

AUSTIN MINE.

COMPARATIVE WAGES AND PRODUCT.

	1919.	1918.	INCREASE.	DECREASE.
PRODUCT	14,869	1,069	13,800	
No.Shifts and Hours	1-8hr	1-8hr		
AVERAGE NUMBER MEN WORKING				
Surface	7	3	4	
Underground	15	1	14	
Total	22	4	18	
AVERAGE WAGES PER DAY				
Surface	4.88	3.92	.96-24%	
Underground	5.90	5.22	.68-13%	
Total	5.58	4.23	1.35-32%	
WAGES PER MONTH OF 25 DAYS				
Surface	122.00	98.00	24.00	
Underground	147.50	140.00	7.50	
Total	139.50	105.75	33.75	
PRODUCT PER MAN PER DAY				
Surface	7.25	-		
Underground	3.34	-		
Total	3.29	-		
LABOR COST PER TON				
Surface	.673	-		
Underground	1.767	-		
Total	2.440	-		
AVG. PRODUCT BRK'G & TRM'G				
" WAGES CONTRACT MINERS	6.29	-		
" " " TRAMMERS	5.90	-		
" " " LABOR	5.04	-		
" " " LABOR	6.13	-		
TOTAL NUMBER OF DAYS				
Surface	2,056 $\frac{1}{2}$	1,010 $\frac{3}{4}$	1,045 $\frac{1}{2}$	
Underground	4,461 $\frac{1}{2}$	321	4,140 $\frac{1}{2}$	
Total	6,517 $\frac{1}{2}$	1,331 $\frac{3}{4}$	5,186	
AMOUNT FOR LABOR				
Surface	10,034.05	3956.42	6077.63	
Underground	26,319.37	1674.68	24644.69	
Total	36,353.42	5631.10	30722.32	

Proportion Surface to Underground Men:

1919 - 1 to 2.1

1918 - 1 to 3.2

Not producing in 1918 on account of flood. Production as shown is stockpile overrun for 1918; started production on small scale again in August, 1919. Closed again Dec.31, 1919, for winter.

AUSTIN MINE.

TIMBER STATEMENT FOR YEAR ENDING DECEMBER 31, 1919.

KIND.	LINEAL FEET.	AVG. PRICE PER FOOT.	AMOUNT 1919.
6" to 8" Timber	604	.043	26.06
8" to 10" "	11,824	.045	533.16
10" to 12" "	1,584	.055	87.12
Total - 1919	14,012	.046	646.34
	LINEAL FEET.	PER 100'.	
5' Lagging	62,050	1.11	688.50
6' "	3,060	.44	13.50
8' "	100,448	.536	538.92
Total Lagging	165,558	.749	1240.92
Poles	13,170	.85	111.93
4 to 6 Cribbing	2,600	1.75	45.50
Total - 1919	181,328	.771	1398.35
Product for Year			14,450
Feet Timber per ton of ore			.964
Feet Lagging "			12.47
Feet Lagging per foot of Timber			12.94
Cost per ton for Timber			.045
" Lagging			.085
" Poles			.011
" Timber, Lagging & Poles			.141
Equivalent of stull timber to Bd. Measure			19,362
Ft. Bd. Measure per ton of ore			1.332
Total cost for Timber, Lagging & Poles - 1919			2044.69
" 1917			3284.03
" 1916			967.56
" 1913			2174.79
" 1912			7351.40
" 1911			6214.48
" 1910			3378.03
" 1909			6356.25

Mine did not operate during 1918 account of being flooded.

AUSTIN MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICE.	AMOUNT 1 9 1 9.
40% Powder, Red Cross	2,050	.1627	333.83
50% " "	4,450	.1736	772.30
50% " Giant Gelatin	150	.1940	29.10
60% " "	50	.2066	10.33
Total Powder	6,700	.1709	1145.56
Fuse	9,900	6.912	68.43
Caps	2,800	1.364	38.19
Cap Crimpers	17	.562	9.55
Tamping Bags	1,000	2.09	2.09
Total Fuse, Etc.			118.26
Total Explosives			1263.82
Product			14,450
Pounds Powder per ton of Ore			.461
Cost per ton for Powder			.0733
" Fuse, Caps, Etc.			.0081
" All Explosives,			.0869
Avg. Price per Lb. for Powder			.1709

Mine not producing in 1918 on account of being flooded.
 Costs per ton are high because of small production and damage caused
 by flood.

STEPHENSON MINE

The Stephenson Mine was closed on December 5th, 1917, on account of flooding. It was idle during 1918, and for nearly ten months in 1919, by which ^{the} time/water was finally pumped out and work resumed.

During the last two months of the year the work of repairing for resumption of mining operations has been underway. Conditions were not nearly as bad as had been anticipated; all the drifts in ore were partially filled due to the ore coming out on the sides and from the back. In some areas the drifts had caved, but the areas that had caved were very small compared with the total area of drifts in ore. As was natural to expect, the wet ore in these drifts has proven difficult to clean up. A small product was obtained the last week of the year, but it will be some time before the mine is producing a product equal to that obtained prior to the flood.

The following table gives the depth of water below the collar of the shaft, with the loss and gain for each month up to the time all the water had been removed from the mine:

	DEPTH BELOW COLLAR <u>STEPHENSON SHAFT</u>	<u>LOSS</u>	<u>GAIN</u>
December 31st, 1918,	160' 3½"		
January 31st, 1919,	165' 5"		5'2"
February 28th, 1919,	154' 8"	10'9"	
March 31st, 1919,	172' 9"		18'1"
April 30th, 1919,	163' 2"	9'7"	
May 31st, 1919,	278' 2"		115'
June 30th, 1919,	319' 7"		41'5"
July 31st, 1919,	382' 4"		62'9"
August 31st, 1919,	471'11"		89'7"
Sept. 30th, 1919,	499' 6"		27'7"
October 31st, 1919,	566'		66'6"
November 2nd, 1919,	Water all out of shaft		
		<hr/> 20'4"	<hr/> 426'1"
	GAIN FOR YEAR,		405'9"

It will be seen from the above that practically no progress was made with the unwatering until in May. The pumps operated during this period at the Stephenson consisted of the No. 1 Layne & Bowler Pump, a 500-gal. Centrifugal Pump on the cage and the blower. At the Austin there was a 1000-gal. Electric Pump and a Steam Pump, operating in the shaft. When it was found, in 1918,

STEPHENSON MINE:

that the pumping equipment could not gain on the water, a second Layne & Bowler pump was ordered. This pump was received early in May and went into commission on May 21st. Before it was installed, however, the drive of the No. 1 Layne & Bowler pump was changed from belt drive to direct drive by the installation of a new motor. This work was completed on the 30th of April, and in May a steady gain was made on the water up to the time that the second Layne & Bowler pump was installed. After the #2 Pump went into commission, the gain was very rapid, the water being lowered about eight feet per day.

In June a considerable gain was made on the water, but not at the same rate as was made in May, due to delays and to the fact that the water had been lowered to the suction of the No. 1 Layne & Bowler. The blower also had gone out of commission in May, after which all the water was handled by the pumps. The Austin pumps went out of commission early in June, due to the water having been lowered to the 5th level.

A new centrifugal pump of 2000-gal. capacity was purchased for use on the Stephenson cage; this pump was received and put in operation on July 21st. After the water was lowered to the suction of the No. 1 Layne & Bowler pump it was held stationary until this new pump went into commission on July 21st, after which a rapid gain was again made in lowering the water. The 2000-gal. pump on the cage discharged into the suction of the No. 1 Layne & Bowler pump. By the end of July the water was down to a point near the 3rd level. In August both the 3rd and 4th levels were unwatered, and the water had been lowered to a point near the 5th level. The 5th level was unwatered in September, which permitted the work of re-opening the old main pump house to be started. The Prescott pump in this pump-house was started up on September 17th. From the 18th of September to the end of the month the water was held stationary at a depth of 499 feet below the collar, or about fifteen feet below the floor of the 5th level. Measurements taken during this period showed the incoming water to be between 2800 and 2900 gallons per minute. After the Prescott pump in the pumphouse was overhauled and in commission, the work of installing the new Aldrich Plunger pump was started and completed in October. The new Aldrich plunger pump went into commission October 22nd, and the work of unwatering the 6th level was then started and completed in a few days. The water remaining in

the shaft below 6th level was pumped out on November 2nd. This completed the work of unwatering.

The No. 2 Layne & Bowler pump was removed from the shaft the last week of October and the No. 1 pump the first week of November. Special sheds were constructed for these two pumps near the shaft, where they were stored.

After the new Aldrich pump was installed in the main pumphouse on 5th level a 1000-gal., 1000-ft. head Centrifugal pump was also installed. This pump station, therefore, now contains two plunger pumps with a combined capacity of 3250 gallons per minute and two centrifugal pumps with a combined capacity of approximately 2500 gallons per minute. The grand total capacity of all the pumps is approximately 5700 gallons per minute. The 6th level pumphouse, which pumps water from the 6th up to the 5th, contains a Centrifugal pump of 1000-gals. capacity and there is now underground, ready to be installed, a 1000-gallon Pole Pump. At the time the mine was flooded an 8" discharge line was put in from surface to 4th level. An air pipe was later installed in this discharge line, and it was operated as a blower until the water was lowered to a point where it was no longer possible to use it for this purpose. After the pumps were installed and the water out of the mine, it was decided to extend this new discharge column from the 4th down to the 5th level and connect it to the discharge header in the pumphouse. This work was completed before the end of the year, and results have more than justified the expense. All pumps are now operated with considerable less back-pressure, and the water is consequently handled more economically. There is also a decreased cost for current.

In order to protect the pumping plant and shaft from a possible repetition of the disaster of December, 1917, it was decided to install concrete dams on the 6th, 5th and 4th levels, some distance in from the shaft. Two of these dams have been constructed, viz: the ones on the 5th and 6th levels. They are 14 feet in length and are installed in the haulage drift in solid granite. There is an opening in the center of the dam, 6 x 7 ft. in size, to permit motors and motor cars to pass through. The average thickness of concrete on the side-wall of dam is between two and three feet. About six feet from the inside end there is a notch made in the concrete for the purpose of installing stop logs, 12" x 18" in size, in case of a future sudden in-rush of water. Another notch was made about 10 feet from the inside end, so that stop logs can be installed

at a second point. In case of a sudden inrush of water it is planned to install both sets of stop logs. Then if conditions seem dangerous, the space between the two stop logs will be filled with concrete, which should indefinitely hold back the water.

In addition to the safe guards planned for the mine itself, several schemes are under consideration for unwatering the deep basin lying South and East of the point where the water came in in December, 1917. If this basin can be unwatered, all future danger from floods will be eliminated. In order to continue mining operations and cave the surface, this basin must be drained.

