GARDNER-MACKINAW MINE.

COMPARATIVE WAGES AND PRODUCT.

	6 Mos. 1919.
PRODUCT	69,326
No.Shifts and Hours	2-8hr.
AVERAGE NO.MEN WORKING	
Surface	16
Underground	46
Total	62
AVERAGE WAGES PER DAY	
Surface	5.02
Underground	5.73
Total	5.55
WAGES FOR MONTH	
Surface	125.50
Underground	143.25
Total	138.75
PRODUCT PER MAN PER DAY	
Surface	14.78
Underground	5.12
Total	3.80
LABOR COST PER TON	
Surface	.340
Underground	1.120
Total	1.460
AVG. PRODUCT BRK'G & TRM'G	5.81
" WAGES CONTRACT MINERS	6.46
" " " TRAMMERS	0
" " " LABOR	6.46
TOTAL NO. DAYS	
Surface	4,688
Underground	13,552¼
Total	18,240¼
AMOUNT FOR LABOR	
Surface	23,547.61
Underground	77,668.37
Total	101,215.98

This mine started on an operating basis July 1, 1919.

GARDNER - MACKINAW MINE.

TIMBER STATEMENT FOR YEAR ENDING DECEMBER 31, 1919.

KIND.	LINEAL FEET.	AVG.PRICE PER FOOT.	AMOUNT 1 9 1 9.
6" to 8" Timber	5,836	.03	175.08
8" to 10" "	2,067	.04½	93.08
10" to 12" "	3,416	.064	228.25
12" to 14" "	2,672	.082	219.20
14" to 16" "	32	.11	3.52
Total - 1919	14,023	.0506	710.13
	LINEAL FEET.	PER 100'.	
5' Lagging	30,600	.515	157.50
7' "	10,727	.404	43.35
8' "	33,372	.637	212.46
Total Lagging	74,699	.553	413.31
Poles 8'	1,296	.85	11.01
Total - 1919	75,995	.558	424.32

Product	55,829
Feet Timber per ton of ore	.251
Feet Lagging "	1.338
Feet Lagging per foot of Timber	5.33
Cost per ton for Timber	.013
" Lagging	.007
" Poles	.000
" Timber, Lagging & Poles	.020
Equivalent of stull Timber to Bd,Measure	31,345
Ft.Bd.Measure per ton of ore	.561
Total cost for Timber,Lagging & Poles - 1919	1134.45

This statement covers 6 Mos.only; mine put on operating basis July 1,1919.

GARDNER-MACKINAW MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

K IND.	QUANTITY.	AVERAGE PRICE.	AMOUNT 1 9 1 9.
50% Powder, Red Cross,	7,600	.1715	1303.78
50% " Gelatin,	29,550	.1925	5687.81
60% " "	38,350	.20667	7926.74
Total Powder,	75,500	.1976	14918.33
Fuse,	150,570	.958	1443.07
Caps,	17,650	1.41	248.38
Cap Crimpers,	17	.569	9.67
Tamping Bags,	5,300	2.019	10.70
Total Fuse, Etc.			1711.82
Total Explosives,			16630.15
Product,			55,829
Pounds Powder per ton of Ore,			1.352
Cost per ton for Powder,			.267
" Fuse, Caps, Etc.			.031
" All Explosives,			.298
Avg. Price per Lb. for Powder,			.1976

This statement covers 6 months only; Mine put on operating basis July 1,1919.

Cost per ton for powder is very high, due to system of mining, the ore being accumulated in the stopes; also the ore in this mine is harder than other mines in the district.

GENERAL SURFACE

Gwinn District Crushing Plant.

The work of overhauling the plant, in preparation for the seasons operations, was started the last of March. Only minor repairs were required at this time; these consisted mainly of replacing worn out plates in chutes and pockets. Some repairs were also made to the rollers on the belt conveyor. In June it was decided to build pockets under the belt conveyor to catch the ore which fell off the belt. This work entailed an expense of about $300.00, but during the operating season it reduced the cost of cleaning up by several times this amount. The dirt which falls from the belt is now caught in these pockets and run off into a tram car, in which it is trammed back and dumped on the belt again.

The crusher was operated on single shift during the past summer. It started operating on June 3rd and was closed down on November 25th. Shipments were small, so that the crusher did not operate nearly to capacity, except in the month of September, when 41,470 tons were crushed.

The following is a summary of operations in 1919:

NAME OF MINE	TONS CRUSHED ⊖ YEAR
Princeton,	21,577
Gwinn,	67,702
Francis,	26,936
Gardner-Mackinaw,	32,333
Austin,	2,334
Stephenson,	1,965
TOTAL,	152,847

The following table gives comparison of operations for the years 1919-1918:

				Decrease	Increase
Year 1919	Tons Crushed,	152,847			
" 1918	" "	284,996		132,149 tons	
			Per Ton.		
Year 1919	General Expense,	612.85	.004		
" 1918	" "	987,16	.003		.001
Year 1919	Maintenance	2574.52	.017		
" 1918	"	2484.99	.009		.008

			Cost Per Ton.	Decrease	Increase
Year 1919	Operating	4587.50	.030		
" 1918	"	8291.75	.029		.001
Year 1919	Total Optg.	13748.53	.090		
" 1918	" "	23514.28	.082		.008

Average Tons Crushed per Day,	1428
Number of Days Operated,	107
Shifts, Number Hours,	1 - 10-hr.
Number days Idle,	45
Rated Capacity of Crusher per 10 hours,	1000 tons.

The maintenance charges for 1919 covered the following work: Pockets under belt conveyor, repairs to rollers on belt conveyor; new plates in chutes under grizzly; repairs to railroad tracks at crusher owned by The Cleveland-Cliffs Iron Company and minor repairs to crusher, chutes, pockets and belts.

The cost for general expense in 1919 was less in actual cost, but higher in cost per ton on account of decrease in the number of tons crushed.

The maintenance cost for the two years was almost exactly the same, but the cost per ton shows a decided increase due to a decrease in the number of tons crushed.

The expense for pockets under belt conveyor was more in the nature of an improvement than a maintenance charge. Considerable expense was incurred in 1919 for maintenance of railroad tracks. A large number of hemlock ties on the curve from the main line into the crusher tracks had to be replaced, this expense amounted to over $300.00. In spite of the increased wages paid during 1919 there was practically no increase in operating cost; this shows increased efficiency of operating crew, particularily in view of the small tonnage crushed. The crew was idle a few hours on many days due to the small number of cars delivered to the crusher. It is reasonable to assume that a lower operating cost would have been made if the crusher had been operated to capacity.

Central Power Plant:

The boiler plant was continued in full operation until the middle of April, when the turbine was shut down. The compressor was changed over to

GENERAL SURFACE:

electric drive at this time. One boiler was continued in operation until the last of June to furnish heat. The turbine was then again operated for a few days on account of an accident to the McClure plant. The entire boiler plant was closed down early in July for an indefinite period, and the work of overhauling it was started. All water pipes, feed pumps and boilers were drained in order that no damage could occur if the plant were idle during freezing weather. Up to the end of the year it had not been necessary to put the plant into commission again. During the past summer the compressor room was thoroughly overhauled; floors repaired and painted and all machinery overhauled.

Central Shops.

A heating plant was installed in the blacksmith shop to furnish steam for heating the various shop buildings and the Central Power Plant compressor room. The boiler came from Princeton Mine. The total cost of this plant was $897.96.

A number of improvements in the arrangement of machines in machine shop were made in the fall. The drill sharpener, forges and water tank for tempering drill steel were re-arranged in order that the sharpening of tools and drill steel could be done more efficiently. A concrete floor was also installed in the blacksmith shop and tracks laid for handling trucks, cars, etc., undergoing repairs. A number of other improvements are planned for the shops in order to increase the efficiency of the men employed here.

District Office.

Early in the fall a boiler was installed in the basement of the District Office to furnish steam for heating the building. A brick chimney was built inside the building and extended about six feet above the roof. Several changes in arrangement of basement rooms were necessary. The total cost of this heating plant was $1033.99.

Gwinn Townsite:

During the past year five houses were erected in Gwinn on lots which had been sold. On Lot 16 of Block 28, a very attractive house was built by the congregation of the Finnish Evangelical Lutheran Church for the Finnish minister. Two business men built cottages on Lots 3 and 4 of Block 11. A house was built by an employee on Lot 8 of Block. 28. The company bought back a house and lot from the widow of an employee and resold it to

another employee. The double house on Lots. 2 and 3 of Block 28 was also sold to an employee. Two of the double houses originally planned to be erected at the Gardner-Mackinaw Location were erected in Gwinn on Lots 9 and 10 and 11 and 12 of Block 28. These houses have concrete basements and are similar to the five double houses erected in 1917 on the opposite side of Pine Street. A number of privately-owned houses in Gwinn have changed hands during the past year, the majority of new owners being Finns. A number of employees have expressed a wish to build houses for themselves but are deterred by the high prices of materials. More houses are needed in the district and it has been recommended that fifteen single houses be built in 1920. If they are not too expensive, they will soon be purchased by employees.

Laboratory and Crusher Building:

When the central boiler plant was closed down, a small boiler was set up out of doors near the crusher building to furnish steam for drying samples. Early in the fall a permanent heating plant was installed in an addition which had been built on the west side of the crusher building. This plant furnishes steam for heating the laboratory and for heating crusher room and drying samples. The cost of this heating plant was $1135.58.

A hot water heater was also installed in the Laboratory. The gasoline heated hot plates formerly used for evaporating solutions have been discarded and electric heated hot plates installed. This change was made largely in the interests of greater safety to employees following the breaking of a gasoline burner which resulted in one of the chemists sustaining a severe burn.

Gwinn Association.

The Gwinn Club House has continued to be the community center for social, athletic and other activities. It was operated without a secretary until in September, 1919, as the secretary who had been employed for several years resigned in December, 1918. A new secretary was obtained in September, also an athletic director. The following is a brief summary of the years activities:

Attendance at building,		52,283
Average monthly attendance,		4,356
Membership January 1st, 1919,		509
Membership December 31st,1919,		526
Average membership for the year,		506
Number of books in library,		1,113
" " new books added during the year,		91
" " books loaned during the year,		2,720
Number of motion pictures shown during the year,		205
" " shows,		611
Attendance at theatre,	Adults,	37,162
	Children,	10,019
	Total attendance,	47,181

A number of improvements and repairs were made to the building and some new equipment was purchased.

The night school work for aliens was started again this fall, classes meeting at the Gwinn Club, Princeton and Gwinn Schools. There are three subjects taught, viz: Beginners English, Advanced English and Arithmetic. The attendance has been larger than in any previous year.

A Chautauqua course of five musical numbers was conducted under the auspices of the Association during September, October and November.

The Gwinn Band has been reorganized and over twenty men are now practicing every week. Prospects seem good for a fine band, all of whom are company employees.

The following activities are under the direction of the physical director: Senior, Junior, Girls and Boys Gymnasium classes; supervised swimming, basket ball activities with four teams, and Boy Scout work with four patrols and a membership of 42.

I would again call your attention to the pressing nececcity of an addition to the motion picture and gymnasium rooms. The town is growing and the facilities of the club house in these two respects are far behind the population. Prohibition has increased the attendance at the movies very materially, and additional seating capacity is badly needed to accommodate the crowds that now have to be turned away at many performances.

GWINN MINE

COST DATA FOR YEARS 1919-1918.

	YEAR 1919	YEAR 1918	INCREASE	DECREASE
Shifts and Hours,	1, 8-hr. Jan. 1, 1919 Dec.31,1919-	2, 8-hr. Jan.-Mar. 4 1, 8-hr. Mar.4-Dec.31		
Product,	137,847	155,534		17,687
Average Daily Product,	458	522		.064
Number of Days Operated,	300	298	2	
Number of Days Idle,	13	15		2
Number of Men - Surface,	36	35	1	
Average Rate Per Day - Surface	$5.09	$4.33	.76	
Tons per Man - Surface	12.32	14.70		2.38
Number of Men - Underground	96	134		38
Average Rate per Day - Underground	$6.25	$5.16	1.09	
Tons per Man - Underground	4.63	4.16	.47	
Total Average Men,	132	170		38
Total Average Rate,	$5.93	$4.98	.95	
Tons Per Man Per Day,	3.37	3.16	.21	
General Expense - Per Ton	.220	.199	.21	
Maintenance - Per Ton	.157	.119	.38	
Mining Expense - Per Ton	2.258	2.041	.217	
Cost of Production " "	2.635	2.359	.276	
Average Daily Cost - Labor	$802.00	$829.00		$27.00
" " " - Supplies	$408.93	$402.00	$6.93	
" " " - Total,	$1210.93	$1321.00		$110.07
Stoping,	10.62 tons	8.94 tons.		

COST OF PRODUCTION	1919	1918	INCREASE	DECREASE
Labor,	240,601.71	247,022.48		$6,420.77
Per Ton	1.745	1.587	.158	
Supplies,	122,678.23	119,845.48	2,832.75	
Per Ton	.890	.772	.118	
Total	363,279.94	366,867.96		3,588.02
Per Ton	2.635	2.359	.276	

WAGE RATES, Increased April 16th, August 1st and October 1st, 1918.

GWINN MINE

ANALYSIS OF MINING COSTS FOR 1919-1918.

	YEAR 1919	YEAR 1918
Product for Year,	137,847 tons	155,534 tons
Average Daily Product,	459	522
Number of Shifts and Hours,	1, 8-hr.	2, 8-hr. 51 1, 8-Hr.247

	1919 AMOUNT	PER TON	1918 AMOUNT	PER TON	PER TON INCREASE	1919 PER TON DECREASE
MAINTENANCE:						
150-Air Pipes	3322.59	.024	3769.78	.024		
166-Ventilation			590.82	.004		
Total	3322.59	.024	4360.60	.028		.004
SUPERINTENDENCE:						
160-Captain & Bosses	10341.31	.075	10012.92	.064	.011	
161-Dry House,	12312.22	.089	5229.07	.034	.055	
Total	22653.53	.164	15241.99	.098	.066	
POWER:						
151-Compressors	27480.08	.200	27266.41	.175	.025	
152-Hoisting,	14078.20	.102	16735.33	.108		.006
153-Pumping,	12582.99	.091	9321.61	.060	.031	
Total,	54141.27	.393	53323.35	.343	.056	
MINING:						
156-Breaking Ore,	105389.63	.765	114355.75	.735	.030	
157-Tramming,	19603.11	.142	22258.89	.143		.001
158-Filling,	138.15	.001	33.71	.000	.001	
159-Timbering,	49059.87	.356	40198.25	.258	.098	
164-Sorting Ore,	2384.57	.013	1361.38	.009	.004	
Total,	176575.33	1.277	178207.98	1.145	.132	
DEVELOPMENT:						
154-Sink. & Shft.Reps.	31585.62	.229	21844.65	.140	.089	
155-Rock Drifting,	10792.10	.078	37255.55	.240		.162
Total	42377.72	.307	59100.20	.380		.073
HANDLING OUTPUT:						
162-Top Landing,	10215.78	.074	5654.36	.037	.037	
163-Stocking Ore,	1708.69	.013	1473.86	.010	.003	
Total	11924.47	.087	7128.22	.047	.040	
TOTAL MINING EXPENSE:	310994.91	2.252	317362.34	2.041	.288	

GWINN MINE.
ANALYSIS OF COST SHEETS EXPLAINING INCREASE OR DECREASE IN VARIOUS ACCOUNTS BETWEEN YEARS 1919 AND 1918.

GENERAL EXPENSE:

Engineering (Acct.#27)	Year 1919	2287.05	Cost per ton	.017
	Year 1918	2465.71	" " "	.016
	DECREASE,	178.66	INCREASE,	.001

The small decrease was due to less engineering work being necessary during 1919. There was less rock drifting and less exploratory work in 1919.

Analysis (Acct.#28)	Year 1919	6915.54	Cost per ton	.050
	Year 1918	9557.75	" " "	.062
	DECREASE	2642.21	DECREASE	.012

In 1918, there were 30,540 determinations, costing .215 each; in 1919 20,613, costing .275 each. The decrease in laboratory charges in 1919 was $885.21. In 1918, the mine charges for underground sampler, for sampling cars at mine and at crusher and for hauling samples to Laboratory was $2999.37; in 1919 these charges were only $1242.37. The decrease in mine charges in 1919 was $1757.00. The number of determinations decreased due to no Bessemer ore hoisted during the greater part of 1919. In 1918 an underground sampler was employed part of the year, in 1919 this work was done by shift bosses for the entire year. There was also less ore shipped and crushed in 1919, hence less charges for sampling.

Personal Injury Expense, (Acct. #30)	Year 1919	2740.64	Cost per ton	.020
	Year 1918	1441.60	" " "	.009
	INCREASE	1299.04	INCREASE	.011

The increase was due to more money paid out as compensation for personal injuries in 1919.

Mine Office, (Acct.#30a)	Year 1919	8136.39	Cost per ton	.059
	Year 1918	6410.36	" " "	.041
	INCREASE	1726.03	INCREASE	.018

The increase was due to higher salaries paid mine and supply clerks in 1919.

District Office, (Acct.#30b)	Year 1919	9376.54	Cost per ton	.068
	Year 1918	10796.24	" " "	.069
	DECREASE	1490.70	DECREASE,	.001

The number of men employed at Gwinn decreased in 1919, while the number employed at Gardner-Mackinaw and Princeton increased. Also the Austin operated five months in 1919 and was idle all of 1918. The proportion of district office expense charged to Gwinn Mine in 1919 was therefore less than in 1918.

MAINTENANCE

Tracks and Yards, (Acct. #125)	Year 1919	1454.82	Cost per ton	.011
	Year 1918	1268.09	" " "	.008
	INCREASE	186.73	INCREASE,	.003

The increase was due to higher wages paid in 1919.

Docks, Trestles & Pockets, (Acct. #126)	Year 1919	863.38	Cost per ton	.006
	Year 1918	480.58	" " "	.003
	INCREASE	382.80	INCREASE	.003

The increase was due to grading for additional stocking grounds.

