity	Price	Amount
Gelamite #2	49,750 lbs.	$11.46 (C)	$ 5,702.26
40% LF Gelatine	3,000 "	10.00 "	300.00
60% LF "	7,300 "	12.70 "	927.45
80% LF "	34,830 "	15.00 "	5,225.13
90% LF "	9,000 "	17.50 "	1,575.00
Total Powder	103,880 lbs.		$13,729.84
Blasting Supplies			
#6 Electric Blasting Caps	0	0	
#2 Wire Countered C. B. Fuse	9,301 ft.	$65.00 (M)	604.56
Plain Cordeau-Bickford Fuse	2,011 "	42.00 "	84.45
Double " " "	1,694 "	47.75 "	80.66
Cord. Couplings	100		.90
Hot Wire Lighters 7"	1,000	6.76 "	6.76
Cap Crimpers	1	.50 (ea.)	.50
Crescent Fuse	22,000 ft.	.56 (C)	123.28
#6 Blasting Caps	3,000	1.22 "	36.60
Total Blasting Supplies			$ 937.71
TOTAL - ALL EXPLOSIVES -			$14,667.55

WEST PIT	Tons	
Broken Ore remaining year 1936	19,087	
Blasted 1937	160,000	
Total	179,087	
Ore Shipped in 1937 ..... 217,586 tons	000,000	38,499 Shipped from overrun.
Estimated Ore on hand, December 31, 1937		

EAST PIT	Tons
Broken Ore remaining year 1936	10,960
Blasted 1937	128,000
Total	138,960
Ore Shipped in 1937	87,832
Estimated Ore on hand, December 31, 1937	51,128

SUMMIT PIT	Tons
Broken Ore remaining year 1936	7,032
Blasted 1937	0
Total	7,032
Ore Shipped in 1937	0
Estimated Ore on hand, December 31, 1937	7,032

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7. OPEN PIT
OPERATIONS (CONT.)

f. Drilling, Blasting & Explosives (Cont.)

3. Statement of Cost of Drilling and Blasting 123,400 tons of Ore - 6".

Net Feet of Holes Drilled - 4243', Lost - 0

Drilling Cost Operating	Labor	Supplies	Total	Cost Per Ft.	Cost Per Ton
Drilling at Mine	$3,516.73	$ 457.57	$ 3,974.30	1.093	
Sharpening Bits	357.67	242.42	600.09	.165	
Pipe & Fittings	3.94	208.45	212.39	.058	
Rope		297.56	297.56	.082	
Drilling Tools		630.00	630.00	.165	
Electric Power		436.03	436.03	.120	
Truck & Tractor	362.15	145.10	507.25	.148	
Total Operating	$4,240.49	$2,417.13	$ 6,657.62	1.831	
Maintenance					
Drills	70.96	21.68	92.64	.026	
Drill Sharpener Equipt.	59.75		59.75	.016	
Total Maintenance	$ 130.71	$ 21.68	$ 152.39	.042	
Total Operating and Maintenance	$4,371.20	$2,438.81	$ 6,810.01	1.873	
Carried over from 1936:					
East Pit - 812'			2,330.44		
West Pit - 1618'			2,588.80		
Blasted - 1937 - 6066'			$11,729.25	1.933	.095
Primary Blasting Costs					
Labor Loading Holes	$ 204.00		$ 204.00		
Explosives		6,113.12	6,113.12		
Other Supplies		78.72	78.72		
	$ 204.00	$6,191.84	$ 6,395.84		.052
Grand Total Operating, Maintenance, and Primary Blasting	$4,575.20	$8,630.65	$18,125.09		.147

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7. OPEN PIT OPERATIONS (CONT.)

f. Drilling, Blasting & Explosives (Cont.)

3. Statement of Cost of Drilling and Blasting 164,600 tons of Ore - 9".

Net Feet of Holes Drilled - 4812', Lost - 80'

Drilling Cost Operating	Labor	Supplies	Total	Cost Per Ft.	Cost Per Ton
Drilling At Mine	$2,614.20	$ 126.34	$ 2,740.54	.891	
Sharpening Bits	521.20	224.93	746.13	.242	
Pipe & Fittings	11.85	79.60	91.45	.030	
Rope		242.96	242.96	.082	
Drilling Tools		701.64	701.64	.231	
Electric Power		325.82	325.82	.111	
Truck & Tractor	513.63	141.90	655.53	.213	
Total Operating	$3,660.88	$1,843.19	$ 5,504.07	1.800	
Maintenance					
Drills	26.00	52.92	78.92	.019	
Drill Sharpener Equipt.	27.86	11.92	39.78	.010	
Total Maintenance	$ 53.86	$ 64.84	$ 118.70	.029	
Total Operating and Maintenance	$3,714.74	$1,908.03	$5,622.77	1.889	
Carried over from 1936: 653'			1,309.00	2.004	
Blasted - 1937 - 3726'			$ 6,931.77	1.866	.042
Primary Blasting Costs					
Labor Loading Holes	$ 176.00		$ 176.00		
Explosives		$7,479.84	7,479.84		
Other Supplies		14.89	14.89		
	$ 176.00	$7,494.73	$ 7,670.73		.047
Grand Total Operating, Maintenance, and Primary Blasting	$3,890.74	$9,402.76	$14,602.50		.089

Combined Statement of Cost of Drilling and Blasting 288,000 tons of Ore.
6" and 9" Holes Combined.

	Cost	Tonnage	Cost Per Ton
Grand Total - 6"	$18,125.09	123,400	.147
Grand Total - 9"	14,602.50	164,600	.089
Combined Cost - 1937	$32,727.59	288,000	.114
Combined Cost - 1936			.123

From the above, it is apparent that the increased efficiency due to the use of the 9" drills for practically 50% of the drill footage, more than offsets two wage increases, totalling more than 20%, and general price increases in materials and supplies.

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7. OPEN PIT
OPERATIONS (CONT.)

g. Loading Operations

Loading operations were begun on April 7th, and continued as called for up to and including November 4th, when shipments for the last cargo were completed. Operations were entirely on a single shift basis and rather intermittent until October, when an increased demand necessitated double shift operations for the greater part of the month. A total of 305,418 tons were loaded and shipped in 153 operating shifts of 8 hours.

The No. 31 shovel worked throughout the year in the East Pit, while Nos. 29 and 46 spent the season in the West Pit. The addition of this 3rd shovel (#46 Marion) has not only tended to increase the daily output of the mine, but has made possible the inclusion of the high sulphur ore in the east side of the West Pit, without materially increasing the sulphur content of the product as a whole. Without the 3rd shovel this mixing would be very difficult, if not actually impossible.

The ore produced by blasting with the 9" holes caused some difficulty at first due to the number of large chunks produced. This had the effect of slowing up the loading for a short time. In the subsequent blasts, powder loads were increased and somewhat re-arranged in an effort to reduce the number of large chunks. This has been more or less successful in that the blasts in the latter part of the season produced much better fragmentation.

The East Pit was extended to the east as much as possible under the 1937 loading schedule, and our present plans call for further extension in this direction and also extension to the north for the next few loading seasons. Up to the present the loading area in the East Pit has been rather restricted, but these extensions to the north and east will greatly facilitate the handling of the product as the Pit becomes larger.

In the West Pit, the intrusion of Diorite at the center has had the effect of making two separate pits in this area, one to the west and one to the east. As has been previously explained, reserves in the Upper Bench are rapidly being depleted, and it is now necessary to open up the Lower Bench, if our present rate of production is to be maintained. The bulk of the stripping for this operation has been completed, and the drilling for the entrance has been started.

In the very near future it will be necessary to decide upon suitable haulage equipment to transport the ore from the Lower Bench to the crusher. Our present steam locomotives are entirely incapable of doing this work.

The present trend in most of the open pit mines to date, is away from haulage equipment on rails, and toward individual hauling units, such as trucks, tractors, semi-trailers, and combinations of all three. The advantages of these individual units are apparent when we consider the tremendous amount of time and money that is spent on track work at this property. Some of these advantages are: elasticity of operations, the ability to move quickly from one portion of the pit to another, both for better loading and grading of the output, ability to haul over grades as steep as 10 or 12%, greater speed, and decreased operating costs.

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8. COST OF OPERATING

a. Comparative Mining Costs

	1937	1936	Increase	Decrease
Production	305,418	291,341	14,077	
Average Daily Product	1,996	1,525	471	
Tons per man per day	45.50	42.61	2.89	
Number of days operating	153	191		38
Number of shifts & hours	113-1-8-hr.	77-1-8-hr.	36	
	20-2-8-hr.	57-2-8-hr.		74
Cost				
Pit Operating Accounts	.322	.300	.022	
Pit General Accounts	.047	.035	.012	
Cost at Mine	.369	.335	.034	
Idle & Winter Expense	.083	.077	.006	
Total Cost at Mine	.452	.412	.040	
Depreciation				
Plant & Equipment	.043	.045		.002
Taxes	.024	.019	.005	
Stripping	.011	.004	.007	
Grand Total Cost at Mine	.530	.480	.050	
Expense Beyond Mine				
Freight - Rail	.640	.640		
Lake Freight	.850	.760	.090	
Cargo Insurance & Analysis	.010	.010		
Shrinkage	.013	.011	.002	
TOTAL COST LOWER LAKES	2.043	1.901		

b. Detailed Cost Comparison

1. Days and Shifts

In 1937, this property operated a total of 153 shifts compared to 191 in 1936, a decrease of 38 shifts. In spite of this decrease, the product for 1937 was greater than in 1936.

2. Production

Production in 1937 was 305,418 tons, an increase of 14,077 over 1936, when 291,341 tons were shipped. The average daily product was increased from 1525 tons per shift to 1996 in 1937, an increase of 471 tons per shift. This increase was due partly to the presence of the 3rd shovel and partly to an improvement in loading conditions.

3. Cost of Production

In 1937 the cost per ton on cars at the mine, before depreciation and taxes, was $0.452 as compared to $0.412 in 1936. This increase of $0.04 per ton was due entirely to higher wage scales, and generally higher prices for materials and supplies, and would have been much greater except for the fact that primary drilling and blasting with the new 9" machines almost entirely counteracted the increases in wages and materials.

TILDEN MINE
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8. COST OF OPERATING (CONT.)

b. Detailed Cost Comparison (Cont.)