PREPARING MINE FOR RESUMPTION OF OPERATIONS:

As soon as it seemed certain that the water would soon be out of the mine, the work of repairing the shaft was started. The installation of the Layne & Bowler pumps had caused considerable damage to the skip roads, and other piping had destroyed some ladder sollar, casing plank, etc. The ladder road was first repaired from surface down to the 4th level. By the time this work was completed the Layne & Bowler pumps had been removed and repair work was started in the skip roads. It was decided to install new skip runners in the upper part of the shaft where the old ones were badly worn. At the same time a number of dividers were replaced so that when this work was finally completed the entire upper part of the shaft had been thoroughly overhauled and put in condition to last many years. The repair work was continued downward as the water was lowered, and by the end of November, was completed to the skip pit in the bottom of the shaft. It required over two weeks to clean up the ore, broken timbers, plank, etc., that had accumulated here. One bailer used early in 1918 had broke away at the surface of the water and fallen to the bottom of the shaft. As it had started under water, it had not gained sufficient velocity to cause any damage to the bailer or to the shaft. All the repair work in the shaft was done on night shift, so as not to interfere with the unwatering or with the work of re-opening the levels.

As soon as the water had been lowered to the 4th level, the work of repairing this level was taken up and continued until it had been completed, ready for the resumption of mining operations. The work done here consisted principally in the repair of the foot-wall drift and the cross-cuts in to the tops of raises from the sub levels where mining was in progress above the 5th level. Supplies, such as timber, powder, etc., are taken into these sub-levels by way of the 4th level, so that it was necessary to repair only this part of the old 4th level drifts.

On the 5th level the proposition was much larger, and the time required for completion, much greater. In addition to cleaning the rock drifts and re-timbering the drifts where the timber had broken down, it was necessary to construct a ditch for a distance of about 800 feet in order to carry the

incoming water. As could be expected, all parts of the mine are now wet, due to the draining of the caved ground above the workings, but it was possible to see a decided improvement in this condition by the end of the year. A few sections of the ore drifts on the 5th level had caved, and it was necessary to drift again through this ground. The work of repairing has been pushed with as large a crew as was possible to work to advantage, and by the end of the year nearly 80% of the level had been put in condition for resumption of operations.

During December, the work of re-opening the sub levels above the 5th was started, and by the end of the month it was possible for several gangs to start working in a solid face of ore. The ditch referred to previously was also completed and the concrete dam in the drift about 300 feet in from the shaft was also completed.

There was comparatively a small amount of cleaning necessary on the 6th level, as practically all the drifts here are in rock. One cross-cut on Section 29 had just struck ore at the time the mine was flooded, and at this point the drift had caved and was filled with ore. Repair work could not be started as soon as on the upper levels, owing to the fact that the water was not removed on the 6th level until the last of October. A concrete dam was installed about 400 feet in from the shaft, ditches cleaned and this level put in condition for resumption of operations early in December. There is a very large amount of development work necessary on the 6th level. By the end of the year drifting had been started at five places; the main haulage (foot-wall) drift on the East side of the 6th level was first given attention, as it is very important that this drift be advanced as rapidly as possible. Work was then resumed in the cross-cuts which had been turned off from the West haulage drift, work being started in three cross-cuts, viz: one on Section 29 and two on Stephenson property. The main West haulage drift was also continued to the South-east towards #42 diamond drill hole from surface, which is about 250' distant. The ore in this hole is 125' below the 6th level and an auxiliary shaft must be sunk in this territory in order to develop and mine this ore.

STEPHENSON MINE

A severe wind storm in August blew down one of the pulley stands. As this stand was found to be badly rotted, an examination was made of the other stands and they were all found in need of repairs. Three were torn down and new ones erected, while the remaining two were braced with guys and timbers.

The stocking trestles that had been town down when the ore in stock was shipped in 1918 have all been re-erected. The trestles have been fully equipped and at the end of the year were ready for stocking ore.

The top tram engines and motors had been taken away during the time the mine was idle, one being sent to the Barnes-Hecker, one to the Francis and one to the Princeton Mine. New ones were delivered early in December to the Stephenson, and by the end of the year two units were again in commission. The third unit is now being installed, and it will also soon be in commission.

Several years ago the shaft house was partly enclosed on the landing. This work has been taken up again and by the end of the year was 30% completed. The cage road is being cased up from the collar to a point twenty feet above the top landing; the skip road from the collar up to the sheaves, just below the top of the shaft house. Early in December a great deal of trouble was caused by ice in the shaft; the work now under way will eliminate all future trouble with ice.

Some of the mine timber in stock at the Stephenson was used in 1918 at the Princeton Mine, but there is still a small stock on hand. This is being framed now and will all be used this winter at the Princeton and Stephenson Mines. About 25% of the hardwood is useless, due to dry rot; the tamarack is all in good condition, as is also all the 5-ft. and 8-ft. lagging.

STEPHENSON MINE

AVERAGE ANALYSIS ON OUTPUT FOR YEAR 1919.

GRADE	IRON	PHOS.	SILICA	MANG.
Stephenson,	59.58	.363	5.85	.952

(Cargoes all mixed).

ORE STATEMENT - DECEMBER 31, 1919.

	STEPHENSON BESSEMER	STEPHEN- SON.	STEPHEN- SON No.1	STEPHEN- WOOD.	TOTAL	TOTAL LAST YR.
On Hand Jan.1st, 1919,				45,907	45,907	88,118
Output for Year,		437			437	
Stockpile Overrun,						3,185
Total,		437		45,907	46,344	91,303
Shipments,	0	0	0	0	0	45,396
Balance on hand,	0	437	0	45,907	46,344	45,907
Increase in output,					437	
Increase in ore on hand,					437	

1919 - Mine idle account water

1918 - Mine idle account water.

STEPHENSON MINE

SHIPMENTS FOR YEAR - 1919.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Stephenson Bessemer,	0	0	0	2,650
Stephenson,	0	0	0	16,076
Stephenson No. 1,	0	0	0	1,459
Stephenwood,	0	0	0	25,211
Total,	0	0	0	45,396
Total last Year,	0	45,396	45,396	
Decrease,			45,396	

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STEPHENSON MINE.

COMPARATIVE MINING COST FOR YEAR.

	1919.	1918.	1917.
PRODUCT	2,402	4,245	253,266
General Expense			.154
Maintenance			.134
Mining Expense			1.148
Cost of Production			1.436
DEPRECIATION.			
Original Purchase			.001
Plant Account			.008
Equipment			.005
Uncompleted Construction			.008
Total Depreciation			.022
Taxes			.098
Central Office			.060
Supply Inventory			-
Miscellaneous			.052
Sundry Expense			.008
Cost on Stockpile			1.676
Loading and Shipping			.129
Total Cost on Cars			1.805
No. Days Operating			282
No. Shifts and Hours			1-8hr
Avg. Daily Product			898
COST OF PRODUCTION.			
Labor			.919
Supplies			.517
Total			1.436

Mine did not produce in 1918 and 1919 on account of being flooded.
Product for 1918 and 1919 as shown is stockpile overrun.

STEPHENSON MINE.

COMPARATIVE WAGES AND PRODUCT.

	1 9 1 9.	1 9 1 8.	INCREASE.	DECREASE.
PRODUCT	2,402	4,245		1,843
No. Hours and Shifts	-			
AVERAGE NUMBER MEN WORKING				
Surface	17	24		7
Underground	16	10	6	
Total	33	34		1
AVERAGE WAGES PER DAY				
Surface	5.22	4.20	1.02-24%	
Underground	5.71	5.23	.48- 9%	
Total	5.47	4.52	.95-21%	
WAGES PER MONTH OF 25 DAYS				
Surface	130.20	105.00	25.50	
Underground	142.75	130.75	12.00	
Total	136.75	113.00	23.75	
PRODUCT PER MAN PER DAY				
Surface	-			
Underground	-			
Total	-			
LABOR COST PER TON				
Surface	-			
Underground	-			
Total	-			
AVG. PRODUCT BRK'G & TRM'G	-			
" WAGES CONTRACT MINERS	-			
" " " TRAMMERS	-			
" " " LABOR	-			
TOTAL NUMBER OF DAYS				
Surface	5,437	7,473½		2,036½
Underground	5,510½	3,365	2,145½	
Total	10,947½	10,838½	109	
AMOUNT FOR LABOR				
Surface	28,397.87	31,387.99		2,990.12
Underground	31,479.55	17,822.01	13,657.54	
Total	59,877.42	49,210.00	10,667.42	

Proportion Surface to Underground Men:

1919 - 1 to 1
 1917 - 1 to 2.9
 1916 - 1 to 3.07
 1915 - 1 to 2.73
 1914 - 1 to 2.88
 1913 - 1 to 3.13
 1912 - 1 to 4.69

No mining done during 1918 and 1919 on account of mine being flooded.

C. & N. W. SECTION 29 MINE

ORE STATEMENT - DECEMBER 31ST, 1919.

	NORTHDALÉ	TOTAL LAST YEAR
On hand Jan. 1st, 1919,	0	28,706
Output for Year,	0	0
Stockpile Overrun,	1,965	1,060
Total,	1,965	29,766
Shipments,	1,965	1,965
Balance on hand,	0	27,801

1919 - Mine idle account water

1918 - Mine idle account water

SHIPMENTS FOR YEAR 1919.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
North Bessemer,	0	0	0	562
Northwestern,	0			1,014
Northdale,	0	1,965	1,965	28,190
Total,	0	1,965	1,965	29,766
Total last Year,	0	29,766	29,766	
Decrease,			27,801	

PRINCETON MINE.

The Princeton Mine was operated on two 8-hour shifts during the year 1919. The product for the year was as follows:

Princeport,	23,055 tons
Sec. 19 Princeport,	<u>27,379</u> "
Total Princeport,	50,434 "
Cambridge,	116,340 "
Sec. 19 Cambridge,	<u>26,454</u> "
Total Cambridge,	<u>142,794</u> "
TOTAL ORE,	193,228 "
Rock,	<u>26,003</u> "
TOTAL ORE AND ROCK,	219,231 "

The product for 1919 increased about 45,000 tons over that of the previous year. There were 53,833 tons mined on the C. & N. W. Lease, Sec. 19, and 139,395 tons on the old Princeton properties. Conditions as regards the production of ore were much better than in 1918. The product would have been 200,000 tons in 1919 if there had been no delays due to accidents to equipment; these delays amounted to 214 hours, or reducing these to actual operating days of two 8-hour shifts, they amounted to 13-3/8 days. The actual loss of product amounted to about 9,800 tons. Your attention is called to the fact that practically none of the equipment at the Princeton Mine is Cleveland-Cliffs standard equipment, but is largely the material which was turned over to the Company when this property was taken over from the Todd-Stambaugh Company. To increase the product from this mine, and reduce the operating cost, it will be necessary to make several changes in the present equipment.

The development work, which had been pushed at all possible speed during 1918, was completed in the early part of 1919; this permitted a material increase in the product. The largest hoist for the year was in March, when nearly 20,000 tons of ore was produced. Later in the year it became necessary to do considerable rock work in order to keep development work ahead of mining operations. This work is being speeded up on account of the unfavorable operating conditions in the territory where ore is being

mined near No. 3 shaft, above the 5th level. The haulage drifts on this level had been driven in ore, and although arrangements had been completed in 1918 for handling ore through raises from the 6th level, it was still necessary to keep the drifts in ore on 5th level open in order to get timber and other supplies in to the contracts. As mining approached the 5th level it became impossible to keep these old drifts open, and it was necessary to drive cross-cuts into the footwall and connect with a drift back in the foot, through which timber and other supplies could be brought in.