Buildings, (Acct. #127)	Year 1919	2182.06	Cost per ton	.016
	Year 1918	1517.15	" " "	.010
	INCREASE	664.91	INCREASE	.006

Enclosing of the shaft house in 1919 cost $918.00. In 1918 an addition was built to barn building, which, in a measure, offset the expense of enclosing the shaft house. All other items were normal for the two years.

Boiler Plant, (Acct. #129)	Year 1919	252.75	Cost per ton	.002
	Year 1918	272.42	" " "	.002
	DECREASE	19.67		.000

The expense for the two years cover normal repairs.

Hoisting Machinery, (Acct. #130)	Year 1919	3967.06	Cost per ton	.029
	Year 1918	1818.54	" " "	.012
	INCREASE	2148.52	INCREASE	.017

The increase was due to two items in 1919 - 263 feet of 12" counter balance pipe, costing $1055.92 was charged out, and overwinding devices costing $415.88 were installed on hoists, the labor charge on these two items was $443.00. The counterbalance pipe installed in shaft from 9th to 10th levels in 1918 was not charged out until in May, 1919, balance of pipe charged in 1919 covered pipe installed from 10th to 11th levels.

Compr. & Power Drills, (Acct. #131)	Year 1919	1338.09	Cost per ton	.010
	Year 1918	957.09	" " "	.006
	INCREASE,	381.00	INCREASE,	.004

In 1918 no drills were charged out, while in 1919, 4 BBR13 Auger drills, costing $500.00, were charged out. The cost of alcohol used in thawing air lines from Central Power Plant and Francis was charged to this account in 1918; in 1919 this expense was charged to account No. 151, operating compressors. This latter item, in a measure, offset the increased charges in 1919 due to purchase of drills.

Pumping Machinery, (Acct. #132)	Year 1919	680.55	Cost per ton	.005
	Year 1918	823.21	" " "	.005
	DECREASE	142.66		.000

This decrease was due to less repairs to electric pumps - $211.68 in 1919 and $823.21 in 1918. In 1919 repairs to air pumps amounted to $176.07 and pump house pumps and ditches, $292.80.

MAINTENANCE:

Top Tram Eng. & Cars, (Acct. #133)	Year 1919	1237.28	Cost per ton	.009
	Year 1918	1901.16	" " "	.012
	DECREASE	663.88	DECREASE	.003

In 1918 general repairs amounted to $1256.13 and in 1919 to $941.02, the decrease in 1919 amounting to $315.11. In 1918, the 5/8" wire rope used on top tram cost $645.03, in 1919, $296.26, the decrease in 1919 amounting to $348.77.

Skips and Skip Roads, (Acct. #134)	Year 1919	1575.65	Cost per ton	.011
	Year 1918	2634.03	" " "	.017
	DECREASE	1058.38	DECREASE	.006

There was no expense in 1919 account auxiliary shafts; in 1918 this item amounted to $379.95. The balance of this 1918 increase is due to installing rails in each skip way, to prevent the skip from catching under the timbers. There was also some extra expense in 1918 account of repairing skips used on auxiliary hoist.

U.G. Tracks and Cars, (Acct. #135)	Year 1919	1190.34	Cost per ton	.008
	Year 1918	1703.94	" " "	.011
	DECREASE	513.60	DECREASE	.003

The decrease is almost entirely due to less rail charged out in 1919. This item alone amounted to $430.36, balance of decrease was due to less repairs to sub-level cars in 1919.

Electric Tram Plant, (Acct. #136)	Year 1919	6409.64	Cost per ton	.046
	Year 1918	4619.47	" " "	.030
	INCREASE	1790.17	INCREASE	.016

The detail of charges for 1918 and 1919 is as follows:

	1919	1918	Increase	Decrease
Locomotives,	944.05	984.01		39.96
Wiring,	1502.08	622.17	879.91	
Main Line Tracks,	3440.79	2531.67	909.12	
" " Cars,	522.72	447.71	75.01	
Spotting Engines,	33.91			33.91
TOTAL,	6409.64	4619.47	1864.04	73.87

The increase was due to wiring and laying tracks on 10th level.

Tel. & Safety Devices, (Acct. #137)	Year 1919	509.97	Cost per ton	.004
	Year 1918	469.00	" " "	.003
	INCREASE	40.97	INCREASE	.001

The increase was largely due to installation of lights on 10th level, which became an operating level in 1919.

MINING EXPENSE:

Air Pipes, (Acct.#150)	Year 1919	3322.59	Cost per ton	.024
	Year 1918	3769.78	" " "	.024
	DECREASE	447.19		

The decrease was due to expense in 1918 account of piping 10th level - 788' of 3" pipe, costing $251.37; also fittings and installing.

MINING EXPENSE:

Compressors, (Acct.#151)	Year 1919	27480.08	Cost per ton	.200
	Year 1918	27266.41	" " "	.175
	INCREASE	213.67	INCREASE	.025

There is only a slight increase in this charge in 1919. An analysis of charges making up the above figures is interesting. In 1918, the Central Power Plant compressor was operated by steam for the entire year; in 1919 it was operated by steam for 3-1/2 months and by electricity for 8-1/2 months. The labor charged to Gwinn Mine from the Central Power Plant in 1918 was $4365.06; in 1919, $2740.65; the labor charge was higher in 1918 account of more labor being necessary when operating by steam. The supply charge from the Central Power Plant compressor in 1919 was, however, $20814.65, as compared with $17901.35 in 1918. The total charges from the Central Power Plant compressor in 1918 were $22266.41, as compared with $23555.30 in 1919. The increase in these charges in 1919 was $1288.89. The Gwinn also gets air from the Francis Mine. In 1918, the Francis charged the Gwinn Mine $5,000.00 for air; in 1919, $3,600.00. This charge was lower in 1919 due to the Francis compressor operating one shift only, while in 1918 it was operated on two shifts for nearly nine months. In 1919, the cost of alcohol used to prevent freezing of air lines from the Central Power Plant and Francis Mine, amounting to $324.78 was charged to operating compressors, in prior years it was charged to maintenance of compressors, account No. 131.

Hoisting, (Acct. #152)	Year 1919	14078.20	Cost per ton	.102
	Year 1918	16735.33	" " "	.108
	DECREASE,	2657.13	DECREASE,	.006

In 1918 the cost of operating auxiliary hoist on 9th level amounted to $3351.00. The decrease in 1919 did not quite equal this amount, due to increased wages paid in 1919.

Pumping, (Acct. #153)	Year 1919	12582.99	Cost per ton	.091
	Year 1918	9321.61	" " "	.060
	INCREASE	3261.38	INCREASE	.031

The large increase in pumping expense is due to pumping 26,626,650 gallons more water in 1919. There was also higher wages paid pumpmen in 1919 and more expense account of shaft pumps, due to sinking the shaft. In 1919 the cost of current used by pumps increased $3209.00, the increased cost account of shaft pumps amounted to $820.73. In 1918 the Jopling Mine was charged $4245.00 by the Gwinn Mine for pumping; in 1919 it was charged $5175.00. The amount of Jopling water pumped by Gwinn pumping plant was greater in 1919 than is indicated by the above charges. There may have been a slight increase in the amount of Gwinn Mine water, the main increase, however, came from the Jopling Mine. It is evident that the amount charged Jopling Mine should have been higher during the last six months of 1919; that is, since water was encountered in the exploratory work on 543' sub-level, near #37 diamond drill hole.

MINING EXPENSE:

Sinking & Shaft Repairs, (Acct. #154)	Year 1919	31585.62	Cost per ton	.229
	Year 1918	21844.65	" " "	.140
	INCREASE	9740.97	INCREASE	.089

The increase was due to increased expense for sinking shaft, account of higher wages and harder ground. In 1918, the shaft was raised 35 feet from 10th to 9th levels and sunk 65 feet below 10th; in 1919 the shaft was sunk 124 feet below 10th level.

Rock Drifting, (Acct. #155)	Year 1919	10792.10	Cost per ton	.078
	Year 1918	37255.55	" " "	.240
	DECREASE,	26463.45	DECREASE,	.162

Drifted in 1918	- 3411 Feet -	per foot	10.92
" " 1919	- 909 "	" "	11.87
Decrease	- 2502 Feet	Increase	.95

The large decrease was due to 2502 feet less drifting in 1919.

Breaking Ore, (Acct. #156)	Year 1919	105389.63	Cost per ton	.765
	Year 1918	114355.75	" " "	.735
	DECREASE	8966.12	INCREASE	.030

The product from the mine decreased 17,687 tons in 1919 and the men employed per day underground decreased from an average of 134 in 1918 to an average of 96 in 1919. This decrease in the number of men employed accounts for the decrease of $8966.12. The increased cost per ton in 1919 is due to increase in wages.

Tramming, (Acct. #157)	Year 1919	19603.11	Cost per ton	.142
	Year 1918	22258.89	" " "	.143
	DECREASE	2655.78	DECREASE	.001

The decreased product of 1919, made it possible to handle the ore underground with less men, there was also a decrease in the power cost, due to less ore trammed.

Filling, (Acct. #158)	Year 1919	138.15	Cost per ton	.001
	Year 1918	33.71	" " "	.000
	INCREASE	104.44	INCREASE	.001

There was more expense for filling in 1919.

Timbering, (Acct. #159)	Year 1919	49059.87	Cost per ton	.356
	Year 1918	40198.25	" " "	.258
	INCREASE	8861.62	INCREASE	.098

The timber used in 1919 cost $17715.48; in 1918, $14307.71, the increase in 1919 amounting to $3407.77. This increase was due to increased cost of timber. There was more re-timbering necessary in 1919 to keep the drifts open on the operating levels. The timber in Gwinn Mine is rotting badly due to poor air and the expense for retimbering will continue during the life of the mine. There was less stull timber used per ton of ore in 1919; the feet of lagging used was slightly greater.

MINING EXPENSE

Captain and Bosses, (Acct. #160)	Year 1919	10341.31	Cost per ton	.075
	Year 1918	10012.92	" " "	.064
	INCREASE	328.39	INCREASE	.011

The increase was due to higher wages paid Captain and shift bosses in 1919. The expense for 1919 averaged $935.00 per month until October, when it dropped to an average of $643.00 per month for the last three months of the year. This was due to a reduction in the number of shift bosses, following the reopening of the Austin and Stephenson Mines.

Dry House, (Acct. #161)	Year 1919	12312.22	Cost per ton	.089
	Year 1918	5229.07	" " "	.034
	INCREASE	7083.15	INCREASE	.055

The large increase in dry house expense in 1919 was due to the following reasons:
Through an error in accounting by the mine clerks in this district, all labor charge for dryman was charged to heating plant which made the cost of heating plant abnormally high in comparison with the mines in other districts. Starting with August, 1919, one half of the labor charge for men working in dry and heating plant was charged to dry house and the balance taken up by heating plant and then charged out to the various accounts. The same distribution of heating plant expense had been carried through the entire year prior to 1919; this was corrected this year and during the summer months practically the entire cost of heating plant was charged to the dry. These two items, together with the increased wages paid in 1919, increased the labor cost. The cost of supplies was higher due to change in distribution of heating plant expense, to increased wages paid teamster hauling coal, fuel adjustment in1918, which made the charge for fuel $ 2004.32 higher in 1919, and to excessively high charge for water in 1919 as compared with previous years. Water for dry cost $ 313.96 in 1918, in 1919 $ 3102.52, an increase of $ 2788.56. This was due to Gwinn Mine being the heaviest user of water from June to the end of the year, prior to which time the Central Power Plant absorbed most of the water charge from Gwinn District Pumping Plant. During these six months the Gwinn dry house carried the greater part of charges for water that were not absorbed by the regular water rents. The starting up of the Stephenson Mine in November, will soon permit of more equitable adjustment of water charges.

Top Landing & Tramming, (Acct. #162)	Year 1919	10215.78	Cost per ton	.074
	Year 1918	5654.36	" " "	.037
	INCREASE	4561.42	INCREASE	.037

The increase was due to four extra men on night shift on landing from May to the end of the year, account of sinking shaft; approximate cost $3400.00; balance mainly on account of increased wages paid landers. There was less ore shipped in 1919, hence more charge to top landing and less to loading and shipping.

MINING EXPENSE

Stocking Ore, (Acct. #163)	Year 1919	1708.69	Cost per ton	.013
	Year 1918	1473.86	" " "	.010
	INCREASE	234.83	INCREASE	.003

The increase was due to more new material charged out for trestles in 1919, and higher labor charge account of increased wages. The detail of charges for 1918 and 1919 follows:

	1919	1918	Increase	Decrease
Maintenance, Erecting Portable Trestles,	83.27	529.20		435.93
	1625.32	944.66	680.66	

Sorting Ore, (Acct. #164)	Year 1919	2384.57	Cost per ton	.017
	Year 1918	1361.38	" " "	.009
	INCREASE	1023.19	INCREASE	.008

The increase was due to more expense in 1919 account of miners picking rock from ore underground.

Ventilation, (Acct. #171)	Year 1919	300.50	Cost per ton	.002
	Year 1918	590.82	" " "	.004
	DECREASE	290.32	DECREASE	.002

The 1918 expense was due to installation of ventilating pipe and operation of fan on 10th level. A part of the 1919 expense was for removal of ventilating pipe on 9th and 10th levels, balance covers cost of ventilating doors on several levels to close off the old workings, in an effort to improve the air in the mine.

PRINCETON MINE

COST DATA FOR YEARS 1919-1918.

	YEAR 1919	YEAR 1918	INCREASE	DECREASE
Shifts and Hours,	2, 8-hr.	2, 8-hr.		
Product,	193,228	147,841	45,387	
Average Daily Product,	655	496	159	
Number of Days Operated,	295	298		3
Number of Days Idle,	18	15	3	
Number of Men - Surface,	35	50		15
Average Rate per Day - Surface,	$4.69	$4.33	.36	
Tons Per Man - Surface,	18.69	9.63	9.06	
Number of Men - Underground,	162	173		11
Average Rate Per Day - Underground,	$5.94	$5.06	.88	
Tons Per Man - Underground,	3.99	2.79	1.20	
Total Average Men,	197	223		26
Total Average Rate,	$5.72	$4.90	.82	
Tons Per Man Per Day,	3.29	2.16	1.13	
General Expense - Per Ton	.195	.253		.058
Maintenance - " "	.202	.355		.153
Mining Expense - " "	2.034	2.551		.517
Cost of Production,	2.431	3.159		.728
Average Daily Cost - Labor	$1172.33	$1159.67	$12.66	
" " " - Supplies,	419.10	411.83	7.27	
" " " - Total,	$1591.43	$1571.50	$19.93	
Stoping,	9.12 tons	7.54 tons	1.58	

COST OF PRODUCTION	1919	1918	INCREASE	DECREASE
Labor,	345,837.39	345,582.83	254.56	
Per Ton	1.790	2.331		.541
Supplies,	123,634.51	122,726.63	907.88	
Per Ton	.641	.828		.187
Total,	469,471.90	468,309.46	1,162.44	
Per Ton	2.431	3.159		.728

WAGE RATES INCREASED April 16th, August 1st and October 1st, 1918.

PRINCETON MINE

ANALYSIS OF MINING COSTS FOR 1919-1918

	YEAR 1919	YEAR 1918
Product for Year,	193,228 tons	148,265 tons
Average Daily Product,	655	497
Number of Shifts and Hours,	2, 8-hr.	2, 8-hr.

	1919 AMOUNT	PER TON	1918 AMOUNT	PER TON	PER TON INCREASE	1919 PER TON DECREASE
MAINTENANCE:						
150-Air Pipes,	3818.12	.020	7199.19	.049		.029
166-Ventilation,	25.47		10.50			
Total,	3843.59	.020	7209.69	.049		.029
SUPERINTENDENCE:						
160-Captain & Bosses,	14983.05	.078	10885.08	.073	.005	
161-Dry House,	6303.19	.033	5748.22	.039		.006
Total,	21286.24	.111	16633.30	.112		.001
POWER:						
151-Compressors,	29636.72	.153	22684.85	.153		
152-Hoisting,	8014.76	.042	5649.20	.038	.004	
153-Pumping,	8306.73	.043	4826.84	.033	.010	
Total,	45958.21	.238	33160.89	.224	.014	
MINING:						
156-Breaking Ore,	144225.97	.746	119099.11	.803		.057
157-Tramming,	37949.69	.197	42195.89	.285		.088
158-Filling,			272.78	.002		.002
159-Timbering,	86965.90	.450	72531.65	.489		.039
164-Sorting Ore,	361.62	.002	617.01	.004		.002
Total,	269503.18	1.395	234716.44	1.583		.188
DEVELOPMENT:						
154-Sink. & Shft.Reps.	4892.22	.025	1823.40	.012	.013	
155-Rock Drifting,	32001.20	.166	68289.03	.460		.294
Total,	36893.42	.191	70112.43	.472		.281
HANDLING OUTPUT:						
162-Top Ldg. & Tramming	8919.09	.046	9185.20	.062		.016
163-Stocking Ore,	6419.28	.033	7245.04	.049		.016
Total,	15338.37	.079	16430.24	.111		.032
TOTAL MINING EXPENSE,	392823.01	2.034	278262.99	2.551		.517

PRINCETON MINE
ANALYSIS OF COST SHEETS EXPLAINING INCREASE OR
DECREASE IN VARIOUS ACCOUNTS BETWEEN YEARS
1919 AND 1918.

GENERAL EXPENSE:

Engineering, (Acct. #27)	Year 1919	3614.76	Cost per ton	.019
	Year 1918	3839.48	" " "	.026
	DECREASE	224.72	DECREASE	.007

More engineering was required in 1918 when the mine re-opened.

Analysis, (Acct. #28)	Year 1919	11409.12	Cost per ton	.059
	Year 1918	8198.95	" " "	.055
	INCREASE	3210.17	INCREASE	.004

The increase was due to more determinations, to higher cost per determination, and to increase in charges from mine account of higher wages. The following tables gives detail of charges:

	No. Determinations.	Rate	Amount
1919,	30,236	.272	8237.25
1918,	24,035	.222	5340.25
Increase,	6,201	.050	2897.00

	1919	1918	Increase 1919
Laboratory charges,	8237.25	5340.25	2897.00
Mine charges,	3171.87	2858.70	313.70
TOTAL,	$11409.12	$8198.95	$ 3210.17

Personal Injury Expense, (Acct. #30)	Year 1919	2478.10	Cost per ton	.013
	Year 1918	5263.28	" " "	.036
	DECREASE	2785.18	DECREASE	.023

A fatal accident in October, 1918, increased the cost for 1918. The 1919 payments cover compensation for personal injuries.