4. Open Pit Costs

	1937	1936	Increase	Decrease
Shifts and Hours	113-1-8 hr.	77-1-8 hr.	36	
	20-2-8 hr.	57-2-8 hr.		37
Production, Tons	305,418	291,341	14,077	
Average Daily Product	1,996	1,525	471	
Number of Days Worked	153	191		38

PIT OPERATIONS	1937		1936		Increase		Decrease	
Direct Ore	Amount	Per Ton	Amount	Per Ton	Amount	Per Ton	Amount	Per Ton
1. Drilling & Blasting	38,659.85	.127	44,161.77	.151			5,501.92	.024
2. Power Shovels Operating	10,912.99	.036	8,399.77	.029	2,513.22	.007		
3. Power Shovels Maintenance	5,020.33	.017	4,003.07	.014	1,017.26	.003		
4. Locos. & Cars Operating	11,108.38	.036	8,360.84	.029	2,747.54	.007		
5. Locos. & Cars Maintenance	986.61	.003	429.46	.001	557.15	.002		
6. Tracks, Expense ...	4,706.52	.015	4,975.89	.017			269.37	.002
TOTAL DIRECT ORE	71,394.68	.234	70,330.80	.241	1,063.88			.007
General Pit Expense								
8. Water Supply	861.48	.003	326.19	.001	535.29	.002		
10. Crushing & Screening	19,676.41	.065	12,189.67	.042	7,486.74	.023		
11. General Open Pit Exp.	5,076.48	.016	3,650.12	.012	1,426.36	.004		
12. Open Pit Supts.....	1,326.68	.004	1,127.55	.004	199.13	.000		
14. Waste Pile Expense..	30.04	.000			30.04	.000		
15. Exploration Drilling	47.73	.000	95.45	.000			47.72	.000
Total General Expense	27,018.82	.088	17,388.98	.059	9,629.84	.029		
TOTAL PIT OPERATION	98,413.50	.322	87,719.78	.300	10,693.72	.022		

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8. COST OF OPERATING (CONT.)

GENERAL MINE EXPENSE	1937 Amount	1937 Per Ton	1936 Amount	1936 Per Ton	Increase Amount	Increase Per Ton	Decrease Amount	Decrease Per Ton
16. Mining Engineering	1,343.27	.004	862.87	.003	480.40	.001		
17. Mechanical and Electrical Eng.	478.72	.002	454.23	.002	24.49	.000		
18. Analysis & Grading	2,700.67	.009	2,523.29	.009	177.38	.000		
19. Safety Department	241.34	.001	62.03	.000	179.31	.001		
20. Local & Gen. Welfare	471.00	.002	308.00	.001	163.00	.001		
21. Special Expense	573.42	.002	654.43	.002			81.01	.000
22. Ishpeming Office	1,576.00	.005	1,035.00	.004	541.00	.001		
23. Mine Office	2,227.03	.007	1,666.26	.006	560.77	.001		
24. Insurance	517.54	.002	137.66	.000	379.88	.002		
25. Personal Injury	1,639.77	.005	1,148.15	.004	491.62	.001		
26. Social Security Taxes	1,603.47	.005	397.75	.001	1,205.72	.004		
27. Employees Vacation Pay	1,004.38	.003	746.10	.003	258.28	.000		
TOTAL GENERAL MINE EXPENSE	14,376.61	.047	9,995.77	.035	4,380.84	.012		
IDLE AND WINTER EXPENSE	25,332.66	.083	23,790.43	.077	1,542.23	.006		
Cost of Production	138,122.77	.452	121,505.98	.412	16,616.79	.040		
28. Deprn. Plant & Equipt.	13,048.56	.043	12,944.91	.045	103.65		105.06	.002
29. Amortization Stripping	3,390.15	.011	1,270.74	.004	2,119.41	.007		
30. Taxes	7,184.41	.024	5,510.00	.019	1,674.41	.005		
Cost at Mine	161,745.89	.530	141,231.63	.480	20,514.26	.050		
31. Inventory Adjustment	178.14				178.14	.000		
TOTAL COST AT MINE	161,924.03	.530	141,231.63	.480	20,692.40	.050		

No explanation of cost change is made for the above items unless the increase or decrease is large enough to be significant.

1. Drilling and Blasting.
The decrease of $0.024 in this item is due to the fact that more than 57% of the total tonnage blasted during the year was drilled with the new 29-T 9" drills, which are much more efficient than the 6".

2. Power Shovels.
The increase of $0.007 is due to the higher wage scale in force during 1937.

4. Locomotives and Cars.
The increase of $0.007 was due to the higher wage scale and the increase cost of coal.

8. Water Supply
The increase of $0.002 is due in part to the general increase in wages and in part to the expense of changing over from dry to wet secondary drilling in both pits.

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8. COST OF OPERATING (CONT.)

b. DETAILED COST OF COMPARISON (CONT.)

10. Crushing and Screening.
The increase of $0.023 is due to the following cost items: installation of ventilating fan and dust filter, one new set of concaves for the 42" gyratories and two sets of new concaves for the 10" gyratories.

11. General Open Pit Expense
The increase of $0.004 is due to general wage increases.

Idle and Winter Expense.
This increase is due in part to the general increase in wages and also to the fact that during the first 3 months of 1937, a tremendous amount of general work was necessary, since strict economy during the past 3 or 4 years kept such work at an absolute minimum. In the report for the year 1936, the above cost comparison was made on the basis of the revised cost sheet as made up in the Cleveland office. In this revised cost sheet, the idle and winter expense was prorated among the various items and not reported as such. The report for this year is based on the original cost sheet and not the revised sheet from Cleveland. In it the winter and idle expense is carried as a separate item and not prorated. In order to arrive at a comprehensive comparison, the costs for 1936 as listed above, are not those used in the annual report for that year, but are taken from the original cost sheet before it was revised.

Idle Expense

	Labor	Supplies	Total
January	$ 2,806.38	$ 2,804.30	$ 5,610.68
February	2,634.75	3,874.33	6,509.08
March	4,052.69	2,938.89	6,991.58
November	1,762.03	815.17	2,577.20
December	2,236.01	1,408.14	3,644.15
Total	$13,491.86	$11,840.83	$25,332.69

9. EXPLORATIONS AND FUTURE EXPLORATIONS

The only exploration work at this property during 1937, consisted of the completion of the diamond drill campaign during the first few months of the year. Holes #52 and #53 were continued and completed early in the year. Hole #54 was started in the spring of 1937 and completed on March 22nd. A complete discussion of this work will be found in the report of the Geological Department.

#52 (North of East Pit)
1-1-37 - 1071' to 1444' - Cherty Magnetite Siderite and Unoxidized Clastic Iron Formation. 1444' to 1701' - Soft Ore Jasper; 1701' to 1765' Chloritic Shist.

#53(Floor of West Pit)
1-1-37 - 1475' to 1617' - S. O. J. and Clastic Iron Formation.
1617' to 1638' Chloritic Shist.

#54 (Floor West Pit - 70° Due South)
0 to 200' - Silicious Ore - 200' to 511' - Sideritic Chert & Cherty Magnetite
511' to 566' - S. O. J. - 566' to 607' - H. O. J.

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10. TAXES

Tilden Township Tilden Mine	1937 Valuation	 Taxes	1936 Valuation	 Taxes
N½ of Sec. 26, 47-27	$270,000	$6,001.83	$170,000	$4,019.09
Personal Supplies & Equipt.	50,000	1,111.45	60,000	1,417.88
Total	$320,000	$7,113.28	$230,000	$5,436.97
Collection Fees		71.13		54.37
Total Tilden		$7,184.41		$5,491.34

11. PERSONAL INJURY

There were no lost time accidents at the Tilden property during 1937.

12. NEW CONSTRUCTION
AND PROPOSED
NEW CONSTRUCTION

As described in the discussion of stripping operations, a new road was constructed leading from the crusher building to the entrance of the Lower Bench at the West Pit. The details of this operation were fully discussed under that heading.

A dust filtering bag house was constructed by company carpenters on the east side of the crusher building along the pocket-track. In general, this structure is of a 10' x 10' cross-section, and 125' long with a galvanized iron floor and roof. The framework was built of 2" x4"s on 2' centers. Inside of this 2" x 4" framework, was hung a fabric purchased from the Bemis Bag Company of St. Louis. This fabric known as "Osnaberg-Cloth", is especially designed to filter dust particles from air. Some 4,000 sq. ft. of this material was attached to the inside of the framework providing plenty of filtering area. Subsequently, water sprays were installed inside the cloth to settle extremely fine particles of the dust that had a tendency to escape through the material. The galvanized iron floor was constructed in a flat V, running on a minus 3% grade. The water produced by the sprays, tends to keep the accumulated dust flowing out the lower end of the building, thus obviating the necessity of cleaning it out by hand. From our experience last year this piece of apparatus works very satisfactorily, and requires very little attention, since with the exception of turning on the water, all other operations are automatic.

During the year, ventilators were constructed on the roof of the bit-dressing shop to allow the heat and gases to escape.

At the present time, the only new construction that is being considered is the completion of the road to the Lower Bench, and the construction of a suitable shed or garage for the new haulage equipment that eventually must be purchased.

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13. EQUIPMENT AND PROPOSED NEW EQUIPMENT

a. Shovels and Crushers

The 3 electric shovels operated throughout the year without any serious break downs, although the total lost time was somewhat greater during 1937 than during the previous year. #480 Marion shovel was responsible for more than half of the total lost time due to shovel break downs. Conditions as a whole were very good and the necessary over-hauling of these 3 pieces of equipment should be considerably less this winter than it has for several years past. Better fragmentation and improved loading conditions had considerable effect on this reduction in winter repair work.

There was a considerable amount of replacement necessary in the crushing plant due to normal wear during a fairly active season. A new set of concaves was installed in the 42" gyratory at a total cost of $917.00, and two new sets of concaves for the 10" gyratories at a total cost of $700.00.

b. Drills and Equipment

Besides the one new 29-T 9" churn drill and bit dressing machine that were purchased late in 1936, the following new equipment was purchased and installed: a second 9" drill, an oil burning bit furnace, an oil burning tempering or hardening furnace, a quenching tank, two electric blowers, and a 1000 gallon capacity fuel oil tank.

The bulk of this new equipment was purchased in an effort to obtain maximum efficiency from the new large size drills. During the "breaking in period", the shop crew experienced a little difficulty in using the new furnaces and machine with the result that the quality of the bits turned out was none too good. This condition naturally had the effect of reducing drilling speeds and increasing costs to some extent. As has been previously mentioned in this report, the cost record of the new drills was very good in spite of these difficulties. Just prior to the beginning of the drilling program in December, a considerable amount of experimenting was continued in the drill shop with the result that we now have a very capable and efficient shop crew, turning out excellent bits. The effect of this has already been seen in the drilling.

14. MAINTENANCE AND REPAIRS

With the exception of the crushing plant and locomotives, the usual program of winter repairs was not started as early as usual, due to the fact that two of the electric shovels were engaged in stripping operations and the third in casting ore from the toe of the north side of the East Pit. This work was carried on during November and December until severe freezing weather made further progress impractical. When the above operations were stopped for the winter, the usual program of over-hauling and repairing was started.

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14. MAINTENANCE AND REPAIRS (CONT.)

The total amount of winter work should be somewhat less during the 1937-38 season than the year previous, due to the fact that all of our equipment was in very good condition at the start of the 1937 season. As far as the idle expense costs are concerned, the 1937 season had to bear the bulk of the previous year's work, which was done in the first three months of the year.