An analysis of operating conditions at the Princeton Mine disclosed one very bad operating feature: viz: that the product obtained during most of the year represents the maximum capacity of the hoisting equipment. It is impossible, with the present equipment, to make up any product lost through delays; this prevents a larger product and also a lower operating cost.

The labor situation during the greater part of 1919 has been very good at this property. The re-opening of the Stephenson Mine in November and December has reduced the working forces about 20%. Unfortunately, at the time of this reduction, it became necessary to put more gangs on rock work, so that there was a decided drop in the product during these two months, which drop will probably persist further before conditions again come back to normal.

During the past year there has been an average of 25 contracts employed at the Princeton Mine, including those working on C. & N. W. Lease, Section 19. These 25 contracts were employed as follows: one contract repairing drifts, five either drifting in rock or raising in rock and nineteen contracts engaged in the production of ore. The output per man per day from the number of gangs actually engaged in the production of ore has, therefore, been excellent. It has, however, not been as high as it would have been if the capacity of the hoist had been greater.

At the end of the year it was very uncertain whether it would be possible to continue to operate this property on double shift during 1920; it depends on the labor situation; if sufficient miners can be obtained to permit of operating the Stephenson Mine to capacity without reducing the Princeton Mine force, it will be possible to continue to operate on double

shift.

Shipments for 1919 and balance of ore in stock are as follows:

	<u>SHIPMENTS</u>	<u>BALANCE OF ORE IN STOCK.</u>
Princeport,	8,777 tons	18,952 tons
Sec. 19 Princeport,	<u>6,528 "</u>	<u>25,995 "</u>
TOTAL PRINCEPORT,	15,305 "	44,947 "
Cambridge,	74,980 "	117,102 "
Sec. 19 Cambridge,	<u>21,332 "</u>	<u>5,040 "</u>
TOTAL CAMBRIDGE,	<u>96,312 "</u>	<u>122,142 "</u>
GRAND TOTAL SHIPMENTS,	111,617 "	TOTAL IN STOCK, 167,089 "

At the end of the year there was approximately 122,000 tons of Cambridge ore in stock, this being an increase of approximately 45,000 tons over that in stock a year ago. There is also more Princeport ore in stock than there was last December. The problem of stocking ore, as well as shipping, at this mine was greatly simplified by the agreement made in March, 1919 whereby the C. & N. W. Ry. Co., permitted the ore from Section 19 to be stocked and shipped directly with the ore from the old Princeton property.

The ore in sight at the Princeton Mine on December 31st, 1919, is as follows:

	<u>PRINCEPORT</u>	<u>CAMBRIDGE</u>	<u>TOTAL</u>
Sec. 20 Ore above 2nd Level, #2 Shaft,	2,550		2,550
" " " " 4th " #2 "		86,807	86,807
" " " " 5th " " "	20,000	115,335	135,335
" " " " 6th " " "	20,000	484,479	504,479
Sec. 18 " " 6th " #1 "	13,300	26,602	39,902
" " " " 7th " " "	<u>5,800</u>	<u>11,650</u>	<u>17,450</u>
Total Developed Ore,	61,650	724,873	786,523
Prospective Ore above 6th Level #2 Shaft,	<u>10,000</u>	<u>90,602</u>	<u>100,602</u>
GRAND TOTAL DEVELOPED & PROSPECTIVE ORE,	71,650	815,475	887,125

The above estimate does not include the ore on C. & N. W. Lease, Section 19. No ore is estimated below the 6th level, the same as in previous years. Development work on the 6th level in No. 3 shaft territory for the past year indicates that fully as much ore will be found here as was anticipated. The above estimate includes 100,602 tons of prospective ore between the 5th and 6th levels, in the territory where the ore has not yet been developed by drifts and cross-cuts on the 6th level.

A larger product of Princeport ore was obtained in 1919 than had been expected. I regret to report, however, that in the areas where mining is now in progress there seems to be very little ore of Princeport grade. All the ore hoisted during 1919 was handled on the 6th level. Over one-half of this ore was produced from the subs above the 5th level in the territory near No. 3 shaft. In the territory between No. 2 and No. 1 shafts, it was produced from subs midway between the 5th and 6th levels. The rock work of 1919 was confined to the 5th, 6th and 7th levels, the same as in the previous year. The work in detail for the year was as follows:

SUBS ABOVE 5TH LEVEL.

260-FT. SUB:

This sub-level was opened in July, 1918, and mining completed early in April, 1919. Four contracts worked here, the broken ore being dumped in raises extending through to the 6th level.

272-FT. SUB:

This sub level was opened in January, 1919, and mining continued throughout the year. In December, 1919 there was still one contract working on this sub level, completing the mining of some pillars near a raise.

282-FT. SUB:

This sub level was opened in July, 1919, and mining had been practically completed here by the end of the year. Only a portion of the ore body near No. 3 shaft is being mined on this sub level; the balance is being mined on the 5th level, up to the 272-ft. sub.

FIFTH LEVEL.

There has been from one to five contracts working on the 5th level during the past year. The rock work done here was probably equal to the work of one contract for the entire year. The repair work done on this level is equal to the work of one contract for a full year. In the early part of the year, mining was started in the pillars along the footwall midway between No. 2 and No. 3 shaft. By the end of the year a section approximately 200 feet in length had been mined out in this territory. After mining was completed on the sub levels above the 5th, near No. 3 shaft, mining was started on the sill floor. At the end of the year there were several contracts en-

PRINCETON MINE:

gaged in drifting and slicing in this territory. It is only a matter of a short time until all mining in the vicinity of No. 3 shaft will be in progress on the sill floor of the 5th level.

The rock work done in 1919 on the 5th level consisted in driving a drift in the foot-wall so that timber and supplies could be brought in from #3 shaft and through cross-cuts to the contracts engaged in mining in this territory. During the year there was a total of 275 feet of footwall drift driven here. The work of driving a footwall drift from No. 3 shaft to the territory near No. 2 shaft, where no mining can be done, is now about 85% completed. In order to provide for mining operations of 1920, and subsequent years, it will be necessary to complete this drift just as soon as possible. In addition to this main footwall drift, a number of cross-cuts were driven through the footwall to the ore during the year, in order to provide means of bringing in timber, powder and other supplies to the contracts. Large sections of the old haulage drift on the 5th level, near No. 3 shaft, had been permanently abandoned by the end of the year, and all useable materials taken out. This has materially increased the cost for maintenance of electric haulage, as the expense for removal of trolley wire, rail, etc., is charged to this account.

The extreme South-east end of the ore body, beyond No. 3 shaft, has not yet been fully prepared for mining on the 5th level. Several of the cross-cuts on the 6th will have to be driven in order that raises may be put up to mine the ore in this territory. This work was under way on the 6th level at the close of the year and some of the necessary raises had already been completed.

There has as yet been no mining below the floor of the 5th level from No. 2 shaft out to the limit of the ore body South and East of No. 3 shaft.

It is evident that the pressure on the timber is increasing very rapidly with the opening of each succeeding sub level at a lower elevation. Until recently it has been possible to mine a considerable distance from a raise before the haulage drift would cave, but as the pressure became greater, it was found impossible to maintain the haulage roads. In order to mine any distance from a raise it has become necessary to drive several drifts from the raise in order to get all the ore. In order to overcome this unfavorable

operating condition, it is necessary to put up a number of additional raises, so that the amount of ore to be mined from any raise is greatly decreased as compared with present operating conditions. It is also expected that conditions can be materially improved by opening a sub level under the hanging in advance of general mining operations on the sub levels above. Most of the water seems to follow the hanging, and if it can be caught on a sub level at a lower elevation it will tend to make very much better working conditions on the sub level above.

SUBS ABOVE 6TH LEVEL.

335-FT. SUB. 45 FT. ABOVE 6TH LEVEL.

Considerable work was done on this sub level during 1918, and also during a portion of 1919. The work of the past year has been confined to the territory between No. 2 and No. 1 shafts. A number of pillars were mined that had been left for many years. Some ore was mined just above this sub level in the area where the pillars were found high enough on the foot to warrant the opening of an auxiliary sub level. By the end of the year, the greater part of all the ore at this elevation outside of the shaft pillar at No. 2 shaft, had been mined out. In December it was necessary to take all contracts out of this territory due to the capping breaking over a large area, which rendered it extremely dangerous to keep men working in this territory. There has been no evidence of the cave extending through to surface, but owing to the connection with the Stegmiller Mine on Section 17, and also the connection with the area already mined on Section 19, the capping in this territory has been cut off over a large area and caving to surface seems inevitable. After about a week, during which there were constant falls of ground over this entire territory, all movement apparently ceased, and at the last of the year work was again resumed on the pillars where mining had not been completed. There is only a very small amount of ore remaining at the elevation of this sub level.

350-FT. SUB. 30 FT. ABOVE THE 6TH LEVEL.

Mining was in progress on this sub level during 1918, as also during all of 1919. To a large extent, mining operations here consisted in mining the old pillars which had been left from previous mining operations. The ore

on this sub level, as well as on the 335-ft. sub, has all been of Princeport grade. By the end of the year, however, mining had been practically completed on Section 18, at the elevation of this sub level. Mining, however, was in progress further to the West at the elevation of this sub level on Section 19.

362-FT. SUB 18 FT. ABOVE 6TH LEVEL.

Work was started on this sub level in September, 1918, and continued throughout the year 1919. The greater part of the ore outside of No. 2 shaft pillar had been mined at the end of the year. A number of contracts are working at the elevation of this sub on C. & N. W. Lease, Section 19. Practically all the ore from Sections 18 and 20 on this sub level was of Princeport grade.

SIXTH LEVEL.

Practically all work done on the 6th level during 1919 has been in rock. In the early part of the year there was some ore mined South and East of the cross-cut from No. 2 shaft, under the hanging, near old Diamond Drill Hole #1. Mining had been carried on at this same point during the greater part of 1918. During the year there was a total of six raises put up from the 6th to the 5th level in the territory near No. 3 shaft. The cross-cuts from the main footwall drift were advanced a total of 245 feet in this same territory during the past year. At the first of the year there was approximately 2,000 feet of rock drifting to be done in the neighborhood of No. 3 shaft to complete the development work. During 1919 360 feet of this drifting was completed, so that there remains 1,640 feet to be done. During the past year, between No. 2 and No. 1 shafts, on Sections 18, 19 and 20, some work has been done. Changes have been made in the grade of drift from #2 to #1 shaft. Several raises have been put up from this old drift to mine the ore remaining above the 6th level in this territory. The work at the elevation of the 6th level on Section 19, will be reported under "C. & N.W. Lease, Section 19".

In addition to the work outlined above, the cross-cut was finished from the footwall haulage drift near No. 3 shaft over to the line of No. 3 shaft. A raise was put up which connected with the bottom of this shaft, just below the 5th level. The ground was then removed and shaft timber installed from 5th to 6th level. All timbering work in the shaft has been

completed and the shaft is now ready for installation of the counter-balance pipe from 5th to 6th level, after which the shaft itself will be ready for operation of the cage to the 6th level. All work could have been completed nearly sixty days before the end of the year, but it has been delayed on account of the non-arrival of the new drum ordered for the hoisting engine at No. 3 engine house. This hoist originally came from No. 1 shaft, but the drum was not large enough to hold the rope necessary for operating the cage to the 6th level. A new drum was ordered last summer, delivery of which is promised in January 1920, so that if no further delays occurs it should be possible to have the cage operating to the 6th level by the first of March, 1920.