Mine Office, (Acct. #30a)	Year 1919	6817.55	Cost per ton	.035
	Year 1918	5590.70	" " "	.038
	INCREASE	1226.85	DECREASE,	.003

There was an increase of $201.00 in office expense, $86.55 Safety Department, $74.12 Traveling and Entertainment; balance account of increased wages and three clerks employed all of 1919.

District Office, (Acct. #30b)	Year 1919	12884.16	Cost per ton	.067
	Year 1918	14038.14	" " "	.095
	DECREASE,	1153.98	DECREASE	.028

The decrease was due to increase in number of employees at the Francis and Gardner-Mackinaw Mines; also the Austin Mine operated for five months in 1919.

MAINTENANCE:

Tracks and Yards, (Acct. #125)	Year 1919	5481.18	Cost per ton	.029
	Year 1918	1799.76	" " "	.012
	INCREASE	3681.42	INCREASE	.017

The increase was principally due to advance payment in November to C.& N.W. Ry. Co., account of tracks to loading pocket, $3154.00; balance of the increase was due to higher wages and more mine labor account of grading No. 3 timber yard.

MAINTENANCE:

Docks, Trestles & Pockets, (Acct. #126)	Year 1919	1596.70	Cost per ton	.008
	Year 1918	5705.09	" " "	.038
	DECREASE	4108.39	DECREASE	.030

In 1918 a pocket and trestle was constructed for Sec. 19 ore; also when the mine opened at the beginning of 1918 all trestles and pockets had to be repaired. The 1919 expense was also high due to extensions to permanent trestle used for stocking rock and to other repairs to the old trestles.

Boiler Plant, (Acct. #129)	Year 1919	777.05	Cost per ton	.004
	Year 1918	1356.37	" " "	.009
	DECREASE	579.32	DECREASE	.005

The higher cost in 1918 was due to installing larger boiler for heating. This work was completed early in 1919. An elevating trap for returning condensed water to boiler was installed early in 1919. The charges since March have been normal.

Buildings, (Acct. #127)	Year 1919	973.97	Cost per ton	.005
	Year 1918	6236.40	" " "	.042
	DECREASE	5262.43	DECREASE	.037

The large decrease was due to additions, repairs and alterations to buildings when the mine re-opened in 1918. The detail of charges for the two years were as follows:

	1919	1918	
Office & Warehouse	128.06	1571.98	- Addition to Captain's office
Heating Plant		35.49	
Shaft House,	155.58	1099.86	- Enclosing landing
Engine "	71.51	459.15	- Remodeling boiler room for warehouse.
Boiler "	6.84	7.58	
Dry "	473.13	1847.44	- Auxiliary building for heating plant.
Coal dock,	43.40	78.83	
Miscellaneous	93.64	366.13	
Stables,	1.84		
	973.97	6236.40	

Hoisting Machinery, (Acct. #130)	Year 1919	1916.02	Cost per ton	.010
	Year 1918	6604.79	" " "	.045
	DECREASE	4688.77	DECREASE	.035

Hoisting equipment for #3 shaft charged in 1918, including cage, counter balance, hoisting ropes, signal system and installing hoist from No. 1 Princeton.

Compr. & Power Drills, (Acct. #131)	Year 1919	1556.92	Cost per ton	.008
	Year 1918	258.70	" " "	.002
	INCREASE	1298.22	INCREASE	.006

Drills charged in 1919 -	1 BC Stoping Drill,	$151.20
	2 #248 Leyners,	662.56
	3 BBR-13 Auger Drills,	468.16
	1 DT-42 Sullivan	275.00
		$ 1556.92

In 1918 - 1 Leyner Drill only.

MAINTENANCE:

Pumping Machinery, (Acct. #132)	Year 1919	1512.15	Cost per ton	.008
	Year 1918	460.57	" " "	.003
	INCREASE	1051.58	INCREASE	.005

The high cost in 1919 account making ditches on 7th level to carry water to new permanent pumping plant at #2 shaft.

Top Tram Eng. & Cars, (Acct. #133)	Year 1919	9068.60	Cost per ton	.047
	Year 1918	5348.33	" " "	.036
	INCREASE	3720.27	INCREASE	.011

One complete top tram unit, purchased in 1919 to replace like equipment which had been borrowed from Stephenson Mine in 1918. Two new top tram cars were built during 1919. Cost in 1918 was high due to building new cars and to overhauling top tram system when the mine reopened.

Skips and Skip Roads, (Acct. #134)	Year 1919	2324.08	Cost per ton	.012
	Year 1918	2712.99	" " "	.018
	DECREASE	388.91	DECREASE	.006

In 1918 skips and skip roads were given a general repairing and this expense extended into 1919. (This account should show an appreciable decrease in 1920)

U. G. Tracks and Cars, (Acct. #135)	Year 1919	2097.41	Cost per ton	.011
	Year 1918	966.55	" " "	.007
	INCREASE	1130.86	INCREASE	.004

The increase was due to charging out seven sets of roller bearing trucks costing $316.65, in 1919, while there were none charged in 1918; also higher cost for rail and for repairing cars at central shops; also a number of new sub-level cars were built in 1919.

Electric Tram Plant, (Acct. #136)	Year 1919	11059.76	Cost per ton	.057
	Year 1918	20101.13	" " "	.136
	DECREASE	9041.37	DECREASE	.079

The detail of charges for the two years was as follows:

	1919	1918	
Motors,	1548.66	1195.61-	increase due to rewinding armatures.
Wiring,	826.79	2961.83-	decrease account wiring 6th level in 1918.
Tracks,	6526.62	15002.56-	(decrease account installing tracks on)6th level in 1918 and maintenance of)tracks on 5th level.
Cars, Spotting Engines) Rotary Dump	)970.15	808.33-	increase account riveting draw heads in 1919.
		132.80-	increase account more maintenance cost for rotary dump.

Tel. & Safety Devices, (Acct. #137)	Year 1919	585.58	Cost per ton	.003
	Year 1918	584.68	" " "	.004
	INCREASE	.90	DECREASE	.001

Same expense for both 1918 and 1919. In 1918, nunerous safety devices were installed when the mine reopened; in 1919, main expense account installation of lights in ladder roads in No. 2 shaft.

MINING EXPENSE:

Air Pipes, (Acct. #150)	Year 1919	3818.12	Cost per ton	.020
	Year 1918	7199.19	" " "	.049
	DECREASE	3381.07	DECREASE	.029

In 1918 this cost was heavy account all piping had to be gone over and repaired. Several new and larger air lines were installed to replace small lines on 6th level. The expense for 1919 is normal, covering replacements of hose and regular extensions to pipe lines.

Compressors, (Acct. #151)	Year 1919	29636.72	Cost per ton	.153
	Year 1918	22684.85	" " "	.153
	INCREASE	6951.87		

The increase was due to Princeton Mine being charged with 50% of Central Power Plant compressor expense in 1919, against an average of 43% in 1918. The total operating cost of the Central Power Plant compressor in 1918 was $52,702.69; in 1919, $58,241.68.

Hoisting, (Acct. #152)	Year 1919	8014.76	Cost per ton	.042
	Year 1918	5649.20	" " "	.038
	INCREASE	2365.56	INCREASE	.004

The hoist at #3 shaft, handling timber and supplies, was operated during 1919 on day shift. This increased the number of brakesmen employed from two men to three men.

Pumping, (Acct. #153)	Year 1919	8306.73	Cost per ton	.043
	Year 1918	4826.84	" " "	.033
	INCREASE	3479.89	INCREASE	.010

There were two men employed on pumps at No. 1 shaft from March 1919, while previously only one man. Also there was some extra operating expense in December, 1919 account of starting up the new pumping plant.

Sinkg. & Shaft Repairs, (Acct. #154)	Year 1919	4892.22	Cost per ton	.025
	Year 1918	1823.40	" " "	.012
	INCREASE	3068.82	INCREASE	.013

The increase was due to sinking No. 3 shaft from 5th to 6th level in 1919.

Rock Drifting, (Acct. #155)	Year 1919	32001.20	Cost per ton	.166
	Year 1918	68289.03	" " "	.460
	DECREASE	36287.83	DECREASE	.294

The decrease was due to less rock drifting in 1919. The detail for the two years was as follows:

	Feet.	Amount.	Cost per Foot.
1918 - - - - -	4937	68289.03	13.83
1919 - - - - -	2166	32001.20	14.77

Breaking Ore, (Acct. #156)	Year 1919	144225.97	Cost per ton	.746
	Year 1918	119099.11	" " "	.803
	INCREASE	25126.86	DECREASE,	.057

The increase was due to larger product, more men employed; also increased average wages.

Product 1919 193,228 tons
" 1918 148,265 "
Increase, 44,963 "

The decrease in cost per ton was due to better operating conditions underground.

MINING EXPENSE:

Tramming,	Year 1919	37949.69	Cost per ton	.197
(Acct. #157)	Year 1918	42195.89	" " "	.285
	DECREASE	4246.20	DECREASE	.088

In 1918 tramming on the 6th level was done by hand until the latter part of the year, when the electric haulage installation was completed on this level. The cost per ton is high for mine having electric haulage, due to the large number of chutemen employed to load the plastic ore.

Timbering,	Year 1919	86965.90	Cost per ton	.450
(Acct. #159)	Year 1918	72531.65	" " "	.489
	INCREASE	14434.25	DECREASE,	.039

This increase was due to higher wages and more labor required, the increase in cost of timber, lagging and poles used amounted to $1179.81. The cost is high due to great amount of retimbering necessary in the ore near No. 3 shaft. The cost per ton shows a decrease in 1919, due to larger product.

Captain and Bosses,	Year 1919	14983.05	Cost per ton	.078
(Acct. #160)	Year 1918	10885.08	" " "	.073
	INCREASE	4097.97	INCREASE	.005

The increase in 1919 was due to increased wages, two extra bosses part of the year, May to August inclusive, also Captain Bone employed during illness of Captain Jory in May and June, during which months salaries of both Captains charged to Princeton Mine.

Dry House,	Year 1919	6303.19	Cost per ton	.033
(Acct. #161)	Year 1918	5748.22	" " "	.039
	INCREASE	554.97	DECREASE	.006

The increase in coal to Dry House, 88 tons, $334.68; balance account increased wages.

Top Landing & Tramming,	Year 1919	8919.08	Cost per ton	.046
(Acct. #162)	Year 1918	9185.20	" " "	.062
	DECREASE	266.12	DECREASE	.016

The decrease was due to less men required to operate top tram since the second top tram unit went into commission. In spite of the increased wages paid in 1919, there was an actual decrease in cost, due to above cause.

Stocking Ore,	Year 1919	6419.28	Cost per ton	.033
(Acct.#163)	Year 1918	7245.04	" " "	.049
	DECREASE	825.76	DECREASE	.016

On account of the mine being reopened in 1918 the cost for repairing and erecting portable trestles was more than in 1919.

Sorting Ore,	Year 1919	361.62	Cost per ton	.002
(Acct. #164)	Year 1918	617.01	" " "	.004
	DECREASE	255.39	DECREASE	.002

The decrease was due to less labor employed picking rock from stockpile in 1919.

E. & A. #369, PUMPING EQUIPMENT, PRINCETON MINE

MADE AUGUST, 1918 PRACTICALLY COMPLETED DEC. 1919

	ESTIMATE	EXPENDED TO DATE	UNEXPENDED BALANCE	OVERRUN
1 Plunger Pump & Motor	14000.00	13937.96	62.04	
2 Centrifugal Pump & Motor	4000.00	2777.41	1222.59	
3 Wiring in Shaft,	1000.00	511.20	488.80	
4 Water Column	1400.00	3305.72		1905.72
5 Station Piping,	4000.00	556.59	3443.41	
6 Sump, Pump House, Dams, etc.	13000.00	20464.74		7464.74
7 Surface Launder & Ditch	2000.00	529.70	1470.30	
Total,	39400.00	42083.32		
10% for Contingencies,	3940.00			
GRAND TOTAL,	$43340.00		$ 1256.68	

There was an overrun in two accounts due to the estimate being too low.

4. Water Column.- Overrun $1905.72. The actual cost was made up as follows: Labor $574.34; Supplies $2731.38. The original estimate of cost was entirely too low. Doubtless some of the extra cost was due to advance in cost of pipe, but this does not account for the entire overrun. It is probable that freight, cost of unloading pipe and cost of installing was not given proper consideration.

6. Sump, Pump House, Dams, Etc. - Overrun $7464.74. The ground excavated for sump was much harder than was expected, this was the main reason for increased cost. It was also necessary to make the pump house larger than originally planned, due to type of pump purchased. The estimate was not made on a liberal enough basis to carry these unforseen expenses.

REPUBLIC MINE.

PRODUCTION.

The product for the year 1919 was as follows:-

No. 9 Shaft,	Bessemer Ore,	Shipped from pockets,	5,330	tons,
"	Pascoe "	" " "	11,243	"
Pascoe "	Bessemer "	" " "	26,432	"
" "	Basic "	" " "	6,746	"
No. 9 "	Bessemer "	Stocked,	24,331	"
" "	Pascoe "	"	26,408	"
Pascoe "	Bessemer "	"	33,406	"
" "	Basic "	"	21,419	"
		Total,	155,315	"

The above ore was separated by grades as follows:-

Bessemer Ore, hoisted,	89,499 tons,	57.8%
Basic " "	28,165 "	18.0%
Pascoe " "	37,651 "	24.2%
Total,	155,315 "	100.0%

The production for the two previous years is shown for sake of comparison:-

	1917		1918	
Bessemer Ore,	101,263 tons,	66.1%	90,125 tons,	63.3%
Basic "	30,682 "	20.0%	31,946 "	22.4%
Pascoe "	21,480 "	13.9%	20,405 "	14.3%
	153,425 "	100.0%	142,476 "	100.0%

The product for 1919 is greater than that of the two previous years. The year 1916 showed a fairly good hoist and we hope the tide continues to turn and that our development work continues favorably so that the 1920 production will show a still further increase. The whole cruix of the situation lies in the speed with which new ore bodies are found and mined. By the shrinkage stope system of mining which is used in this mine, the broken ore is locked up until the miners have finished stoping each particular ore lens. That means that from six months to a year must elapse from the time ore is found before it is available for tramming.

In the meantime, in order to keep up our production, the reserve broken ore on stulls must be tapped. When these reserves are reduced to a small tonnage, our difficulties are apparent. Costs inevitably rise notwithstanding all efforts made to reduce it. The shaft sinking and rock drifting must be carried on without a break regardless of cost, and eventually as new ore bodies are developed, the cost of production will be reduced.

The following table shows the available broken ore reserves at the begining of the last four years:-

ORE RESERVES ON HAND ON JANUARY 1ST.

YEAR	AVAILABLE BROKEN ORE ON STULLS.	AVAILABLE ORE IN PLACE IN SIGHT	TOTAL
1916	177,934 tons,	184,550 tons,	362,484 tons,
1917	132,630 "	63,390 "	196,020 "
1918	73,538 "	100,926 "	174,464 "
1919	53,657 "	153,838 "	207,495 "
1920	40,127 "	179,600 "	219,727 "

It is apparent from the above table that our available broken ore reserves are nil. We are dependent for our daily product on the surplus ore we can draw from our stopes and on the ore we find in development work. Some months we obtained over 50% of our product from development drifts and new stopes being widened out before putting in timber. Naturally the cost of mining is high and will continue so until we can slacken on our development work and break most of our ore in the stopes.

We opened up three new levels during the year and expect to cut three new plats during 1920. With six new levels going, we can increase our reserves rapidly provided we are fortunate in finding ore. I look to the year 1920 to justify our faith in the old Republic Mine and expect to show both increased production and still greater increase in ore reserves.

We have had no shortage of trammers, our only drawback being the scarcity of ore available for them.

The rock hoist for the year was 32,305 tons, practically all of which came from the rock drifts and shaft sinking. This is in excess of last year due to increased amount of development work.

The following table shows the monthly product and the tons per day, etc.:-

MONTHLY PRODUCTION AND TONS PER DAY, ECT.

	YEAR - 1918				YEAR - 1919			
MONTH	PRODUCT	TONS PER DAY	NO. MEN	TONS PER MAN PER DAY	PRODUCT	TONS PER DAY	NO. MEN	TONS PER MAN PER DAY
Jan.,	12,744	490	221	2.21	14,719	566	216	2.57
Feb.,	11,602	483	219	2.20	13,010	542	229	2.35
Mar.,	10,990	440	219	2.01	13,933	536	237	2.26
Apr.,	11,670	449	209	2.15	14,265	594	238	2.49
May,	15,795	585	228	2.57	12,681	507	238	2.13
Jun.,	10,572	441	222	1.99	13,922	579	243	2.38
Jul.,	12,895	496	216	2.27	12,361	492	237	2.09
Aug.,	11,923	459	222	2.06	14,014	539	239	2.26
Sep.,	10,517	457	230	1.98	11,786	471	255	1.85
Oct.,	12,278	455	233	1.95	13,047	483	262	1.85
Nov.,	10,268	446	228	2.04	11,019	459	253	1.81
Dec.,	11,222	493	215	2.17	10,558	440	241	1.95

You will note that we secured fairly good results in 1919 until September. The monthly product for 1919 showed an increase over the corresponding months of 1918 for nine months. The product dropped in September due to delay in finding ore on the bottom level, Pascoe Shaft. It took us three months longer to cut the ore on the 2372' Level than it did on the 2272' Level because of the increased distance from the shaft. After we once get caught up on the development work, we ought to be able to obtain a steady uniform product from the mine.

TRAMMING.

We have no fault to find with the number of cars the trammers are loading per day. As remarked last year, the efficiency of the trammers has risen contrary to the results secured from labor in general. We are getting up just as much ore as we were three years ago with approximately only half the number of trammers employed.