15. POWER

Electric power during 1937 was entirely satisfactory after the installation of the new mine sub-station had been completed. As was discussed in paragraph 2-h, the numerous petty delays due to the drop in primary line voltage have been completely eliminated with the installation of the sub-station which furnishes power transmitted directly to the mine at 33,000 volts instead of having long feeder lines at 2300 volts which were too small for the demands of peak loads.

16. WATER SUPPLY

The water supply was adequate for our needs throughout the year, although it was necessary to run the large pump almost every day in order to keep the water tower filled. Additional demands were made on the supply this year since a considerable quantity of water is now being used in the cooling doors of the bit furnaces, in the water sprays, in the air filtering bag house, and in our secondary drilling, which is now being done under water pressure with both the jack-hammer and tripod drilling machines.

18. NATIONALITY OF EMPLOYEES

	American Born		Foreign Born		Total
English	13	-	6	-	19
Swedish	8	-	0	-	8
Finnish	9	-	7	-	16
Norwegian	1	-	0	-	1
Irish	5	-	0	-	5
German	1	-	0	-	1
French Canadian	2	-	0	-	2
Italian	1	-	0	-	1
Total	40	-	13	-	53

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For purposes of record, we are including the following discussion of the work done during December 1937. #31 shovel spent the greater part of the month casting in the East Pit, after which winter repair work was started. #46 and #29 Proceeded with stripping operations in the West Pit as long as weather permitted, after which they were dismantled for repairs.

Drills #7 and #8 started work in the East and West Pits respectively. Drills #5 and #6 started at the entrance to the Lower Bench.

Two crews of miners spent several weeks drilling and blasting the north toe in the East Pit.

The installation of the culvert under the L. S. & I. tracks was completed.

Several revisions and improvements were made in the bit dressing shop including the installation of a shield in front of the forging furnace and the lowering of the brick arches in both furnaces.

Stripping operations were continued in the East Pit with the 50 H. P. hoist and scraper.

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1. GENERAL:

The Athens Mine operated five days per week with two crews of men from January 1st, 1937 to February 15th at which time the working schedule was increased by adding a small crew on the third shift. From April 10th to October 4th the mine worked day shift on Saturday in addition to the five day three-shift schedule. On October 4th the five day schedule was resumed and continued to December 6th when the schedule was reduced to four days, three shifts. The crew on the third shift was small and at no time was in excess of 27% of the mining gangs.

The outstanding events at the mine during 1937 were as follows: The increase in working schedules with larger product and heavier shipments, development of the 7th level, start made to reopen the 9th level and alignment of runners in both skip roads in the circular concrete shaft.

Shipments of 476,039 tons from pocket and stockpile were the second largest ever made from the mine and were exceeded only in 1929 when 485,940 tons were shipped. Production of 443,098 tons exceeded by 57,637 tons the previous record of 385,461 tons in 1930.

The large product made this year caused certain areas to be subjected to very heavy pressure. This condition was due to rapid mining on three sides of an area where the jasper hanging was lower than the areas being mined. This caused a concentration of pressure on the unmined area due to release of pressure on the surrounding areas. This pressure was so heavy that it was transmitted to the main level drifts over 100 ft. below and to the raises in and adjacent to the area under pressure. The remedy consists in the rapid development of the area under pressure and the mining of one or two sub levels. In December pressure on one area on the 6th level seriously interferred with production. It is expected that within sixty days this area will be mined on one sub level under the hanging and the pressure relieved.

The safety record in 1937 was good when consideration is given to the heavy working schedule and new employees. The men were kept safety conscious by the cash awards made monthly by drawings provided the mine had no compensable accident in the thirty day period. During the year the Athens had seven drawings which shows seven months accident free and five months in which compensable accidents occurred.

The total cash awards for the year amounted to $485.00 and were distributed to 82 employees or 29% of the average number working at the mine. All the foremen at the mine met every sixty days in a joint safety meeting with the foremen from the other mines at which time the accidents were reviewed and a general discussion held on preventive measures, etc.

There is every reason to believe that the great majority of the employees are loyal and well satisfied with working conditions and the wage scale. The Employees Representatives feel free to present demands made by the men and no appeal has been taken from a decision given to the representatives by the Management.

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2. PRODUCTION, SHIPMENTS & INVENTORIES:

a. Production by Grades:

	1937	1936	Increase
Athens Ore	253,134	167,860	85,274
Mitchell Lease Ore	189,964	143,028	46,936
Total Ore	443,098	310,888	132,210
Rock	19,884	7,871	12,013
Total Hoist	462,982	318,759	144,223

b. Shipments:

Grade of Ore	Pocket Tons	Stockpile Tons	Total Tons	Total Last Year
Athens Ore	127,296	169,572	296,868	179,685
Mitchell Lease Ore	98,474	80,696	179,170	159,009
Total	225,770	250,268	476,038	338,694
Total Last Year	169,541	169,153	338,694	
Increase	56,229	81,115	137,344	

Shipments increased 40.5% in 1937 and were 32,940 tons more than the product for the year.

c. Stockpile Inventories:

Grade of Ore	Dec. 31, 1937	Dec. 31, 1936	Increase
Athens Ore	49,728	38,879	10,849
Mitchell Lease Ore	36,957	17,167	19,790
Total	86,685	56,046	30,639

d. Division of Product by Levels:

The ore hoisted from the various levels was as follows:

		1937 Tons	1937 %	1936 Tons	1936 %
6th Level		398,952	90.0	302,518	97.3
7th "		7,276	1.7	-	-
8th "	(*)	36,870	8.3	8,370	2.7
Total		443,098	100.0	310,888	100.0

(*) Ore trammed and hoisted from the 8th level came from development of the 7th level and from mining above the 6th level on the north side of the fault dike. No ore mined in 1937 from 8th level territory.

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

e. Production by Months:

The production by months was as follows:

Month	Athens	Mitchell Lease	Total	Rock
January	15,886	15,349	31,235	1,193
February	18,632	14,238	32,870	1,771
March	22,442	15,742	38,184	1,868
April	22,193	18,574	40,767	1,700
May	21,289	17,009	38,298	2,224
June	25,640	17,891	43,531	1,708
July	23,636	17,534	41,170	2,284
August	12,294	11,616	23,910	1,372
September	30,282	18,131	48,413	864
October	22,140	15,910	38,050	2,472
November	22,011	16,972	38,983	1,632
December	16,689	10,998	27,687	796
Total	253,134	189,964	443,098	19,884
Total 1936	167,860	143,028	310,888	7,871
Increase	85,274	46,936	132,210	12,013

f. Ore Statement:

	Athens	Mitchell Lease	Total	Total 1936
On Hand Jan. 1, 1937	38,879	17,167	56,046	83,952
Product for Year (*)	253,134	189,964	443,098	310,888
Prior Years' Stockpile Overrun	54,583	8,997	63,580	-
Total	346,596	216,128	562,724	394,740
Shipments	296,868	179,171	476,039	338,694
Balance on Hand	49,728	36,957	86,685	56,046
Increase in Output	85,274	46,936	132,210	
Increase in Ore on Hand	10,849	19,790	30,639	

(*) Includes 7,354 tons overrun from ore hoisted in 1937 and shipped from stockpile.

g. Delays:

Following is a list of delays occurring during the year:

April 8th - 4 hrs. delay - Stopped hoisting and put on new skip rope to replace rope that suddenly showed many broken wires - no loss of product.

May 6th - 2 hrs. delay
May 7th - 24 Hrs. delay
May 8th - 8 hrs. delay - South skip left the guides in the circular concrete shaft late on the night shift May 6th and the two following days the mine was idle while the skip road was repaired - loss of product 2,000 tons.

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

g. Delays: (Cont'd)

Aug. 9th to Aug. 20th - Mine idle 28 shifts or 224 hours while new runners were installed in both skip roads from the collar of the shaft to the bottom of the circular concrete shaft 1,080 ft. below surface. Runners installed in exact alignment correcting distortion of steel sets. Men entitled to a weeks vacation with pay took vacations during the shutdown - loss of product 15,000 tons.

Nov. 8th - 10-1/2 hrs. delay on night shift - One top tram car fell off steel trestle and the other car overturned on switch shortly afterwards. During idle hoisting period ore was accumulated in the transfer raises at the shaft and hoisted the following day - no loss of product.

Nov. 17th - 2-1/2 hrs. delay on 6th level due to main air line breaking account of heavy pressure on timber set which caused a leg to push against the air pipe and break it - no loss of product.

Total delays 275 hours or 34 8-hr. shifts - loss of product 17,000 tons.

h. Delays from Lack of Current:

There were no delays from lack of current in 1937.

3. ANALYSIS:

a. Average Mine Analysis on Output:

	1937				1936			
Grade	Tons	Iron	Phos.	Silica	Tons	Iron	Phos.	Silica
Athens Ore	253,134	60.60	.138	7.38	167,860	61.29	.146	6.33
Mitch.Lease	189,964	60.59	.134	7.24	143,028	61.30	.139	6.38

b. Average Analysis on Straight Cargoes:

Grade of Ore	Tons	Mine Iron	Mine Phos.	Mine Silica	Lake Erie Iron	Lake Erie Moisture
Athens Ore		60.66	.131	7.14		None

c. High Sulphur Ore:

No high sulphur ore was encountered in mining during 1937.

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4. ESTIMATE OF ORE RESERVES:

a. Developed Ore:

Assumption: 12.75 cubic feet equals one ton
10% deducted for rock
10% deducted for loss in mining
Percentage of Bessemer - none

	Athens Lots 1,7,10,12	Mitchell Lots 8, 9, 11	Corbit Lot 13	Total Tons
4th Level and above	259,042	259,606	422,296	940,944
4th Level to 6th Level	826,183	979,021	9,436	1,814,640
6th " to 7th "	742,599	169,903		912,502
7th " to 8th "	551,638	7,814		559,452
8th " to 9th "	403,015			403,015
9th " to 10th "	354,812			354,812
Below 10th Level	49,236			49,236
Total developed ore 12/31/37	3,186,525	1,416,344	431,732	5,034,601

The estimate of developed ore this year has been divided into the various ownerships. It increased 315,409 tons over the estimate of 1936 and with the total product in 1937 (including overruns from shipments of ore stocked in 1937 and prior years) is 822,087 tons higher. This comparatively large increase is due to increase in the size of the ore body between the south footwall and the fault dike in the area being mined above the 6th level and to the development of the 7th level which showed an increase in the ore area over that which had been heretofore used in calculating the ore between the 6th and 8th levels. Most of the ore mined in 1937 came from the area between the 4th and 6th levels and due to increase in size of the ore body the estimated tonnage left in this area at the end of 1937 was only 57,000 tons less than in 1936. The ore reserves between the 6th and 8th levels increased 378,214 tons due to opening the 7th level and accurately defining the limits of the ore body.

c. Estimated Analysis:

Ore Reserves: Approximate Expected Natural Analysis:

Tons	Iron	Phos.	Silica	Mang.	Alum.	Lime	Mag.	Sul.	Igni.	Moist.
5,034,601	52.90	.118	6.40	.400	2.75	.620	.730	.011	1.40	13.00

Ore in Stock: Average Natural Analysis:

Grade	Tons	Iron	Phos.	Silica	Mang.	Alum.	Lime	Mag.	Sul.	Igni.	Moist.
Athens	49728	53.10	.116	6.52	.410	2.75	.62	.73	.009	1.32	12.13
Mitch.L	36957	52.86	.112	6.34	.390	2.73	.61	.72	.009	1.31	12.74

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5. LABOR AND WAGES:

a. Comments:

(1) Labor:

Men were added in 1937 so that the average number of employees increased from 221 in 1936 to 283 in 1937. The maximum number employed in 1937 was 326 which included several temporary employees. Skilled local labor was not available as all the trained miners in Marquette County were employed in 1935 and 1936. Untrained men were put in mining contracts with good miners and will become skilled workers in a few years. There is a good feeling among the employees and they only fear a reduction in the working time. Efficiency was somewhat lowered by the untrained men that were put in the mining contracts.