SEVENTH LEVEL.

The development of the 7th level was started when the mine re-opened in 1918. During 1918 the circular haulage drift at the shaft was about 60% completed. The work of cutting the permanent pump house was started and work was continued here until the pump house was completed, early in the Spring of 1919. The work of cutting the sump was started in January 1919 and completed in December. Work however, was not carried on here constantly during the year, as work in the sump was stopped several times in order to complete necessary work at other points on this level. During the year, the circular haulage drift at the shaft was entirely completed and permanent haulage tracks installed. The cross-cut to the ore body has been advanced 150 feet, beyond the point where the circular drift from the shaft holed. During the year a raise was put up from the 6th to 5th level, to be used for carrying water down to the sump of the permanent pumphouse. This raise is located in the main cross-cut to the ore body, about 300 feet South of the shaft. Ditches were cut from the foot of this raise on 7th level in to each of the sumps.

The Aldrich plunger and the centrifugal pumps were installed in the pumphouse in the Fall. All piping and other work was completed in December, and the pumps were put in operation at the end of the year. On completing all the above outlined work, drifting was resumed in the cross-cut to the ore body. This will be extended as rapidly as possible to a point beyond the ore body on Section 19. Raises will then be put up in prepar-

PRINCETON MINE:

ation for mining the downward extension of this ore below the 6th level. The development of the Princeton ore body at the elevation of the 7th level will also be started during the coming year, although it will be several years before it will be necessary to do any mining at this elevation.

C. & N. W. LEASE - SECTION 19

The product for 1919 hoisted through the Princeton shaft, was as follows:

Section 19 Princeport,	27,379 tons
Section 19 Cambridge,	<u>26,454</u> "
TOTAL,	53,833 "

During January and February and until March 22nd, ore of Cambridge grade only was obtained from this lease, due to the fact that there was no separate stocking ground available for Section 19 Princeport ore. However, on March 22nd, when the agreement with the C. & N. W. Ry. Co., became effective, which permitted the mixing of the ore from Section 19 directly with the Princeton ores, it became possible to make two grades of ore. The product of Section 19 Cambridge ore showed an immediate decrease, as most of the product obtained from Section 19 at this time was of Princeport grade. As more gangs were added, the product showed a gradual increase, until it was running above 6,000 tons per month. The largest product was in October, in which month there was 7,791 tons. The shipments and ore in stock at the end of the year was as follows:

	<u>SHIPMENTS</u>	<u>ORE IN STOCK</u>
Section 19 Princeport,	6,528 tons	25,995 tons
Section 19 Cambridge,	<u>21,332</u> "	<u>5,040</u> "
TOTAL,	27,860	31,035 "

It must be remembered that this ore has not been stocked separate from the other ore hoisted at this property since March 22nd, 1919. This statement is ^{included} however, to show the amount of Section 19 ore in stock mixed with the Princeton ores.

The estimate of ore in sight on December 31st, 1919, is as follows:

Section 19 Princeport,	10,000 tons
Section 19 Cambridge,	<u>62,400</u> "
Total Ore in sight,	72,400 "

	72,400 tons
Prospective Ore below 6th Level, Princeport, Cambridge,	5,000 tons <u>30,200 "</u>
TOTAL,	<u>35,200 "</u>
GRAND TOTAL,	107,600 "

The original estimate made from surface diamond drill holes showed 108,000 tons of ore on this lease. The work of 1918 indicated an amount in excess of this tonnage, but in 1919 the estimate was further increased so that it now seems reasonable to expect a tonnage of between 150,000 and 200,000 tons of ore on this property. Very little, however, is known of the downward extension of this ore below the 6th level. In the above estimate of prospective ore it is assumed that it will extend down a distance of 25 feet on the dip. This is equivalent to an area equal to one-half the area of the ore body on the 6th level, being carried down to a distance of 25 feet, or it is equal to the entire area on this level, extending down a distance of 12-1/2 feet. This estimate is conservative, as this ore may extend down to^a considerable distance below the 6th level. The only disappointing feature of this ore is its content of Phosphorus and its plastic character. It was originally assumed that it would probably be largely Princeport grade, and while not likely non-plastic, it would at least be semi-plastic in character. The top of the ore body forty feet above the 6th level was exactly as expected. However, as the upper sub levels were mined out a sudden change occurred, both in the content of Phosphorus and the physical character of the ore. There was an upward turn in the hanging, beyond which it dipped at a flat angle to the South and East; beyond this upturn there was a decided change in the grade and physical structure of the ore. On the 6th level, where some development work has been done through drifting and cross-cutting, the ore is apparently almost exactly similar to the plastic ore body near #3 shaft, except that the Phosphorus does not run as high.

An outline of the work of the past year is given herewith:

SUBS ABOVE 6TH LEVEL, SEC. 19.

335-FT. SUB:

This sub level was opened early in the summer to mine the top of the ore body near the Section 18 boundary line. Mining was completed here in C. & N.W. LEASE, SEC. 19 (PRINCETON MINE)

September.

350-FT. SUB:

Mining was carried on throughout the year on this sub level. In addition to mining some pillars near the Section 18 boundary line, a large extent of new territory was opened to the South and through rolls in the hanging further to the North-west towards No. 1 shaft. A longitudinal section thru this territory shows a series of rolls in the hanging, which resulted in extending the ore out further to the North-west than had been anticipated. Mining had not yet been completed on this sub-level at the end of the year, but the greater part of the ore body had been mined.

362-FT. SUB:

Mining has been in progress for a considerable period of time on this sub level. On the sub above there were horses of rock found between the ore, due to rolls in the hanging, but this sub level was low enough down so that the ore body was continuous. About 60% of this sub level had been mined out at the end of the year.

SIXTH LEVEL.

At the first of the year there was one contract crosscutting the ore body to locate the hanging. After the hanging was reached no further work was done on the main 6th level. This crosscut showed the ore to be plastic in character, being very similar to the ore near No. 3 shaft. The Phosphorus ran from .400 to .600, or above the limit for Princeport ore. In addition to the above work, three raises were put up from the 6th level to the 350-ft. sub level.

SEVENTH LEVEL.

As stated elsewhere in this report, drifting had been started on the 7th level with the idea of driving a drift beneath the 6th level ore body in the rock footwall from which raises will be put up to mine the ore on the sill floor of the 6th, and also the ore below the 6th. This drift has not yet reached Section 19 territory.

PRINCETON SURFACE.

The regular Princeton top tram unit was originally operated with a 50 h.p. motor. During the time the mine was idle this motor was sent to the Negaunee District. When the mine re-opened in 1918, this motor could not be returned at once, so that it was necessary to temporarily borrow a 35 h.p. motor from the Stephenson Mine. This motor was not powerful enough to pull a loaded car up more than a 1% grade. The 50 h.p. motor was returned in the fall of 1918 and installed at once. In the Spring of 1919 when the Cambridge stocking trestles had been filled with ore, it was decided to build a trestle on top of the pile on an up-grade of 2-1/2°; this work was completed in April; it added nearly 40,000 tons to the capacity of the Cambridge stocking grounds. The rail was laid on 4-1/2-ft. ties in preparation for side-dumping after this trestle was filled. Luckily, shipments from pocket started the last of April and it was not necessary to make much use of this trestle until in the fall of 1919. It was filled in November and side-dumping was started. All the Cambridge ore hoisted this winter will now have to be stocked by side-dumping. On top of the soft, plastic, Cambridge pile, side-dumping is always a problem and an added expense over stocking directly from trestles.

The permanent rock stocking trestle was filled early in May and several bents were added. Later in the year additional bents were necessary and finally in December the trestle was extended out into low ground where there is a large stocking capacity per foot of trestle. No further additions should be necessary in 1920.

A portion of the Princeport stocking trestle was torn down in the summer, when this ore was shipped; these bents were erected again in the fall when shipping was completed.

The timber yard at No. 3 shaft was leveled off during the summer and put in good condition for handling timber. This timber yard is handicapped by the railroad tracks being on the same grade as the timber yard; the tracks should be elevated through the yard to provide easy and economical handling of timber and lagging.

PRINCETON MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1919.

GRADE	IRON	PHOS.	SILICA	MANG.
Princeport,	61.61	.257	4.82	.640
Cambridge,	60.14	.916	3.84	1.069

ORE STATEMENT - DECEMBER 31ST, 1919.

	PRINCE- PORT.	CAMBRIDGE SEC.19.	CAMBRIDGE	PRINCE- PORT SEC.19.	TOTAL	TOTAL LAST YEAR
On hand Jan.1st,1919,	4674	5062	75742		85478	3457
Output for Year,	23055	26454	116340	27379	193228	147871
Transferred,		5144		5144		
Stockpile Overrun,						394
Total,	27729	26372	192082	32523	278706	151722
Shipments,	8777	21332	74980	6528	111617	66244
Balance on hand,	18952	5040	117102	25995	167089	85478
Increase in output-31%					45357	
Increase in ore on hand,					81611	

1919 - 2-8 Hour Shifts

1918 - 2-8 Hour Shifts

PRINCETON MINE

SHIPMENTS FOR YEAR 1919.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Princeport,	2,209	6,568	8,777	23,266
Princeport Section 19,	3,057	3,471	6,528	
Cambridge Section 19,	11,394	9,938	21,332	
Cambridge,	51,032	23,948	74,980	42,978
Total,	67,692	43,925	111,617	66,244
Total last Year,	60,713	5,531	66,244	
Increase - 27%			45,373	

PRINCETON MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 9.	1 9 1 8.	INCREASE.	DECREASE.
PRODUCT	193,228	148,265	44,963	
General Expense	.195	.253		.058
Maintenance	.202	.355		.153
Mining Expense	2.034	2.551		.517
Cost of Production	2.431	3.159		.728
Exploratory	.047	.050		.003
DEPRECIATION.				
Original Purchase	.256	.343		.087
Plant	.035	.050		.015
Construction	.040		.040	
Total Depreciation	.331	.393		.062
Taxes	.070	.067	.003	
Central Office	.074	.128		.054
Supply Inventory	.008	.012		.004
Miscellaneous	.021	.074		.053
Sundry Expense	.007	.032		.025
Cost on Stockpile	2.989	3.915		.926
Loading & Shipping	.054	.029	.025	
Cost on Cars	3.043	3.944		.901
No. Days Operating	295	298		3
No. Shifts and Hours	2-8hr	2-8hr		
Avg. Daily Product	655	497	158	
COST OF PRODUCTION.				
Labor	1.790	2.331		.541
Supplies	.641	.828		.187
Total	2.431	3.159		.728

MINE NOT PRODUCING IN 1917.

PRINCETON MINE.

COMPARATIVE WAGES AND PRODUCT.