The following table shows this very clearly:-

YEAR	AVERAGE NO. OF TRAMMERS.	TOTAL CARS TRAMMED.	DAYS	CARS PER TRAMMER PER DAY
1914	33	67,519	5,353	12.6
1915	39	150,969	12,172	12.4
1916	38	140,725	11,429	12.3
1917	30	119,883	9,122	13.1
1918	22	98,359	6,495	15.1
1919	20	102,301	5,625	18.2

You will note in 1916 we employed 38 trammers. In 1919, the number dropped to 20. The number of cars per man per day increased about 50% in the last three years.

COST OF PRODUCTION.

MONTH	1918 COST OF PRODUCTION			1919 COST OF PRODUCTION		
	LABOR	SUPPLIES	TOTAL	LABOR	SUPPLIES	TOTAL
Jan.,	1.832	1.023	2.855	2.266	.704	2.970
Feb.,	1.864	1.108	2.972	2.442	.817	3.259
Mar.,	2.044	1.190	3.234	2.487	.970	3.457
Apr.,	1.981	.984	2.965	2.270	.807	3.077
May,	1.725	.770	2.495	2.651	.880	3.531
Jun.,	2.339	.951	3.290	2.374	.934	3.308
Jul.,	2.024	.957	2.981	2.706	.997	3.703
Aug.,	2.398	.844	3.242	2.539	1.213	3.752
Sep.,	2.495	.940	3.435	2.839	.974	3.813
Oct.,	2.778	.939	3.717	2.829	1.257	4.096
Nov.,	2.790	1.215	4.005	3.023	1.083	4.106
Dec.,	2.677	.994	3.671	2.916	1.134	4.050
AVERAGE,	2.165	1.038	3.203	2.589	.975	3.564

The cost of producing a ton of ore has gone up during 1919 but most of the increase was due to conditions that seriously affected the product during the last six months of the year. These adverse conditions were discussed previously in this report. The cost of production has been subdivided and average daily product tabulated to show this up:-

	FIRST SIX MO. 1918	FIRST SIX MO. 1919		
	UNIT COST	UNIT COST	INCREASE	DECREASE
General Expense,	.156	.167	.011 or 7%	
Maintenance,	.292	.289		.003 or 1%
Mining Expense,	2.485	2.803	.318 or 13%	
Cost of Production,	2.933	3.259	.326 or 11%	
Total Cost on Cars,	3.831	3.652		.179 or 5%
Average Daily Product,	483 tons	554 tons.		
	SECOND 6 MO. 1918	SECOND 6 MO. 1919		
	UNIT COST	UNIT COST	INCREASE	DECREASE
General Expense,	.195	.216	.021 or 11%	
Maintenance,	.326	.559	.233 or 72%	
Mining Expense,	2.965	3.132	.167 or 5½%	
Cost of Production,	3.490	3.915	.425 or 12%	
Total Cost on Cars,	4.650	4.655	.005 or 01%	
Average Daily Product,	464 tons	482 tons		

You will note that we were securing fairly satisfactory results in the first half of the year. The cost of production only increased 11%, whereas the average wages for the 1919 period were 31% greater than the 1918 period. Assuming the cost of supplies to be approximately the same for the two periods, the wage increase of 31% would have increased the cost of production 23%. The actual increase being 11% proves that we were securing better results than the year previous.

You will also note the cost on cars for the first half of the year decreased 5%.

In the last half of the year due to decreased production and due to extraordinary charges on E. & A. 389 and E. & A. 391, the cost was increased 1%. You will note that the chief increase is in the maintenance account.

In the final analysis the total cost on cars is what determines the profit or loss in operating the property. The cost on cars since the Cleveland-Cliffs Iron Company acquired this mine runs as follows:-

COMPARATIVE COST ON CARS.

		COST PER TON
9 Months	1914,	3.087
12 "	1915,	2.298
12 "	1916,	2.845
12 "	1917	3.619
12 "	1918,	4.230
12 "	1919,	4.119

The last two years are the only ones that really give the real cost per ton on cars, because for the first time in years we actually broke the tonnage that we hoisted. In 1915, especially, this mine was practically robbed of broken ore, and for that reason, the above cost is misleading.

The total cost of producing a ton of ore in the Republic Mine has risen 44.7% since January 1st, 1916. When you consider that the wage scale has increased 98% in that period, while supplies have also increased greatly in cost, it would appear that our costs have not increased unreasonably.

However, I am not at all satisfied with the showing but have been hampered on account of the slow development of new ore bodies., I am greatly encouraged by the size of the ore bodies recently developed in the winze and Pascoe Shaft and hope to be able to reduce our costs materially. It is only a question of increasing the daily production. We have set as our goal an average product of 600 tons daily. If we can accomplish this, our total cost on cars will drop to approximately $3.50 per ton with the present wage scale and cost of supplies.

SHIPMENTS.

The shipments for the year were small, the total being only 69,035 tons. The ore was consigned as follows:-

	PRESQUE ISLE DOCK	HICKMAN-WILLIAMS CO.	HULL IRON & STEEL FDYS.	TOTAL
Bessemer Lump,	29,654		48	29,702
" Crushed,	15,774	304		16,078
Basic Lump,	10,243			10,243
" Crushed,	321			321
Pascoe Lump,	8,444			8,444
" Crushed,	4,247			4,247
TOTAL,	68,683	304	48	69,035

The lump shipments totalled 48,389 tons or 70% of the total. We had to restock 23,899 tons of "Fines", however, so that the actual amount of Lump ore secured from the run-of-mine ore was 52%. It was desired to secure as much Lump ore as possible and we therefore took the head out of the Crusher and blocked some of the holes in the revolving screen. To show what we accomplished, I submit the following table:-

YEAR	TOTAL SHIPMENTS	LUMP	%	FINES	%
1916,	209,059 tons	64,161 tons	31%	144,898 tons	69%
1917,	168,250 "	64,364 "	38%	103,886 "	62%
1918,	151,171 "	66,080 "	44%	85,091 "	56%
1919,	69,035 "	48,389 "	52%	20,646 "	48%

The tonnage of Lump ore produced has been increased 68% in the last four seasons. We hope to increase our Lump product to 60% of the run-of-mine next season by the installation of the new revolving screen. There is a premium on this class of ore and it is very desirous to produce as much as possible. Besides, the Lump ore seems to be readily saleable while the "Fine" hard ore has a limited market at present.

GRADING SHIPMENTS.

There was no essential change made in the method of grading and mixing Republic cargoes during 1919, except that we rarely used over 20% Pascoe ore in the mixtures. We did not secure as satisfactory checks with the Lower Lake Chemists as in the years 1917 and 1918. The following table shows the comparative analysis for the last three years:-

	MINE ANALYSIS		LOWER LAKE	
	IRON	PHOS.	IRON	PHOS.
1917.				
Republic Lump,	63.75		63.96	
" Bessemer Crushed,	62.60	.038	62.80	.038
" Basic,	61.59		61.89	
1918.				
Republic Lump,	64.70	.048	64.07	
" Bessemer Crushed,	62.70	.0366	62.51	.0365
" Basic,	62.57	.055	62.73	
1919.				
Republic Bessemer Lump,	66.02	.033	64.89	
" Basic "	64.54	.050	64.05	
" Bessemer Crushed,	63.29	.032	62.81	
" Basic "	62.04	.034	61.67	

You will note that the Lower Lake analysis are lower on each grade in 1919, whereas in 1917 and 1918, they were for the most part higher. This condition is very peculiar as we have generally blamed the Lower Lake results to the admixture of Pascoe ores, but the contrary seems to be the truth in some cases. The following table bears out this peculiar condition:-

	% OF PASCOE ORE IN MIXTURE.	MINE ANALYSIS HIGHER THAN LAKE	MINE ANALYSIS LOWER THAN LAKE
REPUBLIC LUMP.			
YEARS.			
1917, Basic Lump,	22.0%		0.21
1918, " "	20.4%	0.63	
1919, " "	17.0%	1.49	
1919, Bessemer Lump,	18.0%	1.13	
REPUBLIC BESSEMER CRUSHED.			
YEARS.			
1917,	18.3%		0.20
1918,	21.4%	0.19	
1919,	20.0%	0.48	
REPUBLIC BASIC CRUSHED.			
YEARS.			
1917,	31.4%		0.30
1918,	21.4%		0.16
1919,	25.0%	0.37	

In the case of the Lump and Basic Crushed cargoes, the using of greater quantities of Pascoe ore actually gave higher Iron at the Lake Erie ports, but in the Bessemer Crushed cargoes,

the greatest difference in Iron analysis occurs when using only an average amount of Pascoe ore.

To sum up in brief, the average mine analysis for 1919 checks fairly well with the analysis reported by the Lake Erie Chemists on all grades except the Republic Bessemer Lump. One might infer from this that we are reporting too high results on our Bessemer ores. To refute this, however, we have the cargo of the Steamer "Mather" loaded on September 9th, which carried nothing but a straight Bessemer Lump ore on which the mine reported 68.29 Iron and the Lower Lakes reported back 68.26 or almost an exact check.

The cargo mixtures for the season 1919 were made up as follows:-

BESSEMER LUMP CARGOES.

Bessemer Lump Ore,	16,627 tons,		80%
Basic " "	395 "		2%
Pascoe " "	3,659 "		18%
	20,681 "		100%

BASIC LUMP CARGOES.

Bessemer Lump Ore,	13,027 tons		47%
Basic " "	9,848 "		36%
Pascoe " "	4,785 "		17%
	27,660 "		100%

BESSEMER CRUSHED CARGOES.

Bessemer Crushed Ore,	12,150 tons		80%
Basic " "	43 "		---
Pascoe " "	2,982 "		20%
	15,175 "		100%

BASIC CRUSHED CARGOES.

Bessemer Crushed Ore,	3,623 tons,		70%
Basic " "	278 "		5%
Pascoe " "	1,266 "		25%
	5,167 "		100%

SORTING ORE.

The ore from the stopes ran fairly clean for the year. Approximately 10% of the product hoisted through No. 9 Shaft had to be discarded which is just about the same percentage as in 1918. In 1917, over 30% of the material that passed over the Picking Table had to be classed as "Rock".

FARM.

The crops from the farm were fair. The hay crop was 21 tons, and 378 bushels of Oats were produced. The two crops last year were 15 tons and 309 bushels.

TOWNSHIP LIGHTING & POWER.

The Republic Township is getting to be a better customer each month. The homes generally are gradually being wired and the installation of the electric pump at the Water Works Pumping Station increased the consumption of current. Power was sold for 3¢ per K.W.H. until the Hydro-Electric System was cut in, after which the cost per K.W.H. was reduced to 2¢ and less. The following table shows the amount of electricity consumed by the Township:-

YEAR	K.W.H.	RATE
1915,	33,637	3¢
1916,	36,789	3¢
1917,	43,246	3¢
1918,	43,080	3¢
1919,	136,196	1.85 - 3¢

ESTIMATED PRODUCTION.

The product for the year 1920 is estimated at 500 tons per day. Last year the estimated tonnage was 500 tons per day and we actually produced 518 tons per day. We hope to exceed the estimated product for 1920 and can easily accomplish this if our development work continues favorable.

DELAYS.

The number of delays has been steadily reduced. In 1916 we had eighteen serious accidents to equipment causing a loss in production of 3,280 tons.

DELAYS - (CONTINUED).

In 1917, the delays numbered 26 and loss of product 5,315 tons. In 1918, the break-downs were reduced to 15 in number and tonnage lost was reduced to 1,390 tons. In 1919, as shown below, we were unfortunate in having two bad wrecks, one in No. 9 Shaft and the other in the Pascoe Shaft, which reduced our output 4,350 tons.

DATE	HOURS LOST.	SHAFT	CAUSE OF DELAY	PRODUCT LOST.
Feb. 25,	4	Pascoe,	Piston broke on hoist,	100
" 26,	14½	"	" " " "	250
Jul. 22,	10½	"	Skip off track,	200
" 23,	23	"	Repairing Skip-road,	75
" 28-Aug.2,	92	No. 9,	" Cage-road,	1000
Aug. 4,	8	"	" " "	75
Nov. 3,	11	Pascoe,	" Skip-road,	175
" 3,	4	No. 9,	Electric Power off,	50
" 18,	2	"	" " "	75
Dec.15-31,	160	Pascoe,	Repairing Skip-raod,	3350

NEW CONSTRUCTION.

NEW ENGINE HOUSE:-

The new Engine House serving No. 9 Shaft was finished and new electric houst placed in commission in July. The new hoist has operated satisfactorily. Power is secured over the transmission line connecting the Republic Mine with the Barnes-Hecker. The entire project covered by E. & A. #346 was estimated to cost $94,600. The actual cost was $99,975.99, showing an over-run of $5,375.99. Part of the increase was due to the increased cost of the transformers and part was due to the grading, leveling off and improvements around the new power house. No provision for this had been made in the estimate. A plot of ground approximately 150' x 200' surrounding the Engine House was fenced in and graded. A driveway and walks were graded and covered with cinders. The borders of the walks were sodded and the rest of the area seeded.

STOCKING GROUNDS & TRESTLES:-

It was decided to install a revolving screen at the end of the Picking Belt at No. 9 Shaft and to separate the Lump and "Fine" ore and stock it separately. To do this required the building of two trestles and preparing two new stocking areas. The old No. 6 stockpile grounds were enlarged by excavating with the Steam Shovel the waste rock and sand between the old stocking grounds and the Crusher stocking area. The excavated material was dumped into the bay back of the old horse barns and the first two houses in the location nearest the barns. These buildings were torn down. A railway track was constructed leading off the West Republic track near the end of the Central Plant Coal Dock, thence running between the office and Carriage Shed following the road as far as the Horse Barn and then swinging over towards the lake. The area formerly occupied by the buildings mentioned above, is the site of the new Lump ore stockpile grounds. A 40' trestle has been built leading from these grounds back to the No. 9 Dry and eventually this trestle will be connected onto the track running back to the new revolving screen. The foundations for the screen were partially completed at the end of the year.

UNDERGROUND ELECTRIC HOISTS:-

Two electric hoists were installed underground, one at the No. 9 Winze and the other at the 2050' Level, Pascoe Shaft plat. The cost of this work was covered by E.& A. #367. The No.9 Winze hoist was installed and running by September. The Pascoe Shaft hoist was being put together at the close of the year. The estimated cost on the E. & A. was over-run due to increased purchase price of the No. 9 Winze hoist and also due to the excavating necessary at the winze before hoist could be installed. We planned originally on placing the hoist in the end of the sub-drift back of the winze, but found it would be advisable to use this drift to store empty cars.

We then had to cut out a new room for the hoist at right angles to the long dimension of the winze and this work ran up the cost so that we exceeded the estimate by approximately $1,700.00.

ELECTRIC STORAGE BATTERY LOCOMOTIVES:-

We purchased a second locomotive during the year, the first having given us such good results. We have run the first one for approximately eight months and have had no trouble or delays. The only difficulty lies in the length of time it takes to charge the battery. The charging can not be hastened or speeded up because of the harm that would result in feeding the current in too fast. The temperature of the battery solution must be kept below 85° and as a result, it takes from six to eight hours charging daily to keep the battery up so as to handle 200 cars daily. As we plan on eventually hauling 400 cars daily to No. 9 Shaft, we were compelled to buy a second locomotive. A spare battery might have enabled us to keep the one locomotive going to handle the 400 cars, but in case of accident or break-down, the mine would be completely tied up. We decided it would be more advisable to buy a second locomotive complete.

LABOR & WAGES.

We were not troubled by any real shortage of labor underground although there were a few days here and there that the product would have been greater if we had had a few more trammers. As a rule, we had as many trammers as we had places to work them in.

There were no wage increases or reductions during the year. Of course, the average scale of wages for 1919 was higher than the previous year, due to the three increases in 1918. The average scale for 1919 runs 17.2% higher than that for 1913.

INSURANCE.

The amount of insurance carried on the mine buildings and dwellings was increased during the year.

ENGINEERING.

All engineering work is done by men from the Ishpeming Office. This expense increased approximately 50% during 1919 due to extra work involved in making surveys for the new trestles, new stocking areas, revolving screen, etc.

ANALYSIS.

The unit cost under this head decreased slightly compared with last year.

PERSONAL INJURY EXPENSE.

The number of accidents reported in 1919 totalled 65 compared with 61 for the previous year. Of the total for the year, only three were serious accidents. In one case, an employe fell 20 feet and hurt his back, and in the other two cases, a leg was broken. The bulk of our accidents consists of bruises to fingers. The trammers in handling the Lump ore have fingers squeezed between the chunks or between the chunks and the side of the car. These trivial injuries are bound to occur when trammers fill from thirty to forty cars daily. Back in 1914 and 1915 when a gang of fillers only averaged eighteen to twenty-two cars daily, they did not have so many pinched fingers. If you speed up a man's work, you are bound to have more accidents notwithstanding all the safety precautions.

MINE OFFICE EXPENSE.

The increase in the Mine Office expense is entirely due to the increased wages paid compared with the previous year.

MAINTENANCE.

TRACKS & YARDS.

We expended $653.90 during 1918 and $2904.78 in 1919, the latter covering the cost of the track built by the D.S.S.& A.Ry. to serve the new stocking grounds.

DOCKS, TRESTLES & POCKETS.

The expense for 1919 was very high. The total of $9767.91 covers expenditures on E. &. A. #389. The amount expended covers the cost of the new Lump and "Fine" ore trestles, the excavating for the "Fine" ore stocking area, the filling and grading of the Lump ore area, tearing down buildings, changing road, etc. A considerable part of this expense is switch engine service.

All of this new work is made necessary for two reasons. The new scheme of separating the Lumps and "Fines" makes two stocking areas necessary. Then also approximately 90,000 tons of unsold ore was still on hand on November 15th, 1919. Most of which was on the No. 9 stockpile area. This limited the additional stocking capacity to less than 50,000 tons, and we estimate that on March 1st, 1920, we will have to utilize the new trestle.

BUILDINGS - SHOP MACHINERY - BOILER PLANT.

These combined accounts show a considerable decrease, especially the latter. The maintenance on the Boiler Plants dropped to one-third due to shutting down the old No. 5 Steam Plant.