(2) New Construction:

There was no new construction in 1937.

b. Comparative Statement of Wages and Product:

	1937	1936	Increase	Decrease
PRODUCT	443,098	310,888	132,210	
No. Shifts and Hours	22 1-8 hr.	113 1-8 hr.		91
	46 2-8 hr.	180 2-8 hr.		134
	208 3-8 hr.	-	208	
AVERAGE NO. MEN WORKING:				
Surface	59	50	9	
Underground	224	171	53	
Total	283	221	62	
AVERAGE WAGES PER DAY:				
Surface	5.40	4.21	1.19	
Underground	6.24	5.11	1.13	
Total	6.06	4.89	1.17	
AVERAGE WAGES PER MONTH:				
Surface	121.17	91.17	30.00	
Underground	136.51	102.45	34.06	
Total	133.32	99.90	33.42	
PRODUCT PER MAN PER DAY:				
Surface	27.92	23.95	3.97	
Underground	7.53	7.56		.03
Total	5.93	5.74	.19	
LABOR COST PER TON:				
Surface	.194	.176	.018	
Underground	.828	.676	.152	
Total	1.022	.852	.170	

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5. LABOR AND WAGES: (Cont'd)

b. Comparative Statement of Wages and Product: (Cont'd)

	1937	1936	Increase	Decrease
AVERAGE PRODUCT MINING:				
Stoping	19.98	21.16		1.18
Development in Ore	12.62	11.75	.87	
Total	19.30	20.12		.82
AVERAGE WAGES CONTRACT LABOR	6.95	5.81	1.14	
TOTAL NUMBER OF DAYS:				
Surface	15,872	12,983¼	2,888¾	
Underground	58,837½	41,141¼	17,696	
Total	74,709½	54,124¾	20,584¾	
AMOUNT FOR LABOR:				
Surface	85,787.85	54,700.44	31,087.41	
Underground	366,950.05	210,232.36	156,717.69	
Total	452,737.90	264,932.80	187,805.10	
AVERAGE WAGES PER MONTH AS PER LABOR STATEMENT LESS CAPTAIN AND CLERKS:				
Surface	119.34	89.00	30.34	
Underground	136.16	101.58	34.58	
Total	132.79	98.86	33.93	

Six Cents (6¢) per hour increase in wages effective Nov. 16, 1936.
Ten Cents (10¢) per hour increase in wages effective March 16, 1937.

Proportion of Surface to Underground Men:

1937: 1 to 3.80 - 2 8-hr. shifts 5 days and 5 nights per week Jan. 1st to Feb. 15th.
3 8-hr. shifts 5 days and 5 nights per week Feb. 15th to April 11th.
3 8-hr. shifts 6 days and 5 nights per week April 11th to Oct. 4th.
3 8-hr. shifts 5 days and 5 nights per week Oct. 4th to Dec. 6th.
*2 8-hr. shifts 6 days and 6 nights per week Dec. 6th to Dec. 31st.

(*) To give each man 4 shifts per week.

1936: 1 to 3.42 - 1 8-hr. shift, three days per week, Jan. 1st to Feb. 1st.
1 8-hr. shift, four days per week, Feb. 1st to May 4th.
2 8-hr. shifts, five days per week, May 4th to Dec. 31st.

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. LABOR AND WAGES: (Cont'd)

c. Operating Schedules:

Month	Days Mine Worked Per Week	Days Per Month	Days Men Worked Per Week	Avg. Shifts Worked Per Mo. by Each Man	Size of Crew
January	2 Shifts 5 Days & 5 Nights	23	5	22	
February	2 Shifts to 2/15 5 Days & 5 Nights 3 Shifts from 2/15 to 2/28 5 Days & 5 Nights	22	5	21	Small Crew on 3rd shift
March	6 Days & 5 Nights	24	5	24	"
April	6 Days & 5 Nights	24	6 Day - 5 Night	23	"
(1)May	" "	24	" "	23	"
June	" "	25	" "	23	"
July	" "	26	" "	24	"
(2)August	" "	16	" "	15	"
September	" "	25	" "	23	"
October	5 Days & 5 Nights	22	5	22	"
November	" "		5	22	"
December	6 Days & 6 Afternoon shifts from 12/6 to 12/31/ Gives each man 4 days per week	23	4	19	"
Average for Year		23		22	

5. SURFACE:

a-1. Buildings, Repairs:

The engine house was rewired and new lights installed. Several window frames in the dry house were repaired and one new window installed in the electric cap lamp room. More lockers and clothes hangers installed. Also new copper pipe replaced the old iron hot water pipes.

a-2. Docks, Trestles & Pockets:

Needed repairs were made to the coal dock in the spring before coal was received at the mine. A few rotted legs were replaced.

During the last three months of the year eighteen bents were erected on the wooden stocking trestle located between the two steel trestles. Stocking Mitchell Lease Ore from this trestle started in December. New legs, hemlock plank and twelve 12" X 16" X 30'were purchased. The balance of material for the trestle was on hand.

The tracks on the rock pile were moved from the west side to the east side where the rock pile is now being extended by side dumping. The rock pile had been extended to the west by side dumping to the limit of curve on the tracks.

a-3 Scrap Iron:

One carload of scrap iron was loaded and shipped in the fall.

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5. SURFACE: (Cont'd)

a-4. Shaft House Enclosure:

The shaft house enclosure just above the collar of the shaft was enlarged to provide more room for inspecting, repairing and changing the skips and cage. Galvanized sheet iron was used to enclose the addition so as to make it practically fireproof.

b. Stockpiles:

Practically all the ore in stock under the steel trestles was shipped in 1937 and also the ore under the wooden trestle that had been in stock since 1930. There was a small amount left as a rill under each steel trestle and some scattered over the stocking grounds, in total not to exceed 10,000 tons. The stockpile grounds under the wooden trestle were thoroughly cleaned with tractor and scraper. Athens ore was stocked here in 1930 and this winter Mitchell Lease ore will be stocked here. Shipments ceased in October so that stocking was started earlier than usual.

c. Timber Treating Plant:

The timber on hand in the spring that had been peeled late in 1936 and piled for drying out was treated in April. The plant was then idle until in July when several hundred fir ties were treated for the Negaunee Mine. In September the timber that had been framed, peeled and decked for drying during the early summer was treated and the plant closed down for the season on September 30th. Preparation of the balance of timber on hand was completed in October and 265 legs and caps have been piled to dry out during the winter.

	1937 Cost Per Ft.	1936 Cost Per Ft.	1935 Cost Per Ft.
Peeling	.0466	.0398	.0254
Treating	.0501	.0383	.0326
Decking	.0060	.0060	.0018
Zinc Chloride		.0094	.0157
Chromated Zinc Chloride	.0214	.0240	
Heat, Water, etc.	.0136	.0118	.0096
Total	.1377	.1293	.0851
Maintenance Cost	.0066	.0069	.0030
Grand Total	.1443	.1362	.0881

The total cost for treating timber increased slightly in 1937 due almost entirely to the increase in wages. Larger timber was treated which increased the time required for peeling and reduced the number of pieces treated per day.

Year	No. of Pcs. Hardwood Stull Tbr. Treated	No. of Ft. Treated
1937	1407	12,483
1936	1523	13,233

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6. SURFACE: (Cont'd)

c. Timber Treating Plant: (Cont'd)

	1937	1936
No. of Pcs. Used at Athens	1358	1255
No. of Pcs. shipped to Maas & Neg. Mines	66	444
Total Pcs. Used and Shipped	1424	1699

Less timber was shipped to other mines in 1937 but the Maas Mine asked for 250 pieces for later delivery.

	Treated Tbr. on Hand 12/31/37	Peeled Untreated Tbr. On Hand 12/31/37
9 ft. Pcs.	411	142
8 ft. pcs.	353	123
Special Caps	37	
Total	801	265
On Hand 12/31/36	818	394
Decrease	17	129

d. Water Purchased for Heating, Cooling, etc:

The cost of water purchased from the City of Negaunee the last three years was as follows:

	1937		1936		1935	
	Gallons	Amount	Gallons	Amount	Gallons	Amount
1st Quarter	1,689,000	128.87	288,000	26.69	193,000	19.14
2nd Quarter	1,502,000	115.64	603,000	51.78	318,000	30.84
3rd Quarter	3,214,000	236.17	879,000	71.45	679,000	55.99
4th Quarter	1,799,000	136.23	541,000	45.43	380,000	33.97
Total	8,204,000	616.91	2,311,000	195.35	1,570,000	139.94
Product - tons	443,098		310,888		192,534	
Cost Per Ton	.001392		.000628		.00073	

The amount of City water used at the mine in 1937 was 2.6 times greater than in 1936. The main cause of the large increase was the use of City water in the mine for spraying and drilling in rock and cleaning cars at the shaft pockets. The increased operating schedule accounted for a very small amount of the increase.

e. Grounds:

The grounds at the mine were kept clean and in neat condition in 1937. The shrubbery around the buildings was severely pruned as it had grown so high that it cut off the light at the windows. Late in the year fencing of the automobile parking lot across the street from the office was started but freezing weather prevented completion of the work. The parking grounds will be enclosed with a barbwire fence 8 ft. in height to prevent stealing of gasoline from the employees' automobiles which occurred a number of times in the summer and fall months.