	1 9 1 9.	1 9 1 8.	INCREASE.	DECREASE.
PRODUCT	193,288	148,265	44,963	
No.Shifts and Hours	2-8hr	2-8hr		
AVERAGE NUMBER MEN WORKING				
Surface	35	50		15
Underground	162	173		11
Total	197	223		26
AVERAGE WAGES PER DAY				
Surface	4.69	4.33	.36-8.3%	
Underground	5.94	5.06	.88-17.4	
Total	5.72	4.90	.82-16.7	
WAGES PER MONTH OF 25 DAYS				
Surface	117.25	108.25	5.00	
Underground	148.50	126.50	22.00	
Total	143.00	122.50	20.50	
PRODUCT PER MAN PER DAY				
Surface	18.70	9.66	9.04	
Underground	3.99	2.80	1.19	
Total	3.29	2.17	1.12	
LABOR COST PER TON				
Surface	.251	.448		.197
Underground	1.491	1.808		.317
Total	1.742	2.256		.514
AVG. PRODUCT BRK'G & TRM'G	6.37	7.56		1.19
" WAGES CONTRACT MINERS	6.23	5.52	.71	
" Total " TRAMMERS	0	5.21		
" " " LABOR	6.23	5.52	.71	
AMOUNT FOR LABOR				
Surface	48501.14	66406.86		17905.72
Underground	288020.78	268105.95	19914.83	
Total	336521.92	334512.81	2009.11	
TOTAL NUMBER OF DAYS				
Surface	10,336	15,351 $\frac{1}{2}$		5,015 $\frac{1}{2}$
Underground	48,479 $\frac{3}{4}$	52,988 $\frac{3}{4}$		4,509
Total	58,815 $\frac{3}{4}$	68,340 $\frac{1}{4}$		9,524 $\frac{1}{2}$

Proportion Surface to Underground Men:

1919 - 1 to 4.63
 1918 - 1 to 3.48
 1917 - 1 to 1. not producing
 1916 - 1, to 1.29 "
 1915 - 1 to 1.25 "
 1914 - 1 to 1.31 "
 1913 - 1 to 3.13
 1912 - 1 to 4.69
 1911 - 1 to 4.18

PRINCETON MINE.

TIMBER STATEMENT FOR YEAR ENDING DECEMBER 31, 1919.

KIND.	LINEAL FEET.	AVG. PRICE	AMOUNT	AMOUNT
		PER FOOT.	1919.	1918.
6" to 8" Timber	79,077	.0314	2480.10	3892.58
8" to 10" "	78,245	.0472	3693.69	3550.20
10" to 12" "	31,148	.109	3395.05	3784.30
12" to 14" "	8,999	.1007	905.92	975.58
Total - 1919	197,469	.053	10474.76	
Total - 1918	268,902	.0454		12202.66
	LINEAL FEET.	PER 100'.		
5' Lagging	521,900	.9733	5079.66	2629.20
5½' "	25,245	.8075	203.85	
4" to 6" Cribbing	1,120	.80	8.96	304.48
8' Lagging	472,932	.6637	3138.71	2361.91
Total Lagging	1,021,197	.8256	8431.18	5295.59
Poles	16,564	1.1157	184.81	412.69
Total - 1919	1,037,761	.8302	8615.99	5708.28
Total - 1918	854,300	.6682		5708.28
Product			193,228	147,849
Feet Timber per ton of ore			1.02	1.82
Feet Lagging "			5.29	5.77
Feet Lagging per foot of timber			5.17	3.18
Cost per ton for Timber			.054	.0825
" Lagging			.044	.0358
" Poles			.001	.0028
" Timber, Lagging & Poles			.099	.1211
Equivalent of stull timber to Bd. Measure			314,543	491,442
Ft. Bd. Measure per ton of ore			1.628	3.324
Total cost for Timber, Lagging & Poles - 1919				19090.75
" " " " " " " " " " " "				17910.94
" " " " " " " " " " " "				3314.03
" " " " " " " " " " " "				1251.82
" " " " " " " " " " " "				4918.36

PRINCETON MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICE.	AMOUNT 1919.	AMOUNT 1918.
40% Powder,	25,950	.1665	4321.05	3240.57
50% "	17,200	.1814	3120.55	2833.74
60% "	1,100	.2347	258.21	2239.07
80% "				78.30
Total Powder	44,250	.1740	7699.81	8391.68
Fuse,	159,800	.6828	1091.13	963.51
Caps,	38,500	1.419	546.14	431.36
Cap Crimpers,	13	.558	7.25	20.69
Connecting Wires,				.44
Tamping Bags,	6,700	.2028	13.59	22.68
Total Fuse, Etc.			1658.11	1438.68
Total Explosives,			9357.92	9830.36
Product,			193,228	147,849
Pounds Powder per Ton of Ore,			.229	.267
Cost per ton for Powder,			.040	.057
" Caps, Etc.			.008	.0098
" All Explosives,			.048	.0668
Avg. Price per Lb. for Powder			.174	.2124

GWINN MINE

The Gwinn Mine was operated on one 8-hour shift throughout the year 1919. The shaft was sunk from 10th to 11th level on night shift; this work was started in May and practically completed at the end of the year. The product for the year was as follows:

Gwinn Bessemer,	5,645 tons
Gwinport,	130,126 "
Gwinwood,	<u>2,076</u> "
Total Ore,	137,847 "
Rock,	<u>16,604</u> "
Total Ore and Rock, 154,451	

The decrease in product of 18,000 tons in 1919 was partly due to less working places in ore during the greater part of 1919. Part of the decrease is due to the fact that the mine operated on single shift for twelve months in 1919, while in 1918 it operated on single shift for ten months and double shift for two months. Aside from the sinking of the shaft from the 10th to the 11th level, there has been comparatively little development work under way during the year. The cost of the product has continued high, but an improvement has been made in the tons of ore obtained per man per day from stoping. Mining in certain areas has been expensive, due to the thin flat-lying deposit, where it requires more explosives, also more holes to break the ore.

There was a small Bessemer output during the first few months of the year, which gradually decreased each month until in August, since which time there has been no Bessemer product at all. The greater part of the mining done during 1919 has been in the flat-lying deposits. It has been proven that there is no Bessemer ore in these deposits. The development work on 10th level in 1918 indicated that some Bessemer ore would be found in the neighborhood of the 10th level, but there was no mining done here in 1919. Diamond drilling below the 10th level shows an increasing content of Phosphorus in the ore, indicating that there will probably be two grades when this ore is mined, one Gwinport and the other Gwinwood. The Bessemer ore stocked in the Spring of 1919 was shipped during the Summer and practically all graded as "Gwinn Ore", running from .055 to .075 in Phosphorus. One encouraging feature that has

developed during the past two years is that the ore on the lower levels is considerably softer. Auger drill machines are used exclusively in this territory, which permits of a much better output from the contracts. Shipments for 1919 and balance of ore in stock are as follows:

	<u>SHIPMENTS</u>	<u>BALANCE OF ORE IN STOCK</u>
Gwinn Bessemer,	685 tons	
Gwinn,	5,339 "	
Gwinport,	58,737 "	116,352 tons
Gwinwood,	1,905 "	
TOTAL,	66,666 "	116,352 "

The ore in sight at the Gwinn Mine on December 31st, 1919, was 856,847 tons. This is an increase of approximately 52,000 tons over the amount of ore shown a year ago. The actual increase is, however, 189,000 tons, as 137,000 tons must be added to the amount above in order to include the product obtained in 1919.

The estimate of ore in sight is as follows:

	<u>BESSEMER</u>	<u>GWINN</u>	<u>GWINN- PORT</u>	<u>GWINN- WOOD</u>	<u>TOTAL</u>
Ore above 5th Level,	7,380	7,380	14,770		29,530
" " 6th "	42,750	42,750	85,500		171,000
" " 7th "	3,000	3,000	22,470		28,470
" " 8th "	15,000	15,000	99,100		129,100
" " 9th "			113,770		113,770
" " 10th "	15,000	15,000	175,500		205,500
Total Developed Ore,	83,130	83,130	511,110		677,370
Prospective Ore below 10th Level,	10,000	10,000	100,000	59,450	179,450
GRAND TOTAL,	93,130	93,130	611,110	59,450	856,820

Considerable additional prospective ore is shown in this years estimate between the 10th and 11th levels. A number of drill holes were put down during the year from the 10th level and the outlines of the ore body were determined within fairly accurate limits. This permitted an accurate estimate to be made of the probable ore. If the present product is to be kept up during 1920 it will be necessary to push the development of the new 11th level as rapidly as possible. The work in detail for the year was as follows:

FOURTH LEVEL

This level was kept open during 1919 and monthly examinations made of the caving ground in the stopes. There has been no falls of ground in this

territory during 1919.

SUBS BELOW 6TH LEVEL.

Mining of the pillars between old square set rooms Nos. 1 to 5 was completed on the first and second sub levels in 1917, and on the 3rd and 4th sub levels in 1918. Mining was completed in April, 1919, on the 5th sub level, on the 6th sub level in May and on the 7th or bottom sub level early in November. The work of mining out the pillars between the old square set rooms on the sill floor of the 7th level has been started and three contracts were working here at the end of the year. There will be work here for about four months more, which will complete the mining of all the ore between the 7th and 6th levels except the ore in the shaft pillar.

During the past year there has been two gangs working in this territory and for part of the year there were three gangs. The amount of the rock drifting necessary to reach the ore pillars increased as the subs approached the 7th level. The actual cost of mining was materially increased due to the large amount of rock work necessary to obtain a relatively small quantity of ore.

SEVENTH LEVEL.

At the end of the year there were 28,470 tons of ore in sight between the 7th and 6th levels, practically all of which is represented by the shaft pillar. Mining was started on the fill floor of the 7th level in August, a drift being driven in rock towards the pillar on the sill floor between Nos. 4 and 5 square set rooms. A rock drift was started in October in order to mine the pillar between old square set rooms Nos. 3 and 4, and in November a rock drift was started towards the pillar between Nos. 2 and 3 square set rooms. Mining of the pillar between Nos. 4 and 5 rooms was completed in December and a rock drift was started in order to mine the ore between No. 1 and No. 2 rooms. The length of these rock drifts average approximately sixty feet. The ore available from each drift has an area of approximately forty feet by fifty feet.

SUBS ABOVE 8TH LEVEL.

4TH SUB ABOVE 8TH:

This sub was opened in September, 1918, and three gangs of miners worked here during the balance of 1918 and for several months in 1919. The area of the ore body developed here was larger than expected. Two raises were

GWINN MINE:

put up from the 9th level to this territory, and the ore was dumped in these raises and trammed to the shaft on the 9th level. From June on to the end of the year one contract worked here. Mining had not quite been completed at the end of the year, but all work will be completed within sixty days. There has not been much change in the grade of the ore mined here during 1919; it has averaged about 55.00% in Iron, as compared with 54.00% in 1918.

3RD SUB ABOVE 8TH:

This was the original sub opened in the isolated ore body lying between the 7th and 8th level. The work of 1918 disclosed the fact that the ore extended some distance above this sub level, and accordingly subs were opened at a higher elevation. As stated in the previous paragraph, mining was continued throughout 1919 on the 4th sub. Only a relatively small amount of work was done on the 3rd sub during 1919, consisting of a few drifts along the hanging to define the limits of the ore body, as also some cross-cuts in the hanging to connect with the raises from the 9th level. This sub level is all developed ready for mining as soon as work is completed on the 4th sub.