HOISTING MACHINERY.

This maintenance account has more supplies charged to it than any other on the list, and the bulk of it consists of hoisting rope and rope sheaves for the Pascoe Shaft. For instance in 1919, we put on four new ropes or 20,000 feet of rope. This rope is worth approximately 50¢ per foot. We hope to cut down this particular expense considerably in the future. The ropes for No. 9 Shaft are now only 3,000 feet long whereas they used to run 5,000 feet. By diverting the bulk of the ore to No. 9 Shaft, we hope to increase the life of the long ropes used in the Pascoe Shaft.

The average rope can only be used from eight to nine months in the incline shaft. We had one rope break on December 15th that had only been used 145 days. This rope had to be discarded.

COMPRESSORS & POWER DRILLS.

The expenses incurred under this head are largely replacements of old drilling machines. The ground in the Republic Mine is so hard that the ordinary drilling machine will only last four years. At the end of two years, we usually have the cylinder rebored and fitted with an over-size piston and the machine can then be used for about two years more. At the end of four years, all the other parts about the machine are racked to pieces and worn down so that we have to scrap it. We must expect to buy about ten new machines yearly to keep our miners supplied with the proper tools to work with. A poor worn out machine wastes the miner's time and is a bill of expense to the Company.

From my observation of drilling machines, I can unhesitatingly recommend the Ingersoll-Rand #18 and #248 machines as the best all around drilling machines on the market. We have tried out the Denver Dreadnaught, Denver Super-Dreadnaught, Denver Turbo and the Sullivan D.R.6 and D X 61, but find none of them to equal the Ingersoll-Rand #18 and #248, both for up-keep and drilling speed.

PUMPING MACHINERY.

We expended twice as much in 1919 as in the previous year due to changing about pumps. The electric pump was removed from the 1950' Level, Pascoe Shaft, to the 2232' Level, No. 9 Shaft, as explained elsewhere in this report.

By making these changes we have eliminated two electric pumps entirely and have reduced the number of hours of air pumping from ten to two, which in turn reduces the cost of operating the air compressor.

Of course in the Spring of the year when the water is high and we are compelled to waste water, there is no saving as we could operate the compressors continuously; but from July to the following March, some air has to be made by the steam compressor and so the more water we can conserve the better.

The old electric pumps discarded are being repaired and will be used on the lower levels in the winze and in the Pascoe Shaft.

TOP TRAM ENGINES & CARS.

The unit cost for this account was .012 in 1918 and .022 in 1919. The increase is due to supplies charged out, most of which is wire rope. It so happened that in 1918, only one new rope was placed in service on the Pascoe Top Tram. In 1919, three new ropes were put on, one at No. 9 Shaft and two on the Pascoe Top Tram. Also in the past year, eighteen new Manganese car wheels were purchased. Then also one new top tram car was being rebuilt to be used on the new Lump ore trestle.

SKIPS & SKIP ROADS.

This maintenance account also shows a heavy increase in cost due to the wrecks in the shafts and the constant repair work necessary to keep the Pascoe Shaft in shape. As a matter of fact, notwithstanding the constant repairing done in the incline shaft, it is to-day in very poor shape. The skip-road from surface down to the 1335' Level or approximately 2000 feet along the incline, is in need of extensive repairs. We find broken rails and runners frequently and by the constant system of inspection used, we find these defective spots before they are three or four hours old and usually get a chance to repair same before a wreck occurs. In 1917 we spent $11,623.23 under this head. In 1918, expenses were reduced to $7,532.60. During the past year, the total cost amounted to $13,019.66. The only way to eliminate this expense is to divert all the ore to No. 9 Shaft, which is exactly what we are planning

to do and hope to accomplish early in the year 1920. It is questionable whether we can send all the Pascoe Shaft ore to No. 9 but at least the major portion will be hoisted through the vertical shaft. The last wreck in the Pascoe Shaft cost us $3,500.00, approximately.

UNDERGROUND TRACKS & CARS.

The expense under this head although only a little larger than last year is still heavy, due to the construction of new motor cars and tracks. We have so far built twenty-one new motor cars but will need probably twelve more to operate properly. These motor cars are not only used on the motor haulage level but also on all the new levels in the winze, the cars being hoisted on a cage. As all the ore and rock from the lower levels in the Pascoe Shaft will also be handled in motor cars, we really ought to have from thirty-five to forty cars in service to prevent delays.

We have also laid heavier rail on part of the 2050' Level, Pascoe Sahft, so that now all of the motor haulage level is equipped with 30 lb. rail.

ELECTRIC TRAM PLANT.

The maintenance cost of our new motor haulage plant is low due to its newness. In fact, we have had no trouble with new locomotives or storage battery charging outfit.

TELEPHONES & SAFETY DEVICES.

The maintenance under this head was slightly larger in the past year due to the increased cost of supplies for the safety department. We also installed a number of new safety guards in the new Engine House.

WATER POWER PLANT.

Very little money was spent here during the year, the unit cost being only .006 per ton.

MINING EXPENSE.

AIR PIPES:-

The expenses under this head increased 32%. The unit cost was only 23% larger for 1919. In 1918, we employed only one pipeman but in 1919 due to opening up of new territory, we were compelled to add a pipeman's helper to the pay-roll. Then also the average wages for 1919 were 17.2% higher than 1918, being 39% higher in January 1919 than in the corresponding month of the previous year. In April, the difference was reduced to 24% and in July 13%. On October 1st, 1918, the wage scale was identical with the prevailing scale for 1919.

During 1919, we added three new contracts which had to be supplied with hose, pipes, etc. We also replaced considerable ¾" air hose with new 1" hose to gain greater drilling speed.

COMPRESSORS:-

The air compressor plant produced air at a decreased expense in 1919. The total cost for 1918 was $12,065.73, which was reduced to $10,034.53 in 1919. The unit cost for the same years was .085 and .065. This is entirely due to the exceptionally mild winter of 1919. The swamps and tributary streams of the Michigamme River were only slightly frozen and as a result, water was flowing constantly to supply our water power air compressing plant. We were compelled to only operate our steam compressor to capacity during August and September, 1919, and those two months, the unit cost was boosted to .156 and .132.

The following table is submitted showing the greatly reduced air consumption in the last two years compared with previous years:-

YEAR	M. CU.FT.AIR COMPRESSED	NO.DRILL IN OPERATION UNDERGROUND.
1915	1,716,837,000	42
1916	1,841,863,000	30
1917	1,577,113,000	30
1918	1,143,454,000	34
1919	1,228,202,000	42

You will note that in 1919, we had exactly as many drilling machines going as in 1915, and that the amount of air used per drilling machine in 1915 was 40% greater.

The saving was accomplished by scrapping all the old type drilling machines, by substituting electric driven for air pumps, by stopping numerous leaks on the main air lines and by keeping the miners supplied with good sound air hose. Two or three years ago, we found contract after contract using hose patched in dozens of places.

We also tried during the year to operate one of our air compressors by electricity. At the water power plant, the generator that supplied the mine with current before we were hooked up with the Hydro-Electric System was connected to the No. 2 Compressor. This compressor was driven by the generator acting as a motor for a month. We found on figuring up the number of cu. ft. of air compressed per K.W.H. that it was costing us approximately twice as much to make compressed air as it did by operating our steam compressor. We therefore have operated our steam compressor whenever we were short of water.

HOISTING:-

The unit cost under this head was reduced from .320 for the year 1918 to .286 for 1919, notwithstanding the increased scale of wages for the latter year compared with 1918. The decrease is due to the operation of the new electric hoist. On July 19th, the electric hoist was put into service. At the old No. 5 steam plant, we employed three brakesmen and two firemen and the same work is now done by two men. We have had to add two hoisting engineers to operate the electric hoist serving the No. 9 winze so that the labor charges are but little different now than before. The supplies under this head have decreased from $36,514.81 to $33,370.48. The year 1920 should show a still further decrease.

PUMPING:-

We made one radical change in our pumps which eliminated the air pumps at the bottom of the shafts. In No. 9 Shaft, an electric pump, which had previously been placed on 1950' Level, Pascoe Shaft, was installed on the 2232' Level. The water cylinders on this pump were bushed down so that it could throw water up to the main pump on the 1153' Level. This eliminates the air pump previously used on the 2232' Level and the two electric pumps on the 2082' and 1640' Levels. A large sump was constructed by building a concrete wall across the rock drift on the bottom level and an eductor was installed to lift the water out of the sump at the bottom of No. 9 Shaft.

We are still using some air pumps on the lower levels, Pascoe Shaft, but will do away with these by installing an electric pump probably on the 2572' Level.

The unit cost for pumping has risen from .039 for the year 1918 to .049 for 1919, due partly to increased scale of wages but mostly due to the higher rate for electric power charged to pumping after July 19th. Previous to that date, we made our own current at less than .004 but now we are buying it from the Hydro-Electric System at .015. Up until August 1st, our average monthly pumping expense ran .040 per ton. Since that date, it has averaged .064.

SINKING & SHAFT REPAIRS:-

This account shows a very large increase for the year. The total expended for 1918 being $17,009.69 and for 1919, $32,156.08. During 1918, we sank 190 feet of Shaft and during 1919 - 189.5 feet. The cost per foot therefore for the latter year is just about double the previous year. This is due partly to a change in charging out the labor and supplies, partly to increased scale of wages but mostly due to the ground the shafts were sunk through.

In 1918, the No. 9 Winze was sunk in Quartzite for 100 feet. The balance of 90 feet was the sinking in the Pascoe Shaft which was part of the lift from the 2272' to the 2372' Level. This lift was sunk entirely in Sheared Quartzite. In 1919, the Pascoe Shaft was sunk 90 feet in very hard Jasper. In 1918, we made as high as 35 feet a month in the Quartzite, but so far, we have only averaged 15 feet per month in the Jasper. Consequently the cost per foot is more than doubled. The winze was sunk 100 feet more in 1919 and the most of this was also in Jasper. The Quartzite played out a short ways below the 2172' Level and Jasper came in gradually from the East side of the winze. In addition to the change in ground which increased the cost per foot, a change was made in the distribution of the labor and supplies when building storage pockets and cutting out the ground to accommodate them. This was previously charged to account #134, but we are now charging same to account #154 under discussion.

ROCK DRIFTING:-

The total expended for the two years is nearly identical. The footage drifted for 1918 was 960 and for 1919, 1085 feet. The unit cost per foot of drift was reduced from $20.37 to $18.78. Practically every foot of rock work has been done in the Republic Jasper. The smaller consumption of explosives per foot of drift helped to reduce the cost. The following table shows the footage and explosives used for the last four years:-

YEAR	FOOTAGE	LBS.OF EXPLOSIVES USED	LBS.PER FOOT
1916	2,603	46,829	17.9
1917	2,138	34,272	16.1
1918	960	19,000	19.8
1919	1,085	16,675	15.4

You will note the consumption per foot of drift is the least in the four years.

Another reason for the reduced costs is that we usually had enough trammers employed to handle both the ore from the stopes and the rock from the drifts. In 1918, the miners usually had to tram their own rock which resulted in higher costs. As explained in last year's Annual Report, the miners being older men do not clean up the rock as fast as the regular trammers and as a result, the footage per month drifted dropped very low. In 1919, nearly normal conditions have been restored and as a result, costs have been lowered notwithstanding the increased comparative wage scale.

BREAKING ORE:-

The unit cost of breaking ore has risen according to the cost sheet from 1.238 in 1918 to 1.304 in 1919, or only a little over 5%. The actual unit cost according to the tons of ore actually broken increased from 1.306 to 1.428 or approximately 9%. This increase is less than the difference in wages for the two years so that there are no signs of decreased efficiency.

The following table shows the tonnages hoisted and broken for the last four years:-

YEAR	TONNAGE HOISTED	COST PER TON FOR BREAKING ORE	TONNAGE ACTUALLY BROKEN.	ACTUAL COST PER TON BROKEN.
1916	173,096	.717	123,194	1.007
1917	153,425	.799	94,048	1.302
1918	142,476	1.238	135,140	1.306
1919	155,315	1.304	141,785	1.428

It will be noted that the actual cost of breaking a ton of ore has increased only approximately 42% in the last four years and only actually 9% in the last two years, which I believe is a very creditable showing when you consider the wage increases in that period and especially the increase in the price of explosives. Explosives make up a considerable portion of the cost of supplies charged to breaking ore; in fact, from 75% to 80% is the monthly average.

The following table shows how we have reduced the consumption of explosives per ton of ore broken:-

YEAR	TONS ACTUALLY BROKEN	LBS. OF POWDER PER TON OF ORE	AVERAGE PRICE OF LB. OF POWDER
1916	123,194	1.349	.1506
1917	94,048	1.745	.1923
1918	135,140	1.159	.2293
1919	141,785	1.094	.2143

The most encouraging feature of the first table is the fact that in 1918 we broke 94.8% of the ore hoisted, and in 1919, 91.2%. In all the previous years that this Company has operated the Republic Mine, the bulk of the product was secured from stopes in which the ore was broken by the Republic Iron Company. In other words for sake of comparison, the cost sheets for the years 1915 and 1916, especially, are worthless because they do not express the true facts.

I firmly believe that we will be able in 1920 to show more ore broken than hoisted. Our reserves of broken ore are reduced to a minimum, being only about 32,000 tons actually, so that in order to keep our product up, we must break ore pretty lively.

TRAMMING:-

For the first time since the mine was opened up, we are able to report that considerable of the ore hauled to the shaft is handled by motors. The electric storage battery locomotive was put into active service in March. It handles all of the ore broken on the 2082', 2172' and 2272' Levels, No. 9 Shaft, and 2050' Level, Pascoe Shaft. The locomotive has operated perfectly for the last ten months, has given us no trouble at all and has proven to be a safe and reliable way to transport the ore. Although motor haulage has not decreased the actual cost of tramming per ton of ore, it has indirectly cut the cost of production. For instance, all the ore is loaded into motor cars on the levels

tributary to the winze. For this loading, we have to pay trammers the contract rate per car. The motor cars are then hoisted on a cage to the motor haulage level where the motor couples onto them and hauls them to No. 9 Shaft. If we did not have the motor, we would have to employ from six to eight additional trammers on each shift to take the ore from the winze to No. 9 Shaft. The motor handles from 100 to 120 cars daily at a minimum expense. Now, inasmuch as all the ore has to be loaded by fillers into cars as heretofore, you can readily see that it cost just as much to fill the ore now as it did before motor haulage was established. There is absolutely no way to get away from this as our ore can not be loaded into motor cars from chutes.

On the other hand, if we had not installed the motor, our average daily product would be considerably lower and we would have to charge the services of twelve or sixteen extra men onto the tramming cost.

We also propose to make a radical change in the handling of the Pascoe Shaft ore. The underground electric hoist now being installed at the 2050' Level, Pascoe Shaft plat will hoist the ore from the 2372' and 2472' Levels to the motor haulage level, whence this ore will be hauled by motor to No. 9 Shaft. The main haulage drift runs up grade nearly the entire distance, so that mechanical haulage had to be installed to haul this ore. We are planning on diverting all the ore possible to No. 9 Shaft to do away with hoisting through the Pascoe Shaft and also for the purpose of having the run-of-mine ore separated into lumps and "Fines" by the new screen in the No. 9 Shaft House.

TIMBERING:-

The timbering expense shows an increase of 22% over last year. This is entirely due to the increased scale of wages which affects the timbermen's wages more than any other class of employees in the Republic Mine.

All of the timber used in this mine must be handled between shifts. It is lowered down either No. 9 or Pascoe Shafts and in either case must be handled after the skips stop hoisting ore. That means that all of the timbermen receive overtime and have been paid time and a half since October 1st, 1918. It takes five men in each gang to handle the heavy stull timber and due to our small sized shafts, every piece has to be loaded individually onto the cage or timber truck by hand and taken off the same way.

The only way to combat this is to try to do away with the most of the timbering by substituting some other method of mining. The raise and pillar system was tried in this mine four years ago, but did not work out satisfactorily. We are now going to attempt to mine the ore by still another method. The new system will be tried out on the 2372' Level, Pascoe Shaft. This new system is discussed in detail in another part of this report.

CAPTAIN & BOSSES:-

No changes were made in the personnel of the underground bosses.

DRY HOUSE:-

We are still using the old No. 9 Dry. It is badly in need of extensive repairs but have done nothing in this regard as we hope to start construction on a new Dry in the Spring.

TOP LANDING & TRAMMING:-

The unit cost for handling the ore on the Top Trams has gone up 12% due entirely to the increased scale of wages.

STOCKING ORE:-

The expense under this head is slight, due to the fact that only one man was employed on both the stocking areas to build retaining walls and to keep the equipment on the trestle in proper shape.

SORTING ORE:-

We have made no changes in the method of sorting the rock out of the ore. The ore from the No. 9 Shaft territory has been fairly clean, and we have handled as high as 250 tons per shift over the Picking Belt without delaying the hoist. The ore pulled from the Pascoe Shaft stopes contains a large percentage of small Soaprock chunks which must be sorted out as the cars are being filled by the fillers. After this ore will be diverted to No. 9 Shaft, it will still be necessary to employ rock-pickers with each gang of trammers in the Pascoe Shaft, because it would be impossible to pick out the small pieces of rock on the belt without delaying operations. To handle say 300 or 350 tons per shift over the belt means that it must be kept moving constantly and you can not sort out Soaprock properly without stopping the belt three or four times for each skip load. The No. 9 Shaft ore is usually mixed with Jasper or Quartzite and these rocks usually occur in large masses or chunks and can easily be rolled off the belt while it is in motion.

MINING EXPENSE:-

The total mining expense has risen from 2.719 per ton in 1918 to 2.958 in 1919, an increase of less than 9%.

SUPPLIES.

The total amount expended for supplies was $147,946.05 in 1918 and $158,262.89 in 1919. The unit cost was reduced in the past year due to increased production. General supplies increased due to charging out four new hoisting and three new top tram ropes. More Iron and steel was used due to putting a lot of new drill steel into use. We were short of drill steel in 1918. Machinery supplies show an increase due to increased cost of repair parts for drilling machines. The explosives account shows a reduction due to smaller consumption and slightly decreased cost. We show a big decrease in the fuel account due to closing down the old No. 5 Boiler Plant. We purchased $8577.00 worth of electric power from the Hydro-Electric System and this amount added to our fuel bill shows a decrease of approximately $2,000.00 over the 1918 fuel expense.