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7. UNDERGROUND:

a. Shaft Sinking:

There was no shaft sinking in 1937.

b. Development:

There was a heavy development program under way all the year in opening the 7th level. This work was started in December 1936 and is not yet completed. In order to provide more working places it was decided, in the fall, to reopen the 9th level to mine the ore in Block No. 2 and this work was started in November. It was decided to abandon the old drifts through the ore body on the 9th level as they had been retimbered many times and the ground was broken and loose 20 ft. to 30 ft. above them. This made it almost impossible to start new raises. Accordingly a new drift was planned to pass through the ore pillar north of the old 9th level drift. One cross-cut to the south will have to be driven and one other drift to the west. The development program on the 9th level will be underway all during the coming year. During 1937 a small amount of development work was done on the 6th level and the subs above the 6th. Also the two transfer raises at the shaft from the 9th to the 10th level were stripped from 4' X 4' in size to 7' X 7' thereby tripling them in storage capacity and also eliminating all danger of blocking.

Development in Rock

415' Sub Level

An intrusion of the hanging jasper into the ore body made it necessary to drift 15 ft. in jasper on this sub level in order to mine the ore.

550' Sub Level

In driving a ventilation and traveling road from No. 611 raise to No. 618 raise and beyond to a point north of the fault dike near No. 607 raise there was 10 ft. of drifting in the fault dike and a single compartment cribbed raise 37 ft. in height in the dike up to the 515' sub level where an old drift connects to No. 607 raise.

Late in the year it was decided to drive a drift south from No. 612 raise to No. 616 raise on the 550' sub level which would be used as a transfer drift for the ore being mined on the subs above from Nos. 614, 615, 616 and 616-A branch raises. These raises are to be connected to the new transfer drift and the ore allowed to run out from the raises on the floor of the drift where it will be transferred by a 25 H.P. high speed scraper hoist to No. 613 raise which was completed in December from the 6th level to the floor of the new transfer drift. The ore will be scraped into the new raise, No. 613, which will hold a motor train of seven cars and due to its being a short raise the ore will not block. This arrangement should result in speeding up mining from these raises which has heretofore been seriously handicapped by the fact that no more than two cars could be dumped in any of the raises without danger of blocking them. The transfer drift is in lean ore, slate and dike and should not take weight as soon as if in ore. The drift advanced 173 ft. in rock.

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7. UNDERGROUND: (Cont'd)

b. Development: (Cont'd)

6th Level

There was no drifting in rock on the 6th level in 1937 and only one raise, No. 613, in No. 610 cross-cut in rock. This raise was extended from the 6th level to the 550' sub level a distance of 76 ft. on a 65° incline. It will be used for handling ore from the new transfer drift on the 550' sub level.

7th Level

All development work in rock on the 7th level has been charged to E. & A. No. 725.

The rock work in 1937 was as follows:

In January 1937 the drift south from the cage compartment of the shaft was stripped and widened for a distance of 100 ft. to make room for a double track and necessary switches. The drift to the transfer raises was also widened and made higher. The total stripping done here was equivalent to 231 ft. of full-sized rock drift. In order to handle the rock from development of the 7th level a raise was put up from the 8th level that holed to the 7th level 50 ft. south of the transfer raises and the top coned out so that the rocker dump haulage cars could be dumped. This raise was completed prior to any rock work on the 7th level. It has a capacity of fifty cars of rock. After widening the old drifts on the 7th level a motor haulage tail drift was extended 78 ft. north to make room for an eight-car motor train at the transfer raises at the shaft. A connection to the two transfer raises was made later by sinking 15 ft. below the level on an incline. This work had to be done carefully so as not to destroy the concrete walls that enclosed the transfer raises across the 7th level drift. Drifting to the ore body started in April and was completed in September when a connection was made to the drift driven from No. 814 raise in the ore body. The advance was 602 ft. in footwall slate and dikes. The rock transfer raise 50 ft. south of the shaft was extended 90 ft. up to the 6th level to handle rock from that level. With two grades of ore and only two transfer raises at the shaft there was formerly no chance to handle rock at the shaft except by cleaning out one of the ore transfer raises. Even when this was done part of the rock lodged in the soft ore left on the footwall of the raise and lowered the grade of ore hoisted later. Rock can now be accumulated in the transfer raise and transferred to the 8th level pocket at the shaft and hoisted any time during the shift.

The drift in the ore body towards the shaft advanced 25 ft. in rock around the curve to put it on a line with the rock drift from the shaft.

No. 1 cross-cut advanced 20 ft. in rock in crossing the fault dike and 36 ft. in the footwall dike on the north side of the ore deposit. It will be extended later 115 ft. in dike and footwall slate to the ventilation raise in rock which extends from the 10th to the 6th level.

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'. UNDERGROUND: (Cont'd)

b. Development in Rock: (Cont'd)

7th Level (Cont'd)

No. 2 cross-cut encountered mixed ore and dike in which it advanced 31 ft. Work was then temporarily stopped until No. 3 cross-cut was completed and will be resumed here in January 1938. This cross-cut will then be advanced 145 ft. in rock to completion.

No. 3 cross-cut encountered an area of mixed ore and dikes that was 38 ft. in width with 40 ft. of ore beyond. The cross-cut then struck mixed dike, slate and ore in which it advanced 25 ft. when the slate footwall was encountered. The cross-cut had been extended 37 ft. in the footwall at the end of the year with 15 ft. more drifting necessary to complete it.

No. 4 cross-cut was extended north to the large dike which bounds the ore body on the North side. It passed through the fault dike which was 18 ft. in thickness.

In only two of the raises put up this year on the 7th level was rock encountered. No. 732 raise in No. 3 cross-cut was started in mixed dike and ore and was extended 38 ft. when it was temporarily stopped. Work will be resumed in this raise early in 1938.

No. 722 raise in No. 2 cross-cut was extended 5 ft. in mixed dike and ore. It will be completed in 1938.

A powder house was cut in rock near the ore contact and ground excavated for a room 12 ft. deep and 10 ft. wide. The rock was soft and to make it secure the walls on three sides and also the back was lined with six inches of concrete. The floor was also leveled with concrete and a steel door installed. The powder house is fireproof and very easy to keep clean.

Two air lock doors were installed in the 7th level drift from the shaft 500 ft. apart. They are the first air lock doors at the Athens to have a separate man-way door on the side of the drift which adds to the safety of any one traveling through the drift when motor trains are moving.

The total feet of rock drifting on the 7th level was 1,151 and total raising in rock 340 ft. The 340 ft. of raising includes No. 812 raise and the rock transfer raise near the shaft on the 8th level both of which were necessary and useful only for the development of the 7th level. The actual raising in rock on the 7th level was 159 ft.

8th Level

In order to speed up the development of the 7th level a new raise, No. 812, located in No. 810 cross-cut, was extended to the 7th level elevation and was used for transferring ore from No. 4 cross-cut on the 7th to the 8th level. It was later used for transferring ore from two raises in No. 4 cross-cut both of which were completed and mining started above the 6th level before the connection to the shaft on the 7th level was

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'. UNDERGROUND: (Cont'd)

b. Development in Rock: (Cont'd)

8th Level (Cont'd)
completed. A rock transfer and storage raise located 50 ft. South of the pocket at the shaft on the 8th level was extended to the 7th level and all the rock encountered in developing the 7th level was handled through this raise. These two raises were extended 181 ft. in rock and this footage is included in the total reported under "Development in Rock" - 7th Level.

9th Level

In November the 9th level rock drift at the shaft was stripped for 100 ft. to make room for a double track from the cage compartment. The double track is necessary to facilitate handling of timber trucks on and off the cage. The rock work done here was equivalent to 25 ft. of full-sized drift. The two transfer raises to the 10th level shaft pocket were stripped from 4' x 4' in size to 7' x 7' in size thereby tripling the storage capacity of the raises and eliminating danger of blocking. This work was equivalent to about 100 ft. of full-size rock raise.

A new drift to the ore body was started in December on a curve from the old drift at a point 50 ft. from the ore contact. The old drift had been retimbered many times and the ground over the timber was loose, also the drift was partly crushed. The advance in December was equivalent to 5 ft. of full-size rock drift.

Combining the footage throughout the mine shows that the total rock drifting was 1,407 ft. and rock raising 442 ft.

Development in Ore

During the year there was a total of 2,637 ft. of drifting and raising in ore as compared with 2,490 ft. in 1936. Drifting in ore increased 450 ft. and raising in ore decreased 303 ft. Most of the development work in ore was on the 7th level while in 1936 it was on the 6th level.

A brief resume of the development work in ore in 1937 is given herewith:

550' Sub Level - Above 6th Level

A ventilation and traveling road drift was driven from No. 611 raise to No. 618 raise and beyond it 10 ft. in the fault dike from which point a raise connected it to a drift to No. 607 raise on the 515' sub level. The drift advanced 157 ft. in ore.

The transfer drift South from No. 612 raise advanced 15 ft. in ore before encountering rock.

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7. UNDERGROUND: (Cont'd)

Development in Ore: (Cont'd)

6th Level:

Two short drifts were driven in ore in 1937 on the 6th level to connect to 7th levelraises to improve ventilation. The drift to No. 741 raise was 20 ft. in length and to No. 742 raise was 32 ft. in length making a total of 52 ft. of ore drifting on this level.

No. 607 Raise

This raise had been extended to the 450' sub level in 1936 where loose ground was encountered. In 1937 it was extended 32 ft. in the loose ground up to the 415' sub level.

No. 608 Raise

This raise, located in the 6th level haulage drift North of the fault dike, was started in July 1937 and completed in November to the 440' sub level, 184 ft. above. The raise was in loose ground nearly all the way which delayed progress and increased the cost per foot. It provides as second raise, the other is No. 607, to the ore body North of the fault dike in the West half of Block 4.

No. 663 Raise

This raise, located in No. 660 drift on the 6th level, was started in February and completed in April at the elevation of the 500' sub level. The raise advanced 95 ft. in ore.

The total ore drifting on the 6th level was 52 ft. and ore raising 311 ft.

7th Level

The main level haulage drift on the 7th level was driven from No. 814 raise a distance of 489 ft. in ore to the Northeast toward the shaft. No. 1 cross-cut advanced 145 ft. in ore to the North, No. 2 cross-cut 121 ft. in ore to the South, No. 3 cross-cut 152 ft. in ore to the South and No. 4 cross-cut 261 ft. in ore to the North. There was also a 15 ft. connection driven from No. 4 cross-cut to No. 811 ventilation raise. Drifting in ore has been completed for mining the ore in Block 3 from the 6th to 7th level.

The main haulage drift, all of No. 4 cross-cut and a portion of each of the other three cross-cuts were developed from two 8th level raises. Ore was scraped to the raises by large scrapers pulled by high speed 20 H.P. and 25 H.P. scraper hoists. The maximum distance ore was moved by two scrapers was about 500 ft. in the main haulage drift or approximately 250 ft. by each scraper unit. The 7th level was developed in one-half the time that would have been required if all of the work had been done from the shaft. There was no increase in the cost per foot.

The total drifting in ore on the 7th level was 1,183 ft.

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'. UNDERGROUND: (Cont'd)

Development in Ore: (Cont'd)

The following is a summary of raising on the 7th level:

No. 741 raise in No. 4 cross-cut, 7th level, total height to 565' sub level 152 ft. - material ore.