2ND SUB ABOVE 8TH:

This sub level was opened in April and work continued throughout the year, one contract working here. On the hanging side of the 3rd sub, the deposit pinches out; the 2nd sub, ten feet lower, is nearly 150 feet further to the South, indicating that the formation is almost horizontal between the 3rd and 2nd sub. The ore has been followed to the south-west and over the greater part of the sub has proven to be about ten feet in thickness. At the end of the year apparently the south-west limit of the ore had been reached, and the work of slicing the ore off the foot-wall was started. It will apparently be possible to mine up about twenty feet on the foot. Above this point the ore is too thin to be mined.

EIGHT LEVEL.

During 1918, the bulk of the ore in the flat deposit on the 8th level was mined. There were a few pillars left near the foot-wall; these were mined out during 1919, all work being completed here the last of November. The only ore now remaining on the 8th level is in the shaft pillar.

SUBS BELOW THE 8TH:

This sub level was originally opened in 1917; mining was continued here during all of 1918 and all of 1919. In the early part of the year there were nine contracts working here; this number was gradually reduced, however, until at the end of the year there were only four. The ore over a portion of this sub level has been quite thin and it has been necessary to use seven-foot legs. A roll in the foot-wall in the 8th level ore body divides this sub level into two parts, with a horse of rock between. At the end of the year mining had been completed on the south side of this roll, and fully eighty-five percent of the ore had been mined on the North side. Work will be completed here in about three months.

2ND SUB BELOW 8TH:

This sub level was opened in September at the North-east end of the ore body. It is planned to continue to mine all the ore out down to the 9th level in this small section of the ore body. The ore is narrow at this point, averaging less than 25 feet in width, and an area approximately 100 feet long will be mined. Mining was continued on this sub level for the balance of the year, only one contract being employed here, however.

4TH SUB BELOW 8TH:

The work of cutting off the ore vertically above the 9th level was started on the 5th sub level below the 8th, but owing to irregularities in the hanging it was found necessary to open a sub level at a higher elevation, which was known as the 4th sub. The ore area on this sub level was of a small extent, and mining was completed here in a few months.

5TH SUB BELOW 8TH:

Some ore was mined at the elevation of this sub level in 1918, but the work was only partially completed. Mining was continued in 1919, and all of the ore at this elevation removed back to a point vertically above the foot-wall on the 9th level.

6TH SUB BELOW 8TH:

Before completing the mining of the ore on the 5th sub below 8th level, mining was started on this sub level. The floor of this sub was level

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with the back of the main 9th level. Mining was completed here in November.

NINTH LEVEL

Mining of the ore on the sill floor of the 9th level under the hanging was started in 1918, and continued throughout 1919. It had not yet been completed at the end of the year, but the greater part of the ore body had been removed.

1ST SUB BELOW 9TH:

The work of developing this sub level was started in January, 1919, and continued throughout the year. A number of raises have been put up during 1919 from the 10th level to the elevation of this sub level, and during the latter part of the year there were three gangs mining ore on this sub level. By the end of the year an area 100 ft. x 150 ft. in size had been mined out.

2ND SUB BELOW 9TH:

The opening of this sub level was started in October and at the end of the year three contracts were working here, drifting from their raises toward the footwall.

TENTH LEVEL.

The work done in 1919 on the 10th level consisted in putting up four raises from the 10th to the 9th level, and 75 feet of rock drifting. This is independent of the rock drift driven to the south-east to the Wadsworth boundary line, from which diamond drilling was done to define the limits of the ore body below the 10th level, this extraordinary drifting amounting to 430 feet. During 1919 there was 900 feet of rock drifting and rock raising on this level. This level is now fully developed and the ore body outlined.

MAIN SHAFT.

The work of sinking the shaft from the 10th to the 11th level was started in May. It has been done on night shift, two shifts working. The work at first progressed very slowly, as it was necessary to take great care in blasting, so as not to injure the shaft timber and skip pit pocket. It was also necessary to install a set of bearers at the elevation of the skip pit level. As sinking progressed, the ground became harder, until very slow progress was made due to the time required for drilling. The 11th level was opened the last of July at a depth of 124 feet below the 10th. After extending drifts in on

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the plat far enough so that work could be resumed here without injury to the shaft timber, sinking was continued and ground blasted out for installation of loading pocket at the shaft. This work was completed and pocket installed before the end of the year. The shaft was bottomed at a depth of 68 feet below the 11th level. At the end of the year a skip pit level was being opened for handling the dirt which spills from the skips. It is expected that this work will be completed within a month, after which drifting will be started on the 11th level. The cost per foot for sinking the shaft has been very high. There are several reasons for this, which may be briefly outlined as follows: All work done on the night shift; trouble with water, due to low air pressure which prevented the shaft pump from having the shaft pumped out so that work could be carried on; delays in drilling due to poor air pressure and to the extreme hardness of the ground, which was such that at times it required three shifts to drill a round of holes.

DIAMOND DRILLING ON TENTH LEVEL.

An exploratory drift was started to the south-east towards the Wadsworth boundary line on the 10th level in February. Good progress was made with this drift, which was completed in April, in which month drilling was started. The following is a brief summary of the holes drilled in this territory:

Hole No. 17.

This hole is located 550' South and 186 feet East of the shaft. It was a vertical hole, the material encountered being as follows:

0 to 40' - Slate
40 to 84' - Jasper
84 to 103' - Ore

Due to caving, the hole was abandoned at a depth of 103 feet, and hole #18 started.

Hole No. 18:

This hole, located about three feet South of No. 17, was drilled to prove up the ore found in Hole No. 17, which, as stated before, was abandoned.

The material encountered was as follows:

0' to 46' - Slate
46' " 55' - Slate and Jasper
55' " 75' - Chert and Jasper
75' " 85' - Jasper
85' " 105' - Ore
105' " 112' - Slate
112' " 114' - Arkose

The analysis of the sludge samples from this hole was as follows:

85 to 90 - 53.10 Iron - .034 Phos.
90 to 95 - 44.10 " - .381 "
95 to 100 - 52.60 " - .746 "
100 to 105 - 59.30 " - .852 "

Hole No. 19.

Hole No. 19 is located one foot South of Hole No. 18 and was drilled on a dip of 60° and on a course of S 27°. This hole was started on May 24th and completed in June. The material encountered was as follows:

0 to 7' - Slate
7' to 17' - Slate and Chert
17' to 60' - Slate
60' to 65' - Chert
65' to 73' - Chert and Jasper
73' to 82' - Jasper
82' to 100' - Jasper and Lean Ore
100' to 116' - Ore
116' to 129' - Jasper and Arkose
129' to 155' - Arkose

The analysis of sludge samples were as follows:

95 to 100	-	53.00	Iron	-	.292	Phos.
100 to 105	-	58.60	"	-	.346	"
105 to 110	-	58.70	"	-	.570	"
110 to 115	-	60.80	"	-	.634	"
115 to 120	-	53.60	"	-	.727	"

Hole No. 20.

On completing hole #19, hole #20 was drilled from the extreme south-east end of the exploratory drift, about fifteen feet from the Wadsworth boundary line. This was a vertical hole and was drilled to a depth of 124 feet below the 10th level. The material encountered was as follows:

0 to 48'	-	Slate
48' "	60'	Slate and Jasper
60' "	76'	Jasper
76' "	99'	Jasper and Ore
99' "	124'	Ore and Arkose

The analysis of sludge samples were as follows:

95 to 100	-	53.60	Iron,-	.048	Phos.
100 to 105	-	62.00	"	.644	"
105 to 110	-	52.20	"	.842	"

Hole No. 21.

On completing this hole, hole #21 was drilled from the same station, the hole dipping at an angle of 60° to the North. The material encountered was as follows:

0 to 50'	-	Slate
50 to 59'	-	Slate and Chert
59 to 66'	-	Chert

Hole No. 22.

This hole was drilled from the same station as hole #21, on a dip of 60° and on a course of $S 28^{\circ} W$. The material encountered was as follows:

		<u>Iron.</u>	<u>Phos.</u>
Slate,	0 to 78'		
Jasper,	78 to 115'		
Lean Ore,	115 to 125'	53.14	.554
Jasper,	125 to 132'		
Arkose,	132 to 173'		

There was practically no ore encountered in any of the three holes, drilled near the Wadsworth boundary line, viz: Nos. 20, 21 and 22. Apparently the Gwinn ore body does not cross the line at this point, and if it crosses at all, it is much farther to the South.

Hole No. 23 was located 918 feet South-East of the shaft, and was a vertical hole drilled to prove up ore below the 10th level at a point 100 feet West of Holes Nos. 18 and 19. The material encountered was as follows:

Slate	0 to	44
Slate and Jasper	44 "	56
Jasper	56 "	90
Ore	90 "	110
Lean Ore	110 "	115
Arkose	115 "	125

The analysis of sludge samples was as follows:

90 to 110	61.28 Iron	.908 Phos.
110 to 115	49.10 Iron	.965 Phos.

Hole No. 24 was located 818 feet South-East of the shaft, and 100 feet North-west of Hole No. 23, and about 50 feet South-east of the end of the 10th level ore body. It was a vertical hole and was drilled to a depth of 123 feet. The material encountered was as follows:

Jasper	0 to	5
Lean Ore	5 "	10
Ore	10 "	15
Lean Ore	15 "	25
Jasper	25 "	75
Ore	75 "	103
Arkose	103 "	123

The analysis of sludge samples was as follows:

75 to 80	56.60 Iron	.664 Phos.
80 to 85	59.30 "	.731 "
85 " 90	59.90 "	.622 "
90 " 95	61.16 "	.651 "
95 " 100	62.80 "	.612 "
100 " 103	58.70 "	.688 "

Hole No. 23 proved up 20 feet of high grade ore; Hole No. 24, 28 feet. The footwall evidently is very steep below the 10th level in the vicinity of hole No. 24.

GWINN MINE SURFACE.

The work of enclosing the Gwinn head frame was started in 1918 and completed in 1919. A decided improvement was at once noticeable in operating conditions on the top tram, and also in the shaft.

Additional stocking ground was provided at the Gwinn Mine by enlarging and extending the stocking ground to the East of the shaft. A sollar was made here by using silicious ore which was loaded by steam shovel and transferred in railroad dump cars. The sollar was made 8 in. in thickness and after it was all levelled off it was rolled. Trestles were erected early in the fall for stocking ore hoisted during the winter. Before using the new stocking ground it was planned to fill the West stockpile grounds again. All ore shipped from stockpile was loaded from the West stocking ground, the shipments, however, were not large enough to even make one cut for the full length of the pile. Considerable repairs to the trestle were necessary, after shipping was stopped, in order to permit of stocking. This was the second season that a side cut had been taken out without removing sufficient ore to permit of taking down the trestle and re-erecting it, so that many legs have been broken off. It was thoroughly overhauled and will take care of the hoist until nearly the 1st of March, 1920.

FATAL ACCIDENT - GWINN MINE
(Gwinn Mine Accident Report No.199)

I regret to report that John W. Fagerberg received injuries on January 22nd, at 11:20 A.M., on the 9th level of the Gwinn Mine, which caused his death two days later. He was a single man, age 33, and was employed as a motorman.