UNDERGROUND.

The probable life of the Republic Mine was increased during the past year by the discovery of additional ore bodies. At the beginning of 1917, we had only 63,390 tons of ore in sight. In 1918, this was increased to 100,926 tons. On January 1st, 1919, this had further increased to 153,838 tons. On January 1st, 1920, the available tonnage in sight amounted to 179,600 tons or nearly triple the figures of three years ago. Still the ore insight is only a year's production and this shows the terrible handicap that we have to contend with to keep our product up and costs down. The increased ore reserves are reflected in the increased product for 1919. For the first time since 1915, our yearly production shows an increase over the previous year. This is likewise reflected in the costs as for the first time since 1915, we have likewise checked the rapidly rising cost per ton on cars and are actually able to show a decrease for 1919 compared with the previous year. If the showing up of new ore bodies continues, there is no reason why 1920 should not show still further improvement.

For the first time in recent years, three new levels were opened up during one year: two in the winze and one in the Pascoe Shaft. We hope to open up two more levels before July 1st, 1920.

The 2372' Level, Pascoe Shaft, proved the downward extension of the large Bessemer ore stope from the 2272' Level, and at the close of 1919, the prospects were that this stope would be still larger on the lowest level. The Pascoe Shaft was down two-thirds of the distance to the 2472' Level and before the end of the year 1920, we ought to cut this same ore.

The ore bodies in the No. 9 Winze are improving with depth which is a most encouraging sign.

To sum the whole year up in brief, it looks as if the tide had definitely turned in the right direction and that the peak of high costs and low production had been passed and that better results should be expected in the future if our development work continues favorably and after the new equipment authorized on E & A #389 is charged off.

PASCOE SHAFT.

1335' LEVEL:-

Stope #3 was exhausted early in the year and no further mining or drifting was done at this elevation.

1570' LEVEL:-

Mining in #1 Stope was finished in March and the trammers exhausted all the broken ore by May. We do not know of any additional ore bodies contiguous to the Pascoe Shaft at this elevation and the level was consequently abandoned.

1780' LEVEL:-

Stull timber was placed in #3 Stope which is a part of the Pascoe Shaft pillar, but no mining was done. Diamond Drill Holes Nos.: 426 and 427, were drilled just West of the Pascoe Shaft plat and the latter hole cut through four lenses of high grade ore. A drift was driven along the line of the drill hole and two stopes opened up. The first stope pinched out about 40 feet above the level and the second stope was just being started at the close of the year.

Diamond Drill Hole #427 showed up a greater footage of ore than any drill hole ever drilled by the Cleveland-Cliffs Iron Company in the Republic Mine.

1850' LEVEL:-

This level proved up the only real stope discovered in 1919 in the Pascoe Shaft. The South end of the level had been explored for ore and abandoned three or four times but indications forore being favorable, we persisted and finally were rewarded by finding a

fine stope of Basic ore. The ore body was split into two pieces on the sill floor by a horse of Jasper, but about 40 feet above the level, the Jasper gradually played out and the back of the stope showed a stretch of clean ore. On the sill floor, the West stope was 125 feet long and the East stope 180 feet long. At the elevation of the 1780' Level, the ore was 90 feet wide and 100 feet long. The stope is now up approximately 100 feet and there appears to be no diminution in its size so far. During the year, 27,355 tons were trammed from this one stope and approximately 12,000 tons of broken ore were still to be trammed, making a total of approximately 40,000 tons broken in this one stope. Four or five stopes of this size would enable us to keep our product up to an average of 600 tons daily.

A very small tonnage was taken from #2 Stope, which is really a part of the Pascoe Shaft pillar. The ore was stoped out to a height of 16 feet, so that stull timber can be placed in position. Further mining can not be done until the Pascoe Shaft can be abandoned.

2050' LEVEL:-

A small stope of ore was discovered in Diamond Drill Hole #431. This ore was drifted for and stoped out about 30 feet high by the end of the year. The stope is only 30 feet long and 10 feet wide.

Just South of the Pascoe Shaft, another stope was carried up holing to the bottom of the shaft. We intended this to be used for a storage pocket to hold the ore that will be hoisted from the bottom levels by the auxiliary electric hoist. It was intended to build three pockets in the stope and thence draw the ore off into motor cars to be hauled over to No. 9 Shaft. We may not be able to proceed with these plans due to the presence of a number of huge pieces of loose ore right under the Pascoe Shaft skip-road.

The foot-wall of the shaft to all appearances was sound until we had a chance to examine same from underneath, but it seems now that the stoping out of the ore in #1 Stope six or seven years ago, weakened the foot side to such an extent that no further blasting or drilling in this area is advisable. We would probably completely wreck the shaft at this point if we proceeded with the installation of the pocket. We will therefore probably be compelled to dump the skips directly into the motor cars on the 2050' Level instead of into a storage pocket.

2172' LEVEL:-

Tramming from #2 Stope exhausted all the ore left on stulls early in the year.

2272' LEVEL:-

Mining continued in the two stopes discovered at this elevation last year.

Three gangs were employed in #2 Stope and two gangs in #1 Stope. The former stope was holed to the 2172' Level in May and the latter in August. We trammed 49,707 tons from these two stopes in the year. To show how the lower levels are improving in depth, the following table is submitted:-

PASCOE SHAFT LEVEL.	TOTAL TONS OF ORE PRODUCED TO DATE.
2172' Level,	29,954 tons,
2272' "	75,468 "

Both of the 2172' and 2272' Levels are worked out as far as we know. The ground was extensively explored by Diamond Drilling and no ore bodies of any size discovered aside from #1 and #2 Stopes. The upper levels in the Pascoe Shaft usually showed up from six to ten stopes, but these stopes seem to have all petered out except the two mentioned above. The only chance for additional ore lies on the West side of the Pascoe Shaft, which territory has not been explored below the 2050' Level.

The fact that these lower levels have only disclosed two stopes so far again shows the difficulty of operating the Republic Mine and trying to secure production and lower costs. It takes seven months to sink the shaft one level in the exceedingly hard Jasper and then usually six or eight months elaspe before the nearest ore to the shaft can be reached. That means that it takes fourteen or fifteen months to open up a new level. We ought to produce 8,000 tons a month from the Pascoe Shaft territory to maintain a 600 ton daily product so that each new level must show up from 115,000 to 120,000 tons to keep us going. You will note that the 2172' Level only produced one-quarter of that tonnage and the next level about 60% of the desired tonnage.

We simply can not make a satisfactory showing until the lower levels continue to improve with depth.

2372' LEVEL:-

The plat on this level was reached in June and drifting for the ore started as soon as possible. In September, we encountered the first ore but it did not amount to much. Drifting was continued until November 15th when we cut the downward extension of #2 Stope. At the end of the year, this stope showed a width of 60 feet and a length of 40 feet. There was no signs of any rock at the North-East end of the stope and indications were that the ore might extend in that direction for a considerable distance. The ore is a very high grade Specular Hematite.

A rock drift was being driven back into the foot-wall to tap the probable downward extension of #1 Stope. Progress in this drift was slow due to the exceedingly hard nature of the Jasper.

PASCOE SHAFT SINKING:-

The Pascoe Shaft was sunk 80 feet below the 2372' Level by the end of the year. The Shaft is bottomed in Jasper which makes progress exceedingly slow.

NO. 9 SHAFT.

1815' LEVEL:-

The only mining at this elevation was done in the sub-level 20 feet below the main level. A drift was driven parallel to the hanging 100 feet in good Bessemer ore. The bottom of this drift being all in ore led us to believe that the #1 Stope ore body which we previously thought bottomed on the sub-level must extend down somewhere below the sub, notwithstanding that a drill hole put in two years ago to seek this ore, did not show up any ore 10 feet below the sub. Another hole was therefore drilled parallel to the first hole and 20 feet nearer No. 9 Shaft with the result that the ore was found to extend down 80 feet below the sub-level. All work on the sub was then stopped and the men moved down to the next main level to mine this ore from below.

1935' LEVEL:-

At the extreme North end of the level, stoping continued in #4 Stope until we holed to the 1815' Level. All mining here ceased in April and it took the balance of the year for the trammers to clean out the broken ore from the stulls.

In the old #1 Stope, the few remaining pillars were mined and ore completely drawn off.

In the old #2 Stope, there remained a thick floor pillar over the back of the corresponding stope on the 2082' Level which had been left to support the 1935' Level drift until all the ore North of this point had been trammed out. Towards the end of the year, a winze was sunk in this pillar and after holing to the back of the stope was enlarged. We plan on under-hand stoping all of this ore down to the motor haulage level which is by far the cheapest way to break the ore, provided the hanging is good and holds in place.

No. 6 Stope was started underneath the sub-level mentioned above on the strength of the showing in the Diamond Drill Hole which proved the ore within 30 feet of the sill floor of the 1935' level. The stope was started small and gradually increased in size as it approached the 1815' Level. The ore was mixed with Jasper at the start but this gradually cleaned up until at a point 50 feet below the 1815' Level, the ore was free from Jasper seams. This is the very same stope that we supposed we had encountered the day the Cleveland-Cliffs Iron Company took over the mine, but which afterwards proved a disappointment because the original ore was only followed for 10 feet above the level. The ore cut out here and started in again about 10 feet higher up. After this ore is mined, this level will be abandoned as we know of no further ore bodies at this elevation.

2082' LEVEL:-

Trammers pulled all the ore from #1 and #2 Stopes. These stopes turned out over 6,000 tons more than shown on the stull statement. We likewise showed a good over-run on all the other stulls cleaned up during the year, due to the method we now employ in figuring the ore broken on stulls. Three years ago, we usually had a shortage to make up whenever a stull was pulled which had to be adjusted by debiting the shortage to one of the stopes in which we were mining. Now we usually deduct 10% or 20% of the tonnage actually broken each month and only credit the stope with the reduced tonnage.

The Pascoe ore body at the North end of the level was opened up to its entire length which approximate 300 feet and stull timber erected. At the end of the year, this ore had been stoped up to a height of 100 feet at the South end. This grade of ore has given us a lot of trouble during the year. The ground is slabby and liable to fall without the slightest warning.

Props have to be kept in place for the entire length of the stope to keep the travelling road open. A contract is only able to break from 500 to 800 tons monthly, whereas if the ore was Bessemer or Basic, they would break double the tonnage.

2172' LEVEL:-

A nice stope was opened up opposite the winze during the year. The ore varies in width from 10 feet to 25 feet and the length to date is approximately 160 feet. The North breast is still in ore and we have developed so far approximately 40,000 tons of ore between this level and the one above. About half of the ore is Bessemer and the other 50% will have to be hoisted as Pascoe grade due to the presence of seams of Jasper running through the ore.

2272' LEVEL:-

The ore was cut adjacent to the side of the winze at this elevation and by the end of the year was opened up for a length of 200 feet. The width varied from 10 feet to 27 feet. This ore which is probably the downward extension of the stope found on the 2172' Level is of better grade than on the latter level. A cut 16 feet high was taken from end to end and stull timber erected so that by the end of the year we were breaking ore on the stull.

Just North of the winze a sump was cut out into which all the water will be diverted that now runs into the winze and which would interfere somewhat with the sinking operations.

The North drift which is in rock was driven along the hanging for a distance of 150 feet from the winze. We expect to cut the downward trend of #3 Stope on the 2082' Level in this direction.

WINZE:-

The sinking of the winze was resumed just before the close of the year. It is now bottomed 10 feet below the 2272' Level.

DIAMOND DRILLING.

The Diamond Drill was kept going constantly during the year. Twenty-two holes were drilled in various parts of the mine.

No. OF DRILL HOLE.	LOCATION.		FOOTAGE OF ORE DISCOVERED	
			1ST CLASS ORE	2ND CLASS ORE
414	Pascoe Shaft,	2270' Level,	---	---
415	"	" "	7	---
416	"	" "	3	1
417	"	" "	2	---
418	"	" "	7	---
419	"	" "	2	---
420	No. 9 Shaft,	2080' "	---	---
421	Pascoe "	1850' "	14	---
422	No. 9 "	1935' "	---	18
423	Pascoe "	1850' "	3	---
424	" "	" "	15	---
425	" "	2270' "	---	---
426	" "	1780' "	2	---
427	" "	" "	55	---
428	" "	1950' "	18	---
429	" "	" "	11	---
430	" "	1335' "	---	---
431	" "	2070' "	52	---
432	" "	" "	11	---
433	" "	" "	---	---
434	" "	2370' "	19	---
435	" "	2070' "	2	---
436	No. 9 "	2272' "	---	---
437	" "	" "	---	---
438	" "	2172' "	---	---
439	" "	" "	---	4

You will note that a considerable footage of ore was uncovered by the drill. In fact, more lineal feet of ore was cut through in 1919 than in any previous year's drilling. Still the number of tons of ore developed by the drill was exceedingly small. We have not as yet since the Cleveland-Cliffs Iron Company bought this property disclosed any real good sized new ore body with the drill. Practically all of the new ore was developed by drifting and sinking. On the other hand, we have proven by drilling that a lot of territory adjacent to the new levels opened up was barren. I would not have been satisfied if this ground had not been explored, but unfortunately, the area explored by the drill disclosed very little ore, especially on the 1335', 2070' and 2270' Levels,

Pascoe Shaft. On all three of these levels the drill holes were spaced at regular intervals and the territory back from the hanging systematically drilled and no ore body exceeding 2500 tons in size was shown up.

Following is a statement showing the holes drilled since May 1st, 1914, the tonnage directly discovered by drilling and the tonnage discovered by sinking and drifting.

YEAR	NO. OF DIAMOND DRILL HOLE DRILLED.	TONS OF ORE DEVELOPED.		TOTAL
		BY DIAMOND DRILLING	BY DRIFTING & SINKING.	
1915	7	2,000	16,611	18,611
1916	11	6,100	12,632	18,732
1917	29	38,950	78,591	117,541
1918	10	53,894	102,045	155,939
1919	22	34,710	154,737	189,447
TOTAL,	79	135,654	364,616	500,270

It might appear from the table that a little more than one-quarter of all the new ore proven up was found by the Diamond Drills. It happens though that approximately 93,000 tons or the bulk of the tonnage found by the drills was in one stope, which in course of time, would have been found by drifting anyway, so that with this one exception, considerably less than 10% of the new ore was encountered in the drill holes.

There is only one way to develop new ore in this mine and that is to keep on sinking the shafts and drive drifts along the hanging. It probably is good policy to drill the ground 100 feet or 200 feet back from the hanging on each level systematically but so far all of this ground has proven barren on all the new levels. We have cut some ore in these drill holes but found after drifting in for the ore that only small pockets existed. To reach these pockets required considerable rock drifting and as a result of the small lenses, we are getting skeptical of the ore cut by the drill.

To sum the whole matter of Diamond Drilling up in brief, although we have uncovered very little ore, we have satisfied ourselves that we have left no sizable ore bodies behind on the levels we have abandoned.

ORE IN SIGHT.

The following statement shows the tonnage in sight on December 31st, 1919:-

NO. 9 SHAFT.

LEVEL	ORE BROKEN ON STULLS AVAILABLE	ORE BROKEN ON STULLS NOT AVAILABLE	ORE IN PLACE	SHAFT PILLARS	PROSPECTIVE ORE	TOTAL
911'				2,520		2,520
1000'				3,000		3,000
1050'				6,000		6,000
1153'				3,200		3,200
1665'	8,193					8,193
1935'	7,030		14,435			21,465
2082'	11,710		18,130			29,840
2172'			35,600		8,795	44,395
2272'			39,400		24,000	63,400
TOTAL,	26,933		107,565	14,720	32,795	182,013

PASCOE SHAFT.

1640'				2,700		2,700
1710'		12,515		24,000		36,515
1780'		22,000	17,035	21,500		60,535
1850'	12,269	2,790		13,200		28,259
1950'				58,570	3,000	61,570
2050'	925		2,500	18,960		22,385
2370'			52,500		28,800	81,300
TOTAL,	13,194	37,305	72,035	138,930	31,800	293,264
GRAND TOTAL,	40,127	37,305	179,600	153,650	64,595	475,277

The ore in sight exclusive of shaft pillars subdivided into grades is as follows:-

GRADE	DEVELOPED	PROSPECTIVE	TOTAL
Bessemer,	139,115	52,800	191,915
Basic,	27,229	3,000	30,229
Pascoe,	53,383	8,795	62,178
Total,	219,727	64,595	284,322

This shows an increase over last year which in turn showed an increase over the year before. The following table shows this very clearly:-

	1916	1917	1918	1919
Ore in place Jan. 1st,	383,720	291,980	315,479	350,183
" on stulls " "	216,884	171,580	112,203	90,962
Total ore in sight, Jan.1st,	600,604	463,560	427,682	441,145
Product,	173,096	153,425	142,476	155,315
Balance,	427,508	310,135	285,206	285,830
Ore in place, Dec. 31st,	291,980	315,479	350,183	397,845
" Broken, " "	171,580	112,203	90,962	77,432
Total ore in sight,	463,560	427,682	441,145	475,277
Developed during year,	18,732	117,541	155,939	189,447

The ore in sight shown above includes shaft pillars and unavailable broken ore.

You will note that the tonnage of new ore developed is gradually increasing. In 1915, only 18611 tons of new ore were shown up. In 1916, the total was only 18,732 tons. In 1919, we developed five times as much ore as in the two years: 1915 and 1916.

If we can once get two or three years' tonnage developed ahead, we can expect to secure good operating conditions and lower costs.

Following is a statement showing ore on stulls on December 31st, 1919.

AVERAGE ANALYSIS OF ORE BROKEN ON STULLS DURING DECEMBER, 1919.

SHAFT	LEVEL	STOPE	TONS	IRON	PHOS.
Pascoe,	1850'	#1,	2395	66.10	.073
		Pascoe Total,	2395		
No. 9,	1935'	#6,	2375	65.10	.038
"	2082'	#4,	880	57.00	.055
		No. 9 Total,	3255		
		Total Broken,	5650		

AVERAGE ANALYSIS OF ORE HOISTED FROM STULLS DURING DECEMBER, 1919.