No. 742 raise in No. 4 cross-cut, total height to 575' sub level 142 ft., - material ore.

No. 731 raise in No. 3 cross-cut, total height to 550' sub level 162 ft., - material ore.

No. 733 raise in No. 3 cross-cut, height 71 ft. in ore - uncompleted.

No. 721 raise in No. 2 cross-cut, total height to 550' sub level 162 ft., - material ore.

No. 711 raise in No. 1 cross-cut, height 74 ft. in ore - uncompleted.

No. 712 raise in No. 1 cross-cut, total height to 575' sub level 144 ft.

Total raising in ore above 7th level - 909 ft.

The total development in ore on the 7th level, drifting and raising, 2,092 ft.

8th Level

No. 812, a new raise in No. 1 cross-cut 8th level, was put up early in 1937 for handling ore from the development of the 7th level. The last 10 ft. just below the 7th level elevation was in ore.

Total development in ore on the 8th level - 10 ft.

The following table gives location and feet of ore drifting and raising for the mine in the year 1937:

	Drifting in Ore	Raising in Ore	Total
550' Sub Level	172'		172'
6th Level	52'	311'	363'
7th Level	1183'	909'	2092'
8th Level		10'	10'
Total	1407'	1230'	2637'

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7. UNDERGROUND: (Cont'd)

c. Stoping:
(1) General:

In 1937 the product came from Block 3 and the West half of Block 4. Mining was underway the latter part of the year in Block 3 on the North side of the fault dike above the 7th level. The ore body directly South of the fault dike now being mined just above the 6th level will also be mined from 7th level raises within sixty days as two raises from the 7th level have just been completed to the 550' sub level. Mining of the ore body on the South footwall had reached a point sixty ft. above the 6th level at the end of 1937. It is planned to put up raises to this area from the 7th level in 1938 and abandon the 6th level raises.

The ore in the West half of Block 4 was mined above the 6th level on the North and South sides of the fault dike and also on the South footwall. At the elevations mined in 1937 this ore body was divided into three separate bodies, viz., North of the fault dike, directly South of the fault dike and the South footwall. The two ore bodies South of the fault are separated by a mass of jasper hanging. The increase in working time in 1937 and the larger product resulted in the mining of more sub levels than had ever before been mined in a year's time.

The small ore body North of the fault dike in the West half of Block 4 was mined on four sub levels in 1937. One contract mined the two upper sub levels and two mined the two next lower sub levels.

The small ore body directly South of the fault dike in the West half of Block 4 was mined on four sub levels in 1937 by two contracts.

The large ore body on the South footwall in Block 4 was mined on four sub levels in 1937 by four contracts.

The ore body on the South footwall in Block 3 was mined on three sub levels in 1937 with an average of seven contracts working here.

The ore body on the North side of the fault dike in Block 3 was mined on three sub levels by three contracts.

The ore body on the South Side of the fault dike in Block 3 was mined on three sub levels in 1937 by two contracts.

From the foregoing it can be seen that mining was underway in 1937 in six different areas or stated another way, in three areas in Block 3 and three in Block 4. Actually the same three ore bodies separated in one case by the fault dike and in the other by jasper hanging were mined at different elevations in the two blocks.

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'. UNDERGROUND: (Cont'd)

c. Stoping: (Cont'd)
(1) General: (Cont'd)

During 1937 mining was done on twenty-one sub levels which was nearly double the number mined in 1936. An effort was made to separate the contracts so as to give each gang a larger area to mine. Radial slicing was followed wherever possible but due to the layout of raises on the 6th level and the shape of the ore bodies this was not practical in many cases. The narrow ore bodies will be mined above the 7th level lengthwise instead of crosswise in their narrow dimension as was the case above the 6th level. Long slices increase the tons stoping and the 7th level raises have been located to make the slices average 80 ft. or more in length.

(2) Detail of Stoping:

To make the report on stoping clearer and easier to follow, each area is reported separately the same as was done in the 1936 annual report.

North Side of Fault Dike - West Half of Block 4

Mining of this small ore body was started at the jasper hanging in 1936 and was not quite finished on the 4th level elevation at the end of the year. After finishing on the 4th level the 405' sub level was mined by one contract working from No. 607-A transfer raise. The ore was transferred to No. 607 raise on the 450' sub level. By the time the 405' sub level was mined No. 607 raise had been extended in loose ground from the 450' sub to the 415' sub level elevation. The 415' sub level was opened and mined from No. 607 raise and also from No. 607-A transfer raise which permitted two contracts to work here. At the end of the year mining had been completed on the 415' sub level and all the ore except one small pillar had been mined on the 430' sub level. When mining is completed on the 430' sub level the transfer of ore on the 450' sub level will be abandoned as another raise, No. 608, has been put up from the 6th level to the 440' sub level elevation. When the 440' sub is opened in January 1938 one contract will mine from No. 608 raise and one from No. 607 raise. This ore body has been very irregular in shape due to inclusions of jasper hanging on the North side. It is bounded on the South by the fault dike, on the East by a dike, on the North by jasper and dike and on the West by the mined area in Block 3. The width is increasing while the length is decreasing which is slightly increasing the size of the ore body. Good ventilation is maintained in this area as No. 607-B transfer raise is connected to the 4th level main exhaust airway. The small size of the ore body has made it impossible to obtain average output and cost per ton.

South Side of Fault Dike - West Half of Block 4

Mining of this area was started under the hanging in 1936 and several small sub levels mined. Mining was finished on the 450' sub level in January 1937 and by the end of the year mining had been completed on the 460', 470' and 485' sub levels. This ore body has been quite irregular in shape due to inclusions of the hanging jasper. The jasper has finally disappeared on the North side near the fault dike and is expected to disappear on the South side on the 500', the next lower sub level. The ore is cut off to the west by the mined area in Block 3 and to the East by the mining limit set for the West half of Block 4. The small size of the ore body made it possible to mine three sub levels in one year with only two contracts working.

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7. UNDERGROUND: (Cont'd)

c. Stoping: (Cont'd)
(2) Detail of Stoping: (Cont'd)

South Side of Fault Dike - Ore Body on South Footwall - West Half of Block 4

Development of this ore body was started from the 6th level in 1935 and the top sub level at the elevation of the 4th level was 90% mined at the end of 1936. In 1937, mining was finished at the 4th level elevation and also on the 405' and 415' sub levels. Mining was started on the 430' sub level where the ore was found to extend to the West under the hanging and connect with the area mined in Block 3. On the subs above, the hanging cut off the ore to the West except in a small area on the South footwall where the ore extended to the 4th level elevation. Unusual care has been taken in this area to pole down the floors of the sub levels, also the floors of the two top sub levels were entirely covered with wire fencing. The wire fencing is now used only in the areas under new hanging. Mining in this area has been handicapped all year from the ore blocking and hanging up in the 180 ft. raises. It finally became necessary to limit the ore in each raise to not over two tram cars otherwise it blocked so tightly that blasting was necessary to loosen it. A train of empty cars has been left under the raises on the 6th level and filled while a loaded train was taken to the shaft. The cars were spotted at the raises with a hoist and pull rope while the motor was at the shaft. Even this arrangement did not entirely eliminate delays in scraping the ore to the raises. To overcome the delays a transfer sub level was being driven at the end of 1937 on the 550' sub level elevation which is reported under "Rock Drifting". The transfer sub level, located about 60 ft. above the 6th level, will permit scraping to be a continuous operation and should speed up mining materially in this area. Scraping distances from the four raises in this ore body average 80 ft. or more in length which is in accordance with the late developments in mining practice. With the elimination of all delays the results in tons per man stoping should be above the average at the mine. During part of the year five contracts worked here, at the end of the year four were working.

South Side of Fault Dike - Ore Body on South Footwall - Block 3

This area was opened for mining in 1935 in a small area at the 4th level elevation. Mining was continued through 1936 by which time it had been mined down to the 485' sub level where a few pillars remained at the end of 1936. The 500' sub was also being developed for mining at this time. In 1937 mining was finished on the 485' sub and also on the 500' sub level. The ore on the 515' sub level was all mined except two small pillars on the North side of the ore area while the 530' sub had been opened in the south area and was 25% mined at the end of the year. This area was reached by ten raises in 1936 and one, No. 663, was extended to the 500' sub level in 1937. At the end of 1937, five of the eleven raises were out of commission, one was abandoned on account of being in the footwall at the 515' sub level and four had crushed beyond repair. The hanging jasper on the West side of the ore area swung back to the East above No. 660 drift on the 6th level but further North turned back again to the West. As a result ore was mined to the East, South and North in the area above No. 660 drift, leaving a jasper pillar above the drift. The release of pressure on three sides intensified the pressure on this drift which crushed and the pressure also crushed the four raises in the drift. The

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. UNDERGROUND: (Cont'd)

c. Stoping: (Cont'd)
(1) Detail of Stoping: (Cont'd)

pressure was finally relieved when the ore over the drift was mined under the jasper. Two of the raises were repaired and in use again at the end of the year making eight raises available for mining this area. Due to retreating on a 70° angle from the pillar on the foot side to eliminate danger of loss of ore due to caving, the length of slices has decreased on the East side on each succeeding sub level. On the 530' sub level they are only 30 ft. in length and every other raise is used for mining in this area in order to increase the length of the slices. At the end of 1937 three gangs were mining from the raises on the East side of No. 620 cross-cut, two from the raises on the West side and two from the raises in No. 660 cross-cut, making a total of seven contracts in this area of which two were mining on the 515' sub and five on the 530' sub level. Before the end of 1938 this area will be mined from 7th level raises.

South Side of Fault Dike - Block 3

At the end of 1936 mining was finished on the 530' sub level in this area. In 1937 the 540' sub level was mined and the East end of the 550' sub level was also opened and partially mined. Only two contracts worked in this area during the year as it was desired to hold back mining here until mining further south on the South footwall had reached a corresponding elevation. These two ore bodies join in the East half of the area and are separated in the West half by hanging jasper. In 1938 this area will be mined from 7th level raises.

North Side of Fault Dike - Block 3

At the end of 1936 mining had been 70% completed on the 550' sub level. In 1937 mining was finished on the 550' sub level and 80% completed on the 565' sub level. The 575' sub level has been opened from two 7th level raises and about 40% of the sub level area mined at the end of 1937. Only two pillars remain to be mined at the East end of the 565' sub level and a raise from the 7th level will reach this elevation in less than a week after which the balance of ore in the two pillars will be mined from the 7th level raise. On the 6th level this ore body was developed from five raises equally spaced along the center line of the long dimension. The ore body is about 325' in length with an average width of 95 ft. The 7th level raises were put up from No. 1 cross-cut near the East end and No. 4 cross-cut near the West end. The 7th level raises therefore face the long dimension which will make the slices average about 80 ft. in length as compared to 45 ft. from the 6th level raises. Tons stoping from the 7th level raises at the West end of the ore body on the 575' sub level have averaged 25% higher than those obtained from mining from the 6th level raises at the East end of the 565' sub level.