There was no witness of the accident but from the statement of the brakeman the accident occurred while Fagerberg was taking the motor with two empty cars from the shaft on the 9th level in to #2 winze. The brakeman was riding on the coupling of the last car. He intended to ride in beyond a switch near the shaft and switch a timber truck from this siding over to the switch leading to the cage, while Fagerberg went on in with the motor and loaded two cars at the winze. The brakeman is employed both as brakeman and chuteman, as most of the work at the winze is done by the motorman. Just after they passed #5 switch, Fagerberg stopped the motor, got off, and walked ahead to throw #25 switch. While he was doing this the brakeman got off the last car, walked over to his timber truck, which he found he was not able to switch out, as Fagerberg had stopped the cars so that the last car was not clear of the switch. The brakeman then walked around the train and stood by the motor. After Fagerberg had thrown #25 switch he walked back about 25 feet towards the motor and called to the brakeman to bring the motor to him. The brakeman stepped on to the motor, set the controller at one notch, and rode up to the point where Fagerberg stood. When he reached this point he stepped off the motor, as Fagerberg stepped on. He then went back to the switch in order to take the empty timber truck to the shaft when he heard Fagerberg cry and he then ran to overtake the motor, which he reached when it was near #25 switch, and at once stopped it. He found Fagerberg under the first car, backed up the train, pulled him out on the side of the drift, and ran for help. Fagerberg was bruised, also had his hip dislocated and left leg broken. He had been dragged under the train about fifty feet.

Both the motorman and the brakeman are to blame for this accident. It is a common practice in all the mines for brakemen to step on and off of moving trains. The brakeman is to blame for this accident in that he did not stop the train when he reached Fagerberg; also from the fact that he operated the motor on Fagerberg's request, when as brakeman he was not supposed to handle motor; also he should have stayed on the motor to have seen if Fagerberg had control of it before he left it. However, it appears that a great measure of the blame is attached to Fagerberg. He stopped the train in the first place fully 75 feet from the switch, jumped off and ran ahead and threw the switch, then turned and walked back part way to the motor, after which he called to the brakeman to bring the motor to him. He evidently sat down on the edge of the motor while it was in motion and in swinging around to get into the motorman's seat, lost his balance and fell between the motor and the car.

Dr. MacIntyre reports that death was due to acute dilation of the stomach. Fagerberg was under the anaesthetic nearly two hours while his leg was being set. His death was due to his failure to react after the anaesthetic and was therefore not caused by internal injury. His stomach has been in a poor condition for the past five years.

This accident was due to a violation of rules.

FATAL ACCIDENT - - GWINN MINE

(GWINN MINE ACCIDENT REPORT #211)

I regret to report that a fatal accident occurred at the Gwinn Mine at 4:50 P.M., on May 6th, which caused the death of Jim Mascheretti. He was a single man and had been employed by the Company for the last four or five years.

He worked in No. 37 contract with Joe Chigoni and Christ Lee. They were engaged in putting up a raise from the 9th to the 8th level, this raise being located about 150 feet from the shaft. This raise was up approximately 85 feet above the 9th level; the ladders in the raise were up to within one ladder length or about fifteen feet of the back of the raise. Mascheretti and his partner, Joe Chigoni, had prepared thirteen holes for blasting near the end of the shift. These holes were lighted by the two men and they then started down the raise with Joe Chigoni in the lead. Mascheretti pulled the poles over the hole, which they went through at the top of the raise, in order to cover over the ladder road and then proceeded down the ladder behind Chigoni. When Chigoni was on the last ladder in the raise, about twelve feet above the 9th level, a hole went off. Mascheretti was just above him on the ladder, possibly twenty feet above the 9th level. Some of the covering which these men had put over the top of the ladder road was blasted out and fell down the ladder road along with some chunks of ore. Chigoni was hit by some of these falling pieces and fell off the ladder landing across the drift on the 9th level. He immediately got to his feet and went around to the shaft by the longest road. He was somewhat dazed by the accident and his one object seemed to be to get away from the raise as soon as possible. Mascheretti was apparently struck on the head by some of the timbers which had been knocked off the top of the raise. He fell to the foot of the ladder and was covered a few moments later when the other holes went off, at which time more dirt came down the ladder road. The third man who worked in this raise, Christ Lee, was standing at the foot of the raise to warn other miners who might be coming by on their way to the shaft that this contract was blasting. He heard the first

FATAL ACCIDENT - GWINN MINE:

hole go off and almost at the same time saw Joe Chironi come out of the raise, but did not see his partner. He ran back for help, calling out that there was something wrong. Two other miners reached the raise and started to open the chute, thinking that Mascheretti in some unaccountable way had fallen into the dirt chute. Shift Boss, Wm. Johns, heard that something was wrong and immediately ran to the raise but just as he reached it the other holes started to go off. As soon as everything was quiet they dug away the dirt at the foot of the ladder road and found Mascheretti. Johns worked on him attempting to revive him by artificial respiration, but without success.

It happened that Shift Boss Johns was present at the time these miners were making up the fuses for blasting. Joe Chigoni states that he cut the fuses 7' long, while Johns corroborates this statement by stating that he thought the fuses were from $6\frac{1}{2}$ ' to 7' long. Tests were later made of samples taken from the fuses which were left in No. 37's box and these samples were tested against samples from other mines in this district.

The following tables gives the results of these tests:

1st - Fuse used by #37 Contract, inner ring, burned at rate of	.30.0 sec.pr.foot
" " " " outer " " " "	27.8 " "
2nd - " " " " another sample left in box "	31.0 " "
3rd - A sample from Francis Mine burned at the rate of	34.5 " "
4th - . " " Princeton " " " "	31.4 " "

This fuse was purchased of the E. I. DuPont Powder Company and was received at the mine on April 21st. You will note that there is considerable variation in the time of burning, even in the case of the first two pieces taken from one coil of fuse. The first hole went off at least 45 seconds and possibly one minute before the other holes. We have every reason to believe that the fuses were all practically the same length except for the two cut holes which Chigoni stated were two inches shorter than the other fuse. It, therefore, seems certain that the fuse in the first hole burned more rapidly than the other fuse and that this was the cause of the accident. From the location of the men on the ladders, it is evident that they would have been entirely out of danger in less than ten seconds. Assuming that the average rate of burning of the fuse was 30 seconds per foot, a 7'

would allow them 3-1/2 minutes. In this length of time they would light the balance of the fuses, start down the ladder road, stop to cover over the top of the ladder and get down the raise. If 45 seconds is allowed for lighting fuse, one minute for covering over the ladder road and getting on the ladder and then one minute for climbing down the ladder, the total time elapsed would be two minutes and 45 seconds. This would still leave them 45 seconds leeway. It is evident that the first hole went off in less than two minutes and 45 seconds. Chigoni stated that ordinarily they wait at the bottom of the raise from two to three minutes before the first hole went off. This is probably an exaggeration but they probably have had at least one minute leeway,

I do not think that the accident was due to any faulty method of doing work by the miners but that it was caused by this particular fuse burning at too rapid a rate. It would undoubtedly have been wiser for them to have used fuses nine or ten feet in length rather than to work with seven-foot fuses, but even with the seven-foot fuse they would have had almost a minute after reaching the bottom of the raise if this hole had not exploded prematurely.

Mascheretti worked at North Lake from 1914 to 1916, then at the Francis Mine before going to the Gwinn Mine. He therefore has had between four and five years experience as a miner and was probably more experienced in blasting than many other men in our employ.

There is a possibility that the fuse in the hole which went off prematurely was shorter than the other fuses, also that the two men were slower than usual in getting the other holes lighted and down out of the raise. In any event, it is evident that longer fuse should be used in raises over fifty feet in height, so as to give a greater margin of safety.

GWINN MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1919.

GRADE	IRON	PHOS.	SILICA	MANG.
Gwinn Bessemer,	62.27	.065	5.02	
Gwinn,	60.62	.064	6.57	.337
Gwinnport,	58.87	.258	7.89	.313
Gwinnwood,	57.28	.624		.304

Above grades all mixed

ORE STATEMENT - DECEMBER 31ST, 1919.

	GWINN BESSEMER	GWINN	GWINNPORT	GWINNWOOD	TOTAL	TOTAL LAST YR.
On hand Jan.1st,1919,	1,074		44,097		45,171	72,178
Output for year,	5,645		130,126	2,076	137,847	151,922
Transferred,	6,034	5,339	866	171		
Stockpile Overrun,						3,612
Total,	685	5,339	175,089	1,905	183,018	227,712
Shipments,	685	5,339	58,737	1,905	66,666	182,541
Balance on hand,	0	0	116,352	0	116,352	45,171
Decrease in output-9%					14,075	
Increase in ore on hand,					71,181	

1919 - 1-8 Hour Shift

1918 - 2-8 Hour Shifts - Jan. 1st to March 4th
1-8 Hour Shift - Mar. 4th to Dec. 31st.

GWINN MINE.

GWINN MINE

SHIPMENTS FOR YEAR 1919.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Gwinn Bessemer,	483	202	685	20,113
Gwinn,	284	5,055	5,339	21,781
Gwinnwood,	1,905		1,905	
Gwinport,	36,733	22,004	58,737	140,647
Total,	39,405	27,261	66,666	182,541
Total last Year,	75,279	107,262	182,541	
Decrease - 64%			115,875	

GWINN MINE.

GWINN MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 9.	1 9 1 8.	INCREASE.	DECREASE.
PRODUCT	137,847	155,534		17,687
General Expense	.220	.199	.021	
Maintenance	.157	.119	.038	
Mining Expense	2.258	2.041	.217	
Cost of Production	2.635	2.359	.276	
Exploratory	.092		.092	
DEPRECIATION.				
Plant Account	.570	.570	-	
Equipment	-			
Original Purchase	.003	.003		
Total Depreciation	.573	.573		
Taxes	.087	.056	.031	
Central Office	.077	.093		.016
Supply Inventory	-	.028		.028
Miscellaneous	-	.003		.003
Sundry Expense	.007	.022		.015
Cost on Stockpile	3.471	3.134	.267	
Loading & Shipping	.080	.177		.097
Total Cost on Cars	3.551	3.311	.140	
No. Days Operating		298		
No. Shifts & Hours	300-18hr	1-8hr-247 2-8hr 51	2	
Avg. Daily Product	459	522		63
COST OF PRODUCTION.				
Labor	1.745	1.588	.157	
Supplies	.890	.771	.119	
Total	2.635	2.359	.276	

GWINN MINE.

COMPARATIVE WAGES AND PRODUCT.