Pascoe,	1850'	#1,	915	66.00	.082
"	"	#4,	615	65.10	.036
"	2050'	#1, Raise,	370	66.50	.047
		Pascoe Total,	1900		
No. 9,	2082'	#4,	795	53.60	.053
		No. 9 Total,	795		
		Total hoisted,	2695		

SUMMARY.

Ore Broken,	5650
" Hoisted,	2695
" Increase,	2955

AVERAGE ANALYSIS OF ORE ON STULLS, DECEMBER 31ST, 1919.

SHAFT	LEVEL	STOPE	AVAILABLE			NOT AVAILABLE.		
			TONS	IRON	PHOS.	TONS	IRON	PHOS.
No. 9,	1665'	#5, S. end,	8193	55.00	.062			
"	1935'	#6,	7030	65.40	.046			
"	2082'	#4, N.,	2715	54.70	.049			
"	"	#4,	8995	53.60	.053			
		No. 9 Total,	26933					
Pascoe,	1710'	#3,				12515	65.00	.075
"	1780'	#3,				18900	66.00	.066
"	"	#4,				3100	64.00	.068
"	1850'	#1,	10355	66.00	.082			
"	"	#3,				2790	66.00	.087
"	"	#4,	1914	65.10	.036			
"	2050'	#3, North,	925	68.40	.092			
		Pascoe Total,	13194			37305		

SUMMARY.

	AVAILABLE	NOT AVAILABLE	TOTAL
No. 9,	26,933	------	26,933
Pascoe,	13,194	37,305	50,499
Total,	40,127	37,305	77,432

REPUBLIC MINE

ORE STATEMENT - DECEMBER 31, 1919.

	RUN-OF-MINE BESS.	BASIC	PASCOE	BESS. LUMP	BASIC LUMP	PASCOE LUMP	BESS. CRUSHED	BASIC CRUSHED	PASCOE CRUSHED	BESS.CR. P.I.St.P.	BASIC CR. P.I.St.P.	TOTAL	TOTAL LAST YR.
On hand January 1st,1919,	12127	3248	3002							226	189	18792	27487
Output for Year,	89499	28165	37651									155315	142476
Transferred between grades,	56940	19307	16687	29702	10243	8444	39977	321	4247				
Total,	44686	12106	23966	29702	10243	8444	39977	321	4247	226	189	174107	169963
Shipments,				29702	10243	8444	16078	321	4247			69035	151171
Balance on hand,	44686	12106	23966				23899			226	189	105072	18792
Increase in output-9%												12839	
Increase in ore on hand,												86280	

425

REPUBLIC MINE.

REPUBLIC MINE.

REPUBLIC MINE

SHIPMENTS FOR YEAR - 1919.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Republic Bessemer Lump,	16,101	13,601	29,702	33,499
Republic Basic Lump,	4,440	5,803	10,243	19,186
Republic Pascoe Lump,	5,068	3,376	8,444	13,395
Republic Bessemer Crushed,	10,641	5,437	16,078	48,074
Republic Basic Crushed,	79	242	321	18,020
Republic Pascoe Crushed,	3,588	659	4,247	18,997
Total,	39,917	29,118	69,035	151,171
Total last Year,	80,600	70,571	151,171	
Decrease-54%			82,136	

1919 - 2-8 Hour Shifts during year.

REPUBLIC MINE.

REPUBLIC MINE.

REPUBLIC MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR 1919.

GRADE	IRON	PHOS.
Republic Bessemer,	66.42	.035
Republic Basic,	63.73	.057
Republic Pascoe,	56.36	.049

(Cargoes all mixed).

REPUBLIC MINE.

REPUBLIC MINE.

REPUBLIC MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 9.	1 9 1 8.	INCREASE.	DECREASE.
PRODUCT	155,315	142,476	12,839	
General Expense	.190	.175	.015	
Maintenance	.416	.309	.107	
Mining Expense	2.958	2.719	.239	
Cost of Production	3.564	3.203	.361	
Exploratory	.118	.041	.077	
DEPRECIATION.				
Original Purchase		.454		.454
Plant Account		.082		.082
Construction	.053		.053	
Total Depreciation	.053	.536		.483
Taxes	.135	.124	.011	
Central Office	.113	.131		.018
Supply Inventory	-	.018		.018
Miscellaneous	.001	.002		.001
Sundry Expense	.007	.035		.028
Cost on Stockpile	3.991	4.090		.099
Loading and Shipping	.128	.140		.012
Total Cost on Cars	4.119	4.230		.111
No.Days Operating	300	301		1
No.Shifts and Hours	2-8hr	2-8hr		
Avg.Daily Product	518	473	45	
COST OF PRODUCTION				
Labor	2.590	2.220	.370	
Supplies	.974	.983		.009
Total	3.564	3.203	.361	

REPUBLIC MINE.

COMPARATIVE WAGES AND PRODUCT.

	1 9 1 9.	1 9 1 8.	INCREASE.	DECREASE.
PRODUCT	155,315	142,476	12,839	
No.Shifts and Hours	2-8hr	2-8hr		
AVERAGE NUMBER MEN WORKING				
Surface	63	62	1	
Underground	177	160	17	
Total	240	222	18	
AVERAGE WAGES PER DAY				
Surface	5.35	4.50	.85-18.8%	
Underground	5.93	5.01	.92-18.3%	
Total	5.78	4.87	.91-19. %	
WAGES PER MONTH OF 25 DAYS				
Surface	133.75	112.50	21.25	
Underground	148.25	125.25	23.00	
Total	144.50	121.75	22.75	
PRODUCT PER MAN PER DAY				
Surface	8.20	7.65	.55	
Underground	2.92	2.97		.05
Total	2.16	2.14	.02	
LABOR COST PER TON				
Surface	.653	.588	.065	
Underground	2.027	1.689	.338	
Total	2.680	2.277	.403	
AVG. PRODUCT BRK'G & TRM'G	5.57	5.25	.32	
" WAGES CONTRACT MINERS	5.98	5.095	.885	
" " " TRAMMERS	9.17	6,594	3.576	
" " " LABOR	6.78	5.551	1.229	
TOTAL NUMBER OF DAYS				
Surface	18,950¾	18,630¾	320	
Underground	53,112¾	48,006¾	5,106	
Total	72,063½.	66,637½	5,426	
AMOUNT FOR LABOR				
Surface	101396.14	83763.08	17633.06	
Underground	314924.03	240640.79	74283.24	
Total	416320.17	324403.87	91916.30	

Proportion Surface to Underground Men:
1919 - 1 to 2.81
1918 - 1 to 2.58
1917 - 1 to 2.56
1916 - 1 to 3.02
1915 - 1 to 3.
1914 - 1 to 2.34

REPUBLIC MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICE.	AMOUNT 1 9 1 9.	AMOUNT 1 9 1 8.
50% Powder, Extra	17,800	.2021	3597.92	10120.45
" " Gelatine	137,341	.2159	29648.71	25825.71
Total Powder	155,141	.2143	33246.63	35946.16
Fuse,	214,450	7.672	1645.17	1626.36
Caps,	45,568	14,113	643.08	667.72
Tamping Bags,	18,108	2.361	42.75	28.91
Cap Crimpers,	3	.417	1.25	.40
Connecting Wire,				3.21
Battery Caps,	225	6.48	14.58	5.78
Fuse Igniters,	50	1.044	5.22	
Total Fuse, Etc.			2352.05	2332.38
Total Explosives,			35598.68	38278.54
Product			155,315	142,746
Pounds of Powder per ton of Ore			1	1.10
Cost per ton for Powder			.2141	.2523
" Fuse, Caps, Etc.			.0151	.0164
" All Explosives,			.2292	.2687
Avg. Price per Lb. for Powder,			.2143	.2293

ANNUAL REPORT

OF THE

IMPERIAL MINE (1919)

The lease of the Imperial Mine expired early in the year and all material on hand belonging to the Cleveland-Cliffs Iron Co., except the steel head-frame, was removed from the property.

SPIES MINE.

PRODUCTION:-

The product for the year 1919 tottaled 70,914 tons. The mine only operated up to July 1st. The following table shows the comparative product since January 1st, 1917:-

MONTH	YEAR 1917	YEAR 1918	YEAR 1919
Jan.,	1,004	9,273	11,504
Feb.,	1,282	9,955	10,470
Mar.,	2,068	11,095	12,095
Apr.,	2,374	9,380	10,849
May,	4,978	11,300	11,919
Jun.,	6,992	10,046	14,077
TOTAL,	18,698	61,049	70,914
Jul.,	8,912	10,629	
Aug.,	10,062	12,665	
Sep.,	8,424	8,382	
Oct.,	10,124	11,024	
Nov.,	8,608	9,036	
Dec.,	9,753	10,890	
GRAND TOTAL,	74,581	123,675	70,914

Every month in 1919 showed an increase over the corresponding month in 1918. The month of June, 1919, was the banner one for the year. The tons per man per day increased not only due to larger product, but also due to smaller number of men employed. The following table shows the tons per man, number of men, product, etc.

MONTH & YEAR	PRODUCT	AVE. NUMBER OF MEN	TONS PER MAN PER DAY
1917,	74,581	59	4.09
1918,	123,675	85	4.81
Jan., 1919,	11,504	94	4.65
Feb.,	10,470	87	4.95
Mar.,	12,095	89	5.11
Apr.,	10,849	81	5.13
May,	11,919	78	5.89
Jun.,	14,077	80	6.78

You will note that the tons per man per day steadily increased until the peak was reached in June, 1919.

DELAYS:-		
Jan. 6,	5½ hrs.	delay, Steam Hoist broken down,
Jan. 15,	2½ "	" " " "
Jan. 17,	4¾ "	" Crusher out of order,
Jan. 22,	2½ "	" Steam Hoist broken down,
Jan. 24,	1½ "	" " " "
Jan. 28,	7½ "	" " " "
Feb. 19,	3 "	" Top Landing car off track,
Feb. 24,	8 "	" Steam Hoist out of order,
Apr. 21,	2 "	" " " " "
Apr. 23,	6½ "	" " " " " "
May 5,	7 "	" Electric Hoist out of order,
May 8,	8 "	" Coils burned out on hoist motor,
May 10,	4¾ "	" " " " " " "
May 12,	5¾ "	" " " " " " " "
May 13,	16 "	" " " " " " " "
May 14,	16 "	" " " " " " " "
May 15,	4 "	" " " " " " " "
May 19,	3¾ "	" " " " " " " "
May 20,	2½ "	" " " " " " " "
Jun., 2,	2¼ "	" Crusher out of order,
Jun. 20,	8¾ "	" Coils burned out on hoist motor,
Jun. 25,	3 "	" Hoist out of order,
Jun. 26,	3¾ "	" " " " "

The above delays seriously affected the product, especially in the month of May. The electric hoist gave far more trouble than the old steam hoist and the real cause of the trouble was difficult to locate. Four days before the mine was shut down, the electrical department discovered an open circuit which caused an excessive starting load to be thrown onto the motor, thereby burning out the coils.

Notwithstanding all our troubles, the production from the shaft steadily increased, and I can see no reason why the mine can not produce 15,000 tons monthly.

SHIPMENTS:-

We made quite a hole in the stockpile. Some of the ore was shipped out as straight Spies ore and the balance was mixed with the Gwinn District ore. No shipments were made from the stockpile until after the mine was closed down. The Steam Shovel started loading on July 22nd.

Spies Crushed ore to Escanaba from shaft pockets,	26,967	tons,
" " " " " " Stockpile,	90,160	"
Total shipments,	117,127	"

Of the above, 3693 tons is being held over in cars.

ANALYSIS & SAMPLING & GRADING:-

Considerable Spies ore was mixed with the Gwinn District ores and graded as "Cambridge". The Non-Plastic Spies ore mixed with the Plastic Cambridge made a good combination. We had considerable trouble with the samples at the beginning of the season checking with the Lower Lake chemists. Investigation proved that the sampling at the Spies might be responsible for 1/3 of the trouble, but the other 2/3 was due to the Lower Lake samplers taking too much Spies ore. The mixture was supposed to contain half Spies and half Cambridge. Towards the end of the season, considerable straight Spies ore was shipped and with few exceptions, the Lower Lake chemists reported higher results than the mine analysis. The following table shows the difference between the mine sampling and the results from Lake Erie Ports;-

CAMBRIDGE MIXTURE.

BOAT	DATE	TONS	MINE ANALYSIS IRON	LOWER LAKE ANALYSIS IRON	DIFFERENCE.
Panay,	May 6,	5825	58.08	56.65	-1.43
Angeline,	" 10,	6909	58.44	56.81	-1.63
Stackhouse,	" 22,	3409	58.87	57.60	-1.27
Cadillac,	" 26,	5980	58.94	58.25	- .69
Hanna,	Jun. 3,	3577	57.99	58.07	+ .08
Angeline,	" 16,	6339	57.90	56.56	- .34
Angeline,	" 25,	4517	58.34	57.50	- .84
Paisley,	" 26,	1857	58.24	57.95	- .29
Angeline,	Aug. 2,	7211	57.66	57.20	- .46
Hill,	" 28,	3336	57.98	57.45	- .53
Lagonda,	" 30,	3744	58.11	57.80	- .31
Munising,	Sep. 5,	3623	58.40	58.50	+ .10
Munising,	" 5,	3078	57.77	58.17	+ .40
Panay,	" 17,	6043	58.07	58.60	+ .53
Reiss,	" 10,	2495	58.00	58.10	+ .10
Paisley,	" 16,	1256	58.48	57.80	- .68
Paisley,	" 16,	1879	58.00	58.50	+ .50
Schneider,	" 23,	1269	58.96	58.91	- .05
Schneider,	" 23,	1521	58.18	57.75	- .43
Schneider,	" 23,	3020	59.00	59.21	+ .21
Central West	" 24,	1616	58.49	58.70	+ .21
Negaunee,	Oct. 3,	3155	58.59	58.00	- .59
Angeline,	" 11,	4927	58.30	58.35	+ .05
Schneider,	" 20,	3016	57.40	58.20	+ .80
Luzon,	" 28,	1023	58.27	57.86	- .43
Cadillac,	Nov. 3,	3316	58.26	58.10	- .16
Paisley,	" 4,	2784	58.69	58.57	+ .08
Kotcher,	" 6,	3448	58.52	58.00	- .52
Cadillac,	" 10,	4432	57.90	57.00	- .90
Angeline,	" 21,	6856			

SPIES MINE.

STRAIGHT SPIES CARGOES.

BOAT	DATE	TONS	MINE ANALYSIS IRON	LOWER LAKE ANALYSIS IRON	DIFFERENCE
Stackhouse,	Jul. 24,	2030	56.51	56.50	- .01
Reiss,	Aug. 28,	3393	56.00	55.60	- .40
Reiss,	Sep. 17,	3193	56.36	56.81	+ .45
Central West,	Sep. 24,	1979	56.13	55.70	- .43
Reiss,	Sep. 22,	2308	56.26	56.35	+ .09
Lewiston,	Oct. 7,	2457	55.90	56.05	+ .15
Lewiston,	Oct. 18,	2533	55.87	56.70	+ .83
Oglebay,	Oct. 25,	1844	55.66	56.05	+ .39
Andaste,	Oct. 29,	2588	56.46	56.70	+ .24
Paisley,	Nov. 4,	3015	56.03	56.30	+ .27
Kotcher,	Nov. 6,	2557	56.00	56.10	+ .10
Cadillac,	Nov. 10,	1736	54.96	56.14	+1.20
Schoonmaker,	Nov. 17,	12830	55.56		

You will note that although the Lower Lake chemists consistently report lower results on the Cambridge mixture, they invariably got higher Iron on the straight Spies cargoes. As it happens, the Company benefits in both cases. In the case of the Spies cargoes, the higher results at the Lake Erie Ports increases the value of the ore and the lower results on the Cambridge mixture works out the same way, due to the difference in moisture content between the Cambridge and Spies ores. For instance, the average mixture content of a 50% Spies and 50% Cambridge mixture would approximate 10.52 based on the 1918 average analysis. If too much Spies ore is introduced into the sample, the moisture will run lower than it ought to and the Iron Natural will be increased. There is no doubt but that the consistently lower Irons on the Cambridge mixture is due to an undue proportion of Spies ore, which is very likely due to the fact that the latter is a lively running ore and covering over the new faces exposed as the boat is being unloaded.

The average analysis of all shipments for the year 1919 follows:

	TONS	IRON	PHOS.	SILICA
Stockpile ore to C.& N.W. Dock,	59,346	55.79	.519	5.21
" " " CM&St.P. "	27,121	56.09	.513	4.93
Pocket " " " "	1,734	56.09	.453	5.83
" " " C.& N.W. "	25,233	57.16	.471	5.17
Total,	113,434			

SPIES MINE.

COSTS:-

The cost of production was kept down. The last month we operated showed the lowest cost since the property started producing when one considers the wage increases. At that, the total cost was only 5¢ per ton more than that of August, 1918. The following table shows the cost of production from May, 1917, to July, 1919:-

COST OF PRODUCTION.

	LABOR	SUPPLIES	TOTAL
Year 1917,	.933	.633	1.566

	1918			1919		
MONTH	LABOR	SUPPLIES	TOTAL	LABOR	SUPPLIES	TOTAL
Jan.,	.922	.432	1.354	1.169	.415	1.584
Feb.,	.842	.426	1.268	1.110	.449	1.559
Mar.,	.816	.437	1.253	1.060	.379	1.439
Apr.,	.877	.381	1.258	1.054	.465	1.519
May,	.853	.329	1.182	.913	.401	1.314
Jun.,	.875	.391	1.266	.797	.381	1.178
Jul.,	.861	.392	1.253	Mine closed down.		
Aug.,	.837	.289	1.126	"	"	"
Sep.,	1.187	.570	1.757	"	"	"
Oct.,	1.172	.485	1.657	"	"	"
Nov.,	1.117	.575	1.692	"	"	"
Dec.,	1.154	.390	1.544	"	"	"
TOTAL,	.954	.418	1.372	.991	.415	1.406

You will note a slight decrease in the supply expense and an increase of less than 4% in the labor charges, notwithstanding that wages in January, 1919, were 40% greater than January, 1918, In May, 1919, wages were 25% greater than May, 1918.