All work done on the 6th, 7th, 8th and 9th main levels has been reported under "Development in Ore and Rock".

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7. UNDERGROUND: (Cont'd)

Underground Repair Work:

The extent of repair work required at the mine in 1937 warrants special comment and it is included in the report under the above heading.

On account of the depth from surface and the character of the Athens ore, pressure has always been excessive on the drifts. The ground presses on all sides of the opening made by the drifts. The caps break from back pressure and the legs either break from back or side pressure or are pushed out into the drift. The floors rise and if not dug down will in time entirely close the drift. The past year a new situation developed that intensified the pressure on certain areas. This was due to irregularities in the hanging jasper which left areas of jasper directly over the drifts with mined areas on three sides of the jasper. This resulted in tremendous pressure that was transmitted to the level, in one case through a 100 ft. pillar. To relieve this condition it was necessary to mine out a sub level under the jasper hanging at a lower elevation than was being mined on the three sides. The difficulty in mining this lower area arose from the fact that it was almost impossible to maintain raises in the area. In several cases raises were repaired and by the time the work was completed to the top of the raise the bottom would again be crushed.

Maintenance of the drifts on the 6th level under the two areas subjected to this unusual pressure has been very costly and almost a never-ending problem. At times new green caps up to 18" in diameter would break within 72 hours. The pressure on one 6th level area was definitely relieved as soon as the area above the drift was mined and every effort is being made to obtain relief in the other area where a similiar condition developed late in the year. Conditions became so bad in December that mining above No. 610 cross-cut on the 6th level was stopped the third week of the month and all the contracts moved down to repair the 6th level drift and the curve to No. 610 cross-cut. When this work is completed, probably by the fifth of January, the contracts mining above No. 620 cross-cut will repair the 6th level drift between No. 610 and No. 620 cross-cuts which will require ten days at least. In this repair work a new plan is being tried out which consists in removal of ground in the form of a triangle or inverted "V" above the caps of the timber sets. Large poles are used for back lagging directly over the sets and the timber sets are loosely blocked to the back directly over the caps. This gives an open space to be filled before the pressure comes on the caps. The sides are left open three feet above the floor so that the side pressure can partially be relieved by pushing the ore out into the drift without involving the legs of the timber set.

Two other factors that effected the pressure in certain areas should also be mentioned, - one is the rapid rate of mining that did not give the ground time to settle and the other is the lime in the ore which causes the ground to swell and break off in large slabs. These two were contributary to the other causes but by themselves would not have been serious. In order to keep up production and make repairs it was necessary to hire more men which increased the number of employees on dead work. The heavy operating schedule handicapped the repair work as the mine was never idle during the week and repairs had to be made on the main levels while haulage was underway.

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7. UNDERGROUND: (Cont'd)

Underground Repair Work: (Cont'd)

A brief summary of repair work follows:

4th Level

This old level is the main exhaust airway to the shaft and must be kept open. Fortunately it is not under heavy pressure and the repair work in 1937 consisted mainly in replacement of timber that had rotted.

Sub Levels Above 6th Level

Two repair gangs worked the entire year installing lining sets and replacing broken timber in the airway drifts connecting to the exhaust airway raises from the 6th to the 4th level and in the airway and traveling road drifts connecting the three ore areas being mined in the West half of Block 4. At times it was necessary to increase the number of gangs repairing. Late in the year unusual pressure of the jasper mass above No. 610 cross-cut crushed the main exhaust airway on the 550' sub level in spite of the many large props that were installed in an effort to keep it open. A new drift to the airway raises will be driven when the pressure is relieved.

6th Level

This level has been under unusual pressure in two areas and in addition the East-West haulage drifts have been under pressure due to mining on the North and South sides of the fault dike in Block 3 only a short distance above the 6th level. These conditions when combined caused an extraordinary amount of repair work on the level in 1937. All the year two or more repair crews have worked here and in the latter months of 1937 the number was increased to as high as six repair crews. In addition to the repair work on the main level a large number of raises were recribbed, some twice during the year. Under the heavy pressure the cribbing break and are pushed inward until the raise closes. Ground has to be blasted to make room to install new cribbing. It is hoped to eliminate a great deal of the repair work by the transfer of mining to the 7th level raises which had been done at the end of the year North of the fault dike in Block 3 and will be done directly South of the fault dike early in the new year. It is hoped that the diversion of ore to the 7th level together with the relief of the extraordinary pressure above the main drift between No. 610 and No. 620 cross-cuts will reduce the repair work 50% in 1938.

7th Level

In one area on the new level the timber is breaking and is now being repaired and lining sets installed. The breakage here is due to lime in the ore which causes large slabs to break and crush the timber.

8th Level

This level was used for haulage of the ore from the development work on the 7th level in the ore body. Some repair work was required replacing rotted timber and in a few areas to raise the back and install 9 ft. legs to make room for tramming well-filled cars.

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7. UNDERGROUND: (Cont'd)

Underground Repair Work: (Cont'd)

9th Level

Some repair work on this level was necessary in connection with the reopening of the level. The new drift to the ore body turns off near the ore contact and the old drift was timbered with 8 ft. timber through the soft rock near the turn-off. The back was raised and the drift widened for 9 ft. timber for 50 ft. before the new drift was started.

10th Level

Only a few lining sets were installed on this level in 1937. Treated timber is used exclusively in the portion of this old level which is kept open.

To bring out the cost of repair work the following table, giving the number of men, hours worked and labor cost per month is included. Some of the time was spent in timbering over raises when a new sub level was opened but the greater part was incurred in the work referred to in the preceding paragraphs.

Month	No. Men	Hours Worked	Amount
January	35	885¼	$ 4,341.62
February	32	834¼	4,053.73
March	32	816½	4,349.26
April	38	806	5,193.36
May	38	898¼	5,322.28
June	30	714	4,254.99
July	36	901	5,442.83
August	41	1243¾	7,434.57
September	43	1083½	6,451.76
October	44	1104	6,618.48
November	44	1139	6,772.72
December	52	1335	7,787.84
Total	465	11,760½	68,023.44
Avg. Per Month	39	980	5,668.62

d. Timbering:

The cost per ton for timber decreased in 1937 due to the larger product and a decrease of nearly 50% in the amount of cribbing timber used. The cost per ton was the lowest in seven years or since 1930. The average cost per foot for all stull timber increased 44% in 1937 and the feet of timber per ton of ore decreased nearly 56%. The lineal feet of timber used in 1937, including cribbing timber, was 26,033 ft. less than in 1936 but the amount of cribbing timber decreased 79,762 ft. in 1937. The lineal feet of stull timber used in 1937 exclusive of cribbing timber, was 191,244 ft. as compared with 137,515 ft. in 1936 or an increase of 39%. The increase in product in 1937 was 42½% which shows slightly less timber used per ton of ore mined after excluding the cribbing timber. Nine foot timber was exclusively used in mining which increased the tons produced per set of timber. This undoubtedly accounts for the slightly lower amount of timber used per ton of ore. The timber used in repair work does not have much influence on timber costs for the main expense in repair work is for labor and actually not a great deal of timber is required. The increase of 144% in the amount of 8" timber used in 1937 was largely due to using this size timber for building bulkheads or timber pillars around the

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7. UNDERGROUND: (Cont'd)

d. Timbering: (Cont'd)

raises where the ore was mined by radial slicing and also for props in drifts. Ten inch to twelve inch timber is the minimum size used for timbering drifts and slices.

Statement of Timber Used:

	Lineal Feet	Avg. Price Per Foot	Amount 1937	Amount 1936
6" to 8" Cribbing	88,803	.0380	3,378.86	5,549.34
8" to 10" Stulls	36,810	.0721	2,655.72	854.07
10" to 12" "	89,069	.1006	8,962.35	5,593.71
12" to 14" "	45,658	.1333	6,089.22	4,185.32
14" to 16" "	8,099	.1328	1,089.11	760.01
Treated Timber	11,608	.2879	3,341.96	2,400.19
Total 1937	280,047	.0911	25,517.22	
Total 1936	306,080	.0632		19,342.64
7' Lagging	1,138,702	.8027 C	9,140.77	5,839.39
9½' Poles	1,051,125	1.3863 C	14,572.47	10,276.74
Total 1937	2,189,827	1.0829 C	23,713.24	
Total 1936	1,658,618	.9717 C		16,116.13
Wire Fencing	9,900		533.20	261.00
Grand Total 1937			49,763.66	
Grand Total 1936				35,719.77
PRODUCT			443,098	310,888
Ft. Timber per Ton of Ore			.6320	.9845
Ft. Lagging " " " "			2.5698	2.7528
Ft. Poles " " " "			2.3722	2.5823
Ft. Lagging per Ft. of Timber			4,0661	2.7961
Cost Per Ton for Timber			.0576	.0622
" " " " Lagging			.0206	.0188
" " " " Poles			.0329	.0331
" " " " Wire Fencing			.0012	.0008
" " " " Timber, Lagging, Poles & Fencing			.1123	.1149
Equivalent of Stull Timber to Board Measure			527,637	608,310
Ft. of Board Measure per Ton of Ore			1.1907	1.9567
Lin. Ft. of Fencing per Ton of Ore			.0223	.0159
Sq. Ft. " " " " " "			.0931	.0663

Total Cost for Timber, Lagging, Poles, etc:

Year	Amount	Cost Per Ton
1937	49,763.66	.1123
1936	35,719.77	.1149
1935	22,585.11	.1173
1934	19,546.06	.1201
1933	11,372.50	.2401
1932	11,794.89	.1541
1931	28,704.68	.1141
1930	38,001.66	.0985
1929	34,833.71	.1015
1928	29,160.74	.1207

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7. UNDERGROUND: (Cont'd)

e. Drifting and Raising:

The following statement gives comparative figures of footage for drifting and raising in 1937 and 1936:

	Drifting			Raising			Grand
Year	Ore	Rock	Total	Ore	Rock	Total	Total
1937	1407'	1379'	2786'	1230'	442'	1672'	4458'
1936	957'	198'	1155'	1533'	721'	2254'	3409'
Increase	450'	1181'	1631'				1049'
Decrease				303'	279'	582'	

In 1937 drifting increased 141% and raising decreased 26%. The increase in the total of drifting and raising was about 31%. The large increase in drifting was due to the development of the 7th level.

f. Explosives, Drilling and Blasting:

The pounds of powder required to break one ton of ore was practically the same as in 1936 but the cost per pound for powder increased 7% and the cost per ton for powder 7%. There was a small decrease in the cost per ton for fuse, caps, etc. The cost per ton for all explosives increased 3.9%. The cost in 1935 was .0524, in 1936 was .0536 and in 1937 was .0557. The increase in length of fuse in the summer of 1936 accounts for most of the increase as compared with 1935 as the cost per pound for powder was about the same in these years. There was more steel ore encountered under the hanging in 1937 which slightly increased the pounds of powder per ton of ore. The cost for all explosives of .0557 is the fourth year in succession that the cost has run below .056 per ton.