ANALYSIS.

The various items on the cost sheet will now be taken up and increases and decreases explained taking into account the fact that the mine only operated six months in 1919.

ENGINEERING.

The surveying is done by engineers from the General Office at Ishpeming. Surveys were only made once in two months. The expense for 1919 was a little larger than 1918, due probably to the

office work performed on the Geological Sections which were finished during the year.

ANALYSIS.

The laboratory work was performed by the Rogers Mine chemist. During 1918, the laboratory expense was halved compared with 1917, and during 1919, it was reduced still further. This was accomplished by reducing the number of samples taken and by having the laboratory combine the day and night landers samples for the determination of Phosphorus and Silica. During 1917, the average monthly expense ran $251.00. During 1918, it was reduced to $112.00. In 1919, our monthly expense averaged less than $95.00 monthly.

PERSONAL INJURY.

The personal injury expense while operating was approximately $63.00 monthly, which is low. We had no serious accidents during the year for which the Captain, bosses and men deserve a great deal of credit. Although the open stope system of mining used at the the Spies is a safe system, still the men are working partly on benches along the side of the stopes and it requires constant care on the part of the miners and bosses to prevent accidents, as a mis-step would cause the men to fall two or three levels.

MINE OFFICE.

The mine office expense for the six months period was $350.00 less than last year, due to smaller expense for superintendence.

TRACKS & YARDS.

The monthly expense under this heading was a little less than during 1918. We continued to clean up the mine surface and clear out the brush back of the Boiler House to reduce the fire hazard.

DOCKS, TRESTLES & POCKETS.

The year 1919 shows a big decrease. During 1918, the new East stocking trestle was erected. The only expense in 1919 was due to bracing the West stocking trestle to keep it from toppling over, and small maintenance expense.

BUILDINGS.

A 15 foot addition was built onto the Engine House to provide room for the electric hoist installed. This was built by Contractor Proktsch at cost plus 10%. The interior of the Engine Room was white-washed, improving its appearance and reducing the fire risk.

SHOP MACHINERY.

The total charges against this account for the year are only $15.10.

BOILER PLANT.

The boilers having been thoroughly over-hauled during the latter part of 1918 needed no further repairs. Besides one of the two boilers was shut down in 1918 and after the electric hoist was put into commission, the boiler plant was only required for heating purposes. Maintenance charges for the year were nominal, totalling only $15.69.

HOISTING MACHINERY.

The steam hoist was replaced by one operated electrically just before the mine was closed down. From the very beginning, the steam hoist has given us trouble, because it was never designed to handle the size skip used at the Spies Mine. The hoist had been nearly entirely rebuilt in the three years time it operated, having been equipped with new drum, over size pistons, new valve gear, eccentrics, pinion shaft and gear, the latter being put on in February. This hoist was gradually pounding itself to pieces and it was imperative to make a change.

In view of the low rate we pay for electric power to the Peninsula Power Company, and the fact that the old Chase Mine electric hoist was idle, it was decided to install same at the Spies. The installation of the electric hoist was completed in April and we anticipated that our troubles were over. On the contrary, the motor on the hoist burned out one coil after another, causing from three to four hours delay each time. After putting up with delays for a month, the Mechanical Department sent a second electrician to the mine to locate the seat of the trouble. He apparently did some good as the motor ran smoothly for nearly three weeks but finally commenced burning out coils again. This motor had always given some trouble, due to its peculiar winding and for that reason, the Mechanical Department expected to have us put up with some delays. Finally the chief electrician made an examination of the entire installation and found that the motor was operating on only one circuit, which meant that the entire starting load was thrown on only half of the motor. After this was corrected, we had no further trouble.

As soon as the mine was closed down, this motor was shipped away to be completely overhauled and put in first class condition.

COMPRESSORS & AIR DRILLS.

This maintenance account was only one-third of the previous year's corresponding period, due to no new air drills having been purchased. Two mountings for drills were bought and we received two second hand drills from the McClure dam.

PUMPING MACHINERY.

Pumping machinery charges were reduced to less than half the previous year. The big 3rd Level pump needs repairs, however, to put it into first class shape, and the necessary parts are being made in the Republic Mine Shop.

TOP TRAM, ENGINES & CARS.

This item increased due to purchase of new side dump top tram stocking car from the General Shops. We also had to pay $100.00 each for the old end dump stocking cars shipped from the Chase Mine. These old cars were nearly scrap value when first shipped to the Spies, and no charge should ever have been allowed to go through, but the previous superintendent had agreed to pay this amount and so the charge had to stand.

SKIPS & SKIP-ROADS.

Maintenance under this head increased in 1919, due to the fact that the skips were beginning to show signs of wear and had to be repaired. A number of sets of dumping rollers and pedestals on which the former are mounted were made at the Republic Mine shops.

UNDERGROUND TRACKS & CARS.

A number of new car axles and wheels were put onto the cars. The car axles were made at Republic and the wheels from the Lake Shore Engine Works. The car bodies and trucks are still in fair shape.

MINING EXPENSE.

AIR PIPES.

The cost per ton for expenditures under this head was .015 for 1919 and .014 for 1918, which therefore means less labor employed under this head. On account of the increase in wages, the expenses would ordinarily have increased a little more than one-third.

COMPRESSORS.

The cost per ton under this account shows only a slight increase namely from .023 to .024, notwithstanding the wage increases.

HOISTING.

The hoisting expense decreased from .106 per ton to .071, due to the installation of the electric hoist. The hoist only operated two months but showed a saving of approximately $800.00 per month. The first four months of 1919, our average monthly expense for hoisting was $1228.29. During May and June, it dropped to $355.53 monthly. It cost us approximately $2800.00 to install the hoist which includes expense of taking it out of the Morris shaft, repairing motor, freight, foundation, etc., so that the expenditure would be entirely covered by the saving in less than four months. In addition to the reduction in the hoisting expense, there will be a substantial decrease in the boiler house expense when the mine resumes operations. Another big factor in favor of the electric hoist should be the absence of delays. The break-downs of the steam hoist caused a loss in production of from a few hundred to 2,000 tons a month.

PUMPING.

The pump house on the 3rd Level contained one large electric and two steam pumps. It was customary to keep steam on the latter pumps but as explained in last year's report, the steam in the line leading from the Boiler House to the shaft was shut off in June, 1918. As a result, the expense for the first six months of 1918 was .047 per ton, whereas the cost for the same period, 1919, was only .041. Labor represents over 80% of the pumping cost and although the scale of wages in January, 1919, was 35% higher than 1918, the cost per ton decreased.

BREAKING ORE.

We kept just about the same number of miners employed for the last two years. We keep the maximum number of drilling machines working that the air compressor can take care of. The miners are only employed day shift and as a result, they are more efficient

than when working alternately day and night shift. It is also easier to keep our contracts filled up as men are attracted from the other mines. By the system of mining used at the Spies, the miners never tram any ore as all the ore broken falls into the stopes. This fact also tends to keep our mining gangs intact.

The unit cost of breaking ore increased from .435 to .553 or 27%. The two big items entering into the cost are labor and explosives. The explosives for the first six months of 1918 cost .149 per ton. For 1919, the cost was less, being .146 per ton. The labor cost increased from .285 per ton to .377 or 32% which corresponds closely with the wage increase for the same period.

TRAMMING.

The unit cost for tramming ore was kept down ao that notwithstanding the 35% increase granted in 1918, the cost under this head only increased from .322 to .362 per ton or 12.5%. This was due to the larger number of cars trammed per gang per day. In my 1918 report, I remarked that the tramming expense was too high having increased 40% over the 1917 costs. We regularly employed five gangs of trammers on each shift. Three of these gangs drew ore from #30, #40, #60 and #80 raises, where the bulk of our product comes from. We found that the men were delayed in filling cars by chunks blocking the chutes, so we rebuilt and enlarged them. As the result of fewer delays from this source, the average daily product was increased and cost decreased.

TIMBERING.

Very little timber is required and this expense is therefore nominal.

DRY HOUSE.

The cost of heating the Dry ran up the total under this head. This was due to shutting down the steam hoist. After the month of April, all the boiler house expense had to be charged to heating Dry which naturally increased the cost against this one item.

TOP LANDING & TRAMMING.

During the latter part of 1918, a new side dumping top tram car was put into service which decreased the expense of operating the top landing. This is shown in the comparison of the costs for the first six months of 1918 and 1919, the unit cost for the periods being .056 and .047. The expense was less and the scale of wages had been advanced 35%.

COST ON CARS.

The comparative cost on cars since the mine started operating is as follows:-

8 months,	1917,	$2.315
Year,	1918,	2.168
6 months,	1919,	2.091

You will note that the cost has steadily decreased regardless of the increase in wages and increased cost of supplies. This decrease is due mainly to installation of electric hoist, changing top tram cars from end to side dumping, elimination of all steam pumps underground and widening and enlarging underground chutes. Several minor changes, such as reducing the average daily laboratory expense $8.00 per diem, and operating with one man only as blacksmith helper and sampler combined instead of employing one man for each position, also reduced the cost.

The mine was just hitting the proper stride when it was closed down and we expected to reduce the cost on cars to approximately $1.75. In June, 1919, the last month we operated, the cost on cars was only $1.783 in the face of a maintenance charge of .12 per ton, which is above normal.

UNDERGROUND.

The development work proved up considerable new ore during the year. Most of this ore was found in the East - West crosscut driven on the 3rd level to the West boundary. Several small lenses were found on the North end of the second level.

ORE RESERVES:-

All of the ore in the mine is Non-Bessemer.

MAIN ORE BODY	NET TONS AVAILABLE.	NET TONS UNAVAILABLE.	PROBABLE.
Ore above First Level,	76,942		
" " Second "	6,936		
" " Third "	11,170	2,502	
" below " "			5,848
NORTH LENS:-			
Ore above First Level,	50,107		
" " Second "	10,491		
" " Third "	14,582	500	
" below " "			2,728
TOTAL,	170,228	3,002	8,576

The following table gives the tons of ore as estimated on January 1st, 1919:-

	NET TONS AVAILABLE.	NET TONS UNAVAILABLE.	PROBABLE.
Total of both Main Ore body and North Lens,	207,026	3,002	3,912

This shows a decrease of 36,798 tons in the available ore and an increase of 4,664 tons of probable ore. Our product for the year 1919 being 70,914 tons shows that 34,116 tons of new ore was proven up.

From the general geological conditions, it would appear that the future of the Spies Mine depended largely on the prospects of finding ore on the neighboring Virgil Mine and acquiring same.

NORTH LENS.

825' SUB-LEVEL:-

This sub which was started in October, 1918, continued to be developed during 1919 until it attained a length of 240 feet. The foot-wall and hanging were exposed except along the middle of the East side; at this point, there is a possibility of the ore trending to the North-East and joining the ore discovered in Diamond Drill Holes Nos.: 40 and 42.

There is over 50,000 tons of ore left in this area between the sub and the bottom of the sand.

First Level:-

Three raises were put up at the North end of the main level drift to draw ore from the shrinkage stope being opened up above the level.

Shrinkage Stope between First & Second Levels:-

The North portion of this stope which was 36 feet below the floor of the First Level was mined up to within 15 feet of the latter, corresponding to the floor pillar left in the back of the South half of this same stope. A raise was put up to the First Level at the extreme North end of the stope which will give us a starting point to commence work from when this floor pillar can be mined.

Shrinkage Stope between Second & Third Levels:-

This stope has been carried up to within 20 feet of the Second Level. We have only mined out the North half of this particular ore body. The South half lies intact from the Third Level up. The stope lies so flat that some ore has been left along the East side. This will have to be mined after part of the broken ore has been drawn out of the stope. It can be mined cheaper using the open stope method, as it avoids re-handling the dirt.

Second Level:-

At the North end of the main level drift, there was a small leader of ore leading to the North-West. This was followed and a new lens of ore uncovered approximately 80 feet long and from 10' to 35' wide. This ore had a reddish cast which differs from the usual yellowish color of all the other Spies ore. The mine was closed down before any raising could be done, so that we have no information regarding the extent of this ore body. The Diamond Drill Hole #9 showed two lenses of ore at the elevation of the Second Level but gave no clue as to the possibilities either above or below the level.

MAIN ORE BODY.

845' Sub-Level:-

This sub was opened up during the year and nearly all the ore mined out at this elevation. There remains a strip of ore about 25 feet wide along the foot-wall. The horse of rock between the North and South areas of this ore body is much smaller on this level and it appears as if it were going to pinch out entirely on the next sub higher up. The ore vertically over this horse of rock is being mined so as to leave a wedged shaped pillar to prevent the broken ore from the upper levels lodging and hanging up on top of the pillar.

There still remains 105 feet of ore between the floor of the sub and the bottom of the sand, so that three more subs at least can be safely opened up and mined by the regular open stope method.

825' Sub-Level:-

Only three small pillars of ore are left standing between the North end of the stope and #60 raise. The pillar between #40 and #60 raise will be left in to keep the horse of rock from slabbing off the hanging and falling into the main stope.

First Level:-

All of the ore has been mined except a narrow strip 15 feet wide along the West side of the main level drift from the first cross-cut to #60 raise.

784' Sub-Level:-

All of the ore at this elevation was mined out during 1919, except a narrow strip along the foot left to support the main level drift on the First Level.

764' Sub-Level:-

We have mined all of the ore available on this sub-level except a narrow lens along the foot, which was left to support the main level drift as above.

744' Sub-Level:-

From this point down to the Third Level, all the ore in the main stope has been mined out from foot to hanging and from the extreme North to the limits on the South side.

Third Level:-

The most important ore find for the year was the proving up of the ore from the main stope West to the Virgil Mine boundary. This ore body proved to be 220 feet long to the boundary and varied in width from 10 feet to 60 feet. At the boundary, a raise was put up 50 feet in ore. At a point 60 feet East of the line, another raise went up 50 feet in ore. The tops of both raises were in ore when work was stopped, due to closing down the mine. We have absolutely no information regarding the depth of the ore below the Third Level.

SPIES MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1919.

GRADE	IRON	PHOS.	SILICA
Spies,	56.65	.466	5.98

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1919.

GRADE	Mine IRON	Mine PHOS.	Mine SILICA	Lake Erie IRON	Lake Erie MOIST.
Spies,	56.17	.545	5.11	56.19	8.20

ORE STATEMENT FOR YEAR - 1919.

	SPIES	SPIES LUMP	TOTAL	TOTAL LAST YEAR
On hand January 1st,1919,	143,429		143,429	68,535
Output for year,	70,914		70,914	123,675
Total,	214,343		214,343	192,210
Shipments,	113,434		113,434	48,781
Balance on hand,	100,909		100,909	143,429
Decrease in output-43%			52,761	
Decrease in ore on hand,			42,520	

1919 - 1-8 Hour Shift - Jan. 1st to June 30th
1918 - 1-8 Hour Shift - during year.

SHIPMENTS FOR YEAR 1919.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Spies,	30,258	83,176	113,434	46,530
Spies Lump,				2,251
Total,	30,258	83,176	113,434	48,781
Total last year,	48,781		48,781	
Increase - 133%			64,653	

SPIES MINE.

SPIES MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 9.	1 9 1 8.	INCREASE.	DECREASE.
PRODUCT	70,914	123,675		52,761
General Expense	.077	.081		.003
Maintenance	.116	.092	.024	
Mining Expense	1.231	1.199	.032	
Cost of Production	1.424	1.372	.052	
DEPRECIATION.				
Original Purchase	-	.044		.044
Plant	.564	.564		
Total Depreciation	.564	.608		.044
Taxes	.026	.033		.007
Central Office	.050	.055		.005
Supply Inventory		.009		.009
Idle Expense	.183		.183	
Sundry Expense	.006	.038		.032
Cost on Stockpile	2.253	2.115	.138	
Loading & Shipping	.261	.053	.208	
Total Cost on Cars	2.514	2.168	.346	
No.Days Operating	150	299		149
No.Shifts and Hours	1-8hr	1-8hr		
Avg. Daily Product	473	413	60	
COST OF PRODUCTION.				
Labor	1.008	.954	.054	
Supplies	.416	.418		.002
Total	1.424	1.372	.052	

Mine closed June 30,1919.

SPIES MINE.

COMPARATIVE WAGES AND PRODUCT.

	1 9 1 9.	1 9 1 8.	INCREASE.	DECREASE.
PRODUCT	70,914	123,675		52,761
No.Shifts and Hours		1-8hr		
AVERAGE NUMBER MEN WORKING				
Surface	11	22		11
Underground	32	63		31
Total	43	85		42
AVERAGE WAGES PER DAY				
Surface	4.88	4.16	.72-17.3%	
Underground	5.72	4.80	.92-19.2%	
Total	5.51	4.64	.87-19%	
WAGES PER MONTH OF 25 DAYS				
Surface	122.00	104.00	18.00	
Underground	143.00	120.00	13.00	
Total	137.75	116.00	21.75	
PRODUCT PER MAN PER DAY				
Surface	20.28	18.79	1.49	
Underground	6.87	6.46	.41	
Total	5.13	4.81	.32	
LABOR COST PER TON				
Surface	.241	.221	.020	
Underground	.832	.744	.088	
Total	1.073	.965	.108	
AVG. PRODUCT BRK'G & TRM'G	9.58	9.64	.0	.06
" WAGES CONTRACT TRAMMERS	Co.Acct	Co.Acct		
" " " LABOR	"	"		
TOTAL NUMBER OF DAYS				
Surface	3,500½	6,580¼		3,079¾
Underground	10,323	19,148		8,825
Total	13,823½	25,728¼		11,904¾
AMOUNT FOR LABOR				
Surface	17091.44	27389.93		10298.49
Underground	59029.88	91979.35		32949.47
Total	76121.32	119369.28		43247.96

Proportion Surface to Underground Men:
1919 - 1 to 2.91
1918 - 1 to 2.86
1917 - 1 to 3.2