Statement of Explosives Used: (Ore Development and Stoping)

	Quantity	Average Price	Amount 1937	Amount 1936
50% Gelatin	167,000	11.85	19,782.51	12,853.38
60% "	600	11.50	69.00	135.75
Total Powder 1937	167,600	11.84	19,851.51	
Total Powder 1936	117,350	11.07		12,989.13
Fuse - Ft.	646,500	5.63	3,642.52	2,530.85
Caps - No. 6	87,625	11.93	1,045.21	744.14
Tamping Bags	24,000	2.02	48.50	47.98
Fuse Lighters	15,200	6.65	101.12	63.44
Connecting Wire - ft.	40	.40	16.00	4.00
No. 14 Duplex Lead Wire - ft.	500	14.00	7.00	
Electric Caps & Delays				283.75
Total Fuse, etc. 1937			4,860.35	
Total Fuse, etc. 1936				3,674.16
Total All Explosives - 1937			24,711.86	
Total All Explosives - 1936				16,663.29

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7. UNDERGROUND: (Cont'd)

f. Explosives, Drilling and Blasting: (Cont'd)

	Amount 1937	Amount 1936
PRODUCT	443,098	310,888
Pounds Powder per Ton of Ore	.3782	.3775
Tons of Ore per Lb. of Powder	2.643	2.649
Cost per Ton for Powder	.0448	.0418
Cost per Ton for Fuse, Caps, etc.	.0109	.0118
Cost per Ton for All Explosives	.0557	.0536

Sinking, Rock Development, Etc.

	Quantity	Avg.Price	Amount	Amount
50% Gelatin	1,250	11.35	141.88	407.27
60% "	18,900	12.43	2,349.75	570.50
Total Powder - 1937	20,150	12.36	2,491.63	
Total Powder - 1936	8,850	11.44		977.77
Fuse - ft.	46,300	5.65	261.62	219.66
Caps - No. 6	6,375	12.01	76.58	51.59
Electric Caps & Delays	750	9.85	73.90	80.37
Connecting Wire	20	.40	8.00	7.50
Shot Firing Cord - ft.	1,000	11.40	11.40	
Tamping Bags				.63
Total Fuse, etc. - 1937			431.50	
Total Fuse, etc. - 1936				359.75
Total All Explosives - 1937			2,923.13	
Total All Explosives - 1936				1,337.52
Total Explosives Used in Mine - 1937			27,634.99	
Total Explosives Used in Mine - 1936				18,000.81
Avg. Price per Lb. for Powder			.1190	.1109

g. Mining and Loading:

In only one of the six separate areas mined during the year was the scraping distances from the raises in accordance with the latest mining practice. At the end of the year the second area was approaching this goal and in 1938 the third and fourth areas will attain it. This will leave two areas, one on each side of the fault dike in the West half of Block 4 where the scraping distances are short due to the ore body being small in size.

The layout of haulage drifts on the levels, the location of raises and the size and shape of the ore body are the factors that control scraping distances. The old levels at the Athens were not planned for present day practice as they preceded the introduction of scraper hoists by more than ten years. The new 7th level has been planned for long scraping distances and also the new drifts on the 9th level. The gain due to the modern layout will be apparent in the increased tons per man per day stoping.

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7. UNDERGROUND: (Cont'd)

g. Mining and Loading: (Cont'd)

There was only slightly less expense in 1937 for covering down the floors of sub levels under new hanging. Four of the six areas being mined were advancing under new hanging all the year. Next year only two areas will be advancing under the jasper hanging.

In 1937, one 25 H.P. and two 20 H.P. scraper hoists were purchased, also four 15 H.P. hoists. In the future only 20 H.P. hoists will be purchased as the larger units are necessary for the longer hauls.

Water sprays were used in many of the raises to help preserve the cribbing from rotting. In some cases it seemed to act as a lubricant and prevent the ore from blocking in the raises. It did not prove to be beneficial in the long raises, 160 ft. to 180 ft. in height, where the ore packs so tightly that it has to be blasted out.

h. Ventilation:

Ventilation in the mine was good in most of the areas mined in 1937. It was hot in the areas North and South of the fault dike in Block 3, until the 7th level raises were holed to the 6th level after which doors in the 6th level drifts forced the air up to the sub levels and the hot air out. Several booster fans were in operation for short periods in areas that were hot but on the whole the air was quite good on the sub levels and at no time deficient in oxygen or high in CO_2. Some expense was incurred in 1937 for maintenance of exhaust airway drifts above the 6th level and a start was made in driving a drift in rock from the end of No. 1 cross-cut on the 7th level to the main rock airway raise that extends from the 10th level to the 6th level. It is necessary to maintain airway drifts between the various areas being mined above the 6th level in order to provide outlets for the air to the raises through which it exhausts to the 4th level. The cost per ton for ventilation was the same in 1937 and 1936.

i. Pumping:

The pump at the Breitung operated the entire year except from August 2nd to August 17th when it was out of commission due to a burnout of the motor. A new pump was ordered as it was impossible to fix the other pump without a long delay in pumping. The pump which was burned out has been repaired and will be used as a spare. It is planned to change the pumps every eighteen months in order to clean and dry out the motor which, it is hoped, will prevent future burnouts.

The average water pumped at the Athens only increased one gallon per minute in 1937 - from 256 in 1936 to 257 in 1937.

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7. UNDERGROUND: (Cont'd)

i. Pumping: (Cont'd)

The following table gives data on pumping at the Athens and Breitung shafts:

Period	Avg. K.W. Per Day - Athens	K.W.Per Month Breitung Pump	Avg. Gals.Per Min. - Athens	Total Cost Both Mines From Athens Cost Sheet
January	2757	2800	244	$ 1643.34
February	2900	2700	239	1527.30
March	2755	2500	237	1596.36
April	2790	3200	242	1675.94
May	3094	6900	266	1894.07
June	3133	4800	269	1741.57
July	3143	4000	271	1795.46
August	3165	1100	271	1853.43
September	3094	3500	263	1832.87
October	3040	2600	262	1766.23
November	3045	2600	260	1822.31
December	3123	2700	263	1840.51
Avg. Cost in 1934 prior to pumping at the Breitung				2611.79
Avg. Last 6 Mos. 1935	3103	4366	265	2087.93
Avg. First 8 Mos. 1936	2967	3912.5	255	1790.04
Avg. First 8 Mos. 1937	2967	3500	255	1715.95
Avg. Last 6 Mos. 1936	2999	3383	262	1776.35
Avg. Last 6 Mos. 1937	3101	2750	265	1818.46
Avg. Year 1936	2949	3583	255.5	1766.08
Avg. Year 1937	3003	3283	257	1749.12
Saving in 1935 when expense was heavy account of installing pump at Breitung				2600.59
Saving in 1936				10148.52
Saving in 1937				10352.04
Total saving in three years				23101.15

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7. UNDERGROUND: (Cont'd)

i. Pumping: (Cont'd)

The number of gallons pumped at the Athens Mine per minute in each month of the year for the past seven years is given in the following statement:

Month	1937	1936	1935	1934	1933	1932	1931
January	244	242	367	318	372	278	243
February	239	244	361*	317	358	286	244
March	237	235	313	313	340	296	250
April	242	238	292	307	326	307	253
May	266	261	290	329	365	312	255
June	269	274	293	361	416	326	282
July	271	284	288	373	422	597	262
August	271	266	278	360	411	542	263
September	263	258	263	356	399	486	262
October	262	261	261	354	356	431	263
November	260	255	253	355	342	402	268
December	263	249	249	355	326	391	274
Average	257	256	292	341	369	388	260

(*) Pumping started at the Breitung shaft.

j. Shaft:

Ordinary maintenace work was continued in the shaft until in May when the South skip partially dumped in the shaft near surface and damaged a number of the guides and steel sets. The mine was idle on Friday and Saturday, May 7th and 8th, and work was resumed on Monday, May 10th. It was decided to stretch a line from surface to the top of the square shaft 1,080 ft. below and measure from the line to the guides to accurately locate them in both the North and South and the East and West planes. After this was done in both skip roads the measurements were plotted and the actual location of the guides were determined. A number of the steel sets were out of line and the displacement was carried to the guides which are bolted to the steel dividers. It was found that the error could be corrected in the North and South plane by sawing the guides with a band saw to make the correction in one plane and in the East-West plane by offsetting the guides. It was decided to prepare new guides for each skip road from surface to the top of the square shaft 1,080 ft. below which required the preparation of 4,320 lineal feet of guides. A strip of oak 3/4" x 4" was inserted on the side of the guides having the greatest amount of wear from the shoes on the skip. The guides were ready for installation early in August and the mine was closed down from August 8th to August 20th while the old guides were removed and the new ones installed. Every guide was numbered and the offset marked on the side of the guide. The work was done on continuous eight-hour shifts. A special steel cage was made 24 ft. in length with two decks which was set above the skip and fastened to the bale of the skip. This long cage enabled work to be done on both ends of the guide at one time and helped in handling the guides and speeding up the work. When hoisting was resumed the skip rope no longer whipped in the shaft and the skip operated as smoothly as in any of the mines.

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7. UNDERGROUND: (Cont'd)

j. Shaft: (Cont'd)

After this job was completed the badly worn guides in the square shaft were replaced so that at the end of the year the skip roads were in fine condition from surface to the bottom of the shaft 2,500 ft. below surface.

8. COST OF OPERATING:

a. Comparative Mining Costs:

	1937	1936	Increase	Decrease
PRODUCT	443,098	310,888	132,210	
Underground Costs	1.268	1.131	.137	
Surface Costs	.216	.207	.009	
General Mine Expenses	.185	.159	.026	
Cost of Production	1.669	1.497	.172	
Taxes	.179	.211		.032
TOTAL COST	1.848	1.708	.140	
No. of Days Operated	276	293		17
No. Shifts & Hours	22 1-8 hr.	113 1-8 hr.		91
	46 2-8 hr.	180 2-8 hr.		134
	208 3-8 hr.		208	
Avg. Daily Product	1605	1061	544	

COST OF PRODUCTION:

	1937	%	1936	%	Increase
Labor	1.035	62.0	.873	58.3	.162
Supplies	.634	38.0	.624	41.7	.010
Total	1.669	100.0	1.497	100.0	.172

b. Detailed Cost Comparison:

(1) Days and Shifts:

Year	Days Mine Worked	Shifts & Hours	Men Employed	Total Shifts Worked
1937	276	1,2 & 3 8-hr.	283	74,709 1/2
1936	293	1 & 2 8-hr.	221	54,124 3/4
Increase			62	20,584 3/4
Decrease	17			

(2) Wages:

There was an increase of six cents (6¢) per hour effective 11/16/36.
There was an increase of ten cents (10¢) per hour effective 3/16/37.