	1919.	1918.	INCREASE.	DECREASE.
PRODUCT	137,847	155,534		17,687
No.Shifts and Hours	1-8hr	1-8hr247 2-8hr 51		
AVERAGE NUMBER MEN WORKING				
Surface	36	35	1	
Underground	95	125		30
Total	131	160		29
AVERAGE WAGES PER DAY				
Surface	5.09	4.33	.76-17.5%	
Underground	6.25	5.16	1.09-21%	
Total	5.93	4.98	.95 - 21%	
WAGES PER MONTH OF 25 DAYS				
Surface	127.25	108.25	19.00	
Underground	156.25	129.00	27.25	
Total	148.25	124.50	23.75	
PRODUCT PER MAN PER DAY				
Surface	12.36	14.61		2.25
Underground	4.65	4.16	.49	
Total	3.38	3.24	.14	
LABOR COST PER TON				
Surface	.412	.296	.116	
Underground	1.344	1.242	.102	
Total	1.756	1.538	.218	
AVG. PRODUCT BREK'G & TRM'G	8.07	7.03	1.04	
" WAGES CONTRACT MINERS	6.59	5.40	1.19	
" " " TRAMMERS	0	0		
" " " LABOR	6.59	5.40	1.19	
TOTAL NUMBER OF DAYS				
Surface	11,151½	10,642½	509	
Underground	29,654	37,419		7,765
Total	40,805½	48,061½		7,256
AMOUNT FOR LABOR				
Surface	56780.77	46087.60	10693.17	
Underground	185241.06	193153.05		7,911.99
Total	242021.83	239240.65	2781.18	

Proportion Surface to UndergrounndMen:

1919 - 1 to 2.64
 1918 - 1 to 3.57
 1917 - 1 to 3.63
 1916 - 1 to 3.50
 1915 - 1 to 3.22
 1914 - 1 to 2.16

GWINN MINE.

TIMBER STATEMENT FOR YEAR ENDING DECEMBER 31, 1919.

KIND.	LINEAL FEET.	AVG. PRICE	AMOUNT	AMOUNT
		PER FOOT.	1919.	1918.
4" to 6" Timber				396.71
6" to 8" "	64,931	.0379	2462.36	3104.98
8" to 10" "	58,071	.0728	4228.18	3143.83
10" to 12" "	21,243	.0017	2160.13	1751.28
12" to 14" "	4,009	.1353	542.40	519.92
Total - 1919	148,254	.0635	9413.07	
Total - 1918	199,962	.04459		8916.72
	LINEAL FEET.	PER 100'.		
5' Lagging	174,675	.8266	1443.96	1467.25
7' "	16,100	.5500	88.55	
8' "	631,104	.7684	4848.90	3616.47
Total Lagging	821,879	.7764	6381.41	5083.72
Poles	113,835	.7974	907.64	307.27
4" to 6" Cribbing,	211,176	.4799	1013.36	
Total - 1919	1,146,890	.7239	8302.41	5390.99
Total - 1918	654,120	.8241	5390.99	
Product			137,418	155,534
Feet of Timber per ton of ore			1.079	1.285
Feet of Lagging "			5.982	4.005
Feet of Lagging per foot of timber			5.544	3.13
Cost per ton for Timber			.069	.057
" Lagging			.046	.033
" Poles			.014	.002
" Timber, Lagging & Poles			.129	.092
Equivalent of Stull timber to Bd. Measure			223,873	421,408
Ft. Bd. Measure per ton of ore			1.63	2.71
Total cost for Timber, Lagging & Poles - 1919				17715.48
" 1918				14307.71
" 1917				11775.63
" 1916				6297.88
" 1915				6946.16
" 1914				4629.28

GWINN MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICE.	AMOUNT 1 9 1 9.	AMOUNT 1 9 1 8.
50% Powder, Red Cross	150	.1740	26.10	3405.35
50% " Gelatin	28,165	.2022	5695.69	5080.02
60% " "	35,150	.2166	7614.39	9019.11
Total Powder	63,465	.2101	13336.18	17504.48
Fuse	188,200	.860	1617.76	1614.34
Caps	38,100	14.22	541.84	564.96
Cap Crimpers	10	.566	5.66	7.57
Tamping Bags	6,400	2.04	13.05	14.38
Total Fuse, Etc.			2178.31	2201.25
Total Explosives			15514.49	19705.73
Product			137,418	155,534
Pounds Powder per ton of Ore			.462	.446
Cost per ton for Powder			.097	.112
" Fuse, Caps, Etc.			.016	.013
" All Explosives,			.113	.125
Avg. Price per Lb. for Powder			.210	.252

JOPLING MINE.

In order to make more clear the object of the work done on this property during 1919, a brief summary of the exploratory work done in previous years is given herewith:

Work was started in 1916 at the elevation of the 7th level drift, Gwinn Mine. This drift was extended across the Jopling property over to the line of the shaft. A raise was started on the line of the shaft in 1917, but so much water was encountered that it was necessary to abandon work after the raise had been extended up a distance of ninety feet. A sub-level was opened at an elevation of 83 feet, and a total of approximately 400 feet of drifting done here during 1917-1918. A narrow seam of lean ore was developed for a short distance on the foot-wall, but no merchantable ore was discovered. Before abandoning work on this sub level, several diamond drill holes were drilled, but no ore was found. As a result of the development work on this sub level, the water had been cut off from the raise. Raising was resumed in 1918 and the raise continued to an elevation of 380 feet above the drift from the Gwinn Mine. A sub-level was opened at an elevation of 363 feet, or at a point of 543 feet below surface, and in 1918 a drift was driven a distance of 195 feet from the raise. This sub-level was opened just below the elevation of the ore found in #37 diamond drill hole, with the idea of proving up both the grade and size of the ore body. No work was done on this sub-level in December, 1918, or in January 1919, owing to trouble with the cribbing in the raise. Two months were spent in making repairs, and work was resumed on the 543' sub-level in February, 1919.

As stated before, the object of the drift on this sub-level was to find and develop the ore shown up by #37 diamond drill hole. The drift was continued along the footwall until it reached a point opposite to #37 diamond drill hole, it was then turned to the south-east where it crossed the formation over to the supposed location of the drill hole. It was continued a short distance further to the South and the drill hole was actually found. Up to this point the drift had been in lean ore, averaging from 40.00 to 52.00% in Iron. It showed a large area of enriched Jasper. It was decided to put

JOPLING MINE:

up a raise near the diamond drill hole until ore was encountered and then cross-cut the ore. The raise was extended up about thirty feet and a sub-level opened twenty feet above the main sub-level. A cross-cut was driven forty feet to the North of the raise and thirty-five feet to the South, making the total width of the ore body on this sub-level seventy-five feet, the average analyses was 54.41 Iron, .366 Phosphorus. Both the North and South breasts of the cross-cut stopped in lean ore, and in neither case was the foot or hanging actually reached. On completing the work on this auxiliary sub, it was decided to drive the drift on the main sub further to the South. It had been stopped about twenty feet beyond the drill hole, in lean slaty material which resembled the hanging wall, but after blasting a few cuts, good ore was encountered. It was driven a distance of 62 feet further to the South; for part of the distance it was in ore averaging 58.00% in Iron, and was finally stopped in the hanging. Work was then stopped and tools, rails, pipe, etc., on the sub-level were removed, as it was not considered likely that any further work would ever be done at this point. As a result of a conference with Mr. H. L. Smyth, Consulting Geologist, it was decided to recommend that some additional drifting be done at the elevation of the 7th level drift from the Gwinn Mine, and from the end of this new drift to do a small amount of diamond drilling. This work was later authorized, and the drift was started in August. It was planned to extend this drift 400 feet to the South-east. Work was continued throughout the balance of the year and completed the latter part of December. Ground was removed for a drill station at the end of the drift by the end of the month, so that everything is prepared for the diamond drilling, which it is planned to do at this point.

A report of the year's work on this property would not be complete without an explanation of the results of the work. This covers the ore developed by the exploratory work, also the advisability of completing the Jopling shaft and equipping this property, and also the possibility of handling the Jopling ore through the Gwinn Mine shaft. As a matter of fact, the last two points are answered by the first. The ore proven up by the development work on the 543-ft. sub-level and the sub, twenty feet above it, is found in a roll in the footwall near a sharp fold. The ore lies on this flat footwall

and above this point there may be a considerable tonnage of ore. The development work done on the 83-ft. sub level, as well as at the elevation of the 7th level drift from the Gwinn Mine, however, showed that this ore did not extend down on its dip any distance below the 543-ft. sub. In other words, there was no evidence that there was sufficient ore below the 543-ft. sub to warrant opening this property; in fact to even continue further exploration in this territory. The ore on and above the 543-ft. sub level is not considered available due to the fact that the ground is quite porous, which permits a large amount of water to come down from surface through the ore formation. There is now to exceed 250 gallons of water coming every minute from the raise on the line of shaft, so much in fact that it was extremely difficult to carry on work in the ore encountered on the 543-ft. sub level. This 543-ft. sub level is only about 400 feet below the ledge, and there is from 100 to 150 feet of quick sand above the ledge. In view of these facts, the mining of any ore on or above this sub level is considered inadvisable.

If the ore disclosed by the development work on these sub levels be eliminated from consideration and there is apparently no downward extension of this ore, there remains only one possibility on this property. This possibility lay in the territory further to the south-east along the strike of the formation, beyond the limits of previous explorations. At a point 500 feet below surface, ore was shown in several holes along the strike south and east of hole #37, but no holes had been drilled so as to intersect this ore at a lower elevation or further down on the dip. Therefore, before recommending that the lease on this property be surrendered it was decided that several holes be drilled in this territory. As stated in a previous paragraph of this report, the drift to the point where this drilling is to be done had been completed by the end of the year. It will, therefore, only be a matter of about sixty days until definite information is available and a final decision can be reached in regard to this property.

If this property was opened, and the ore mined on and above the 543-ft. sub, and if the surface then caved, letting in sand and water, not only would the Jopling Mine be lost but it probably would be impossible to save the Gwinn Mine.

FRANCIS MINE.

The Francis Mine was operated on one 8-hour shift during the year 1919. It went on an operating basis May 1st, 1918, so that the year 1919 represents the first full year that this property has operated. The product for the year was as follows:

Franport,	80,522 tons
Franwood,	<u>6 "</u>
TOTAL ORE,	80,528 "
Rock,	<u>20,612 "</u>
TOTAL ORE & ROCK,	101,140 "

The hoist for 1919 is practically double that of the previous year, in which, however, the mine operated for only eight months. The definite limits of the ore body in all directions has been fairly well determined during the past year, and there is not much possibility of extensions beyond the present limits. The downward extension below the 5th level has also been determined by diamond drilling. A disappointing feature has also been disclosed by this work, viz: that the trough narrows and the ore body stops at a point about 200 feet west of its present limits on the 5th level. The shipments for 1919 and balance of ore in stock are as follows:

<u>SHIPMENTS.</u>	<u>BALANCE OF ORE IN STOCK</u>
Franport Ore, 26,936 tons	Franport, 66,130 tons

The ore in sight on December 31st, 1919 was 227,301 tons. A year ago there was 229,400 tons in sight. The estimate of this year, therefore, shows that during the past year there has actually been 78,000 tons of ore developed. The estimate of ore in sight is as follows:

Ore above 4th level,	12,444 tons
" " 5th "	<u>182,457 "</u>
Total Developed Ore,	194,901 "
Prospective Ore below 5th Level,	<u>32,400 "</u>
GRAND TOTAL,	227,301 "

Practically all the ore produced during 1919 was of Franport grade. There was only a few tons of Franwood ore produced. It has developed that the

FRANCIS MINE:

ore which runs high in Phosphorus also runs so low in Iron as to make it undesirable. As a general rule, the ore on the North footwall has run low in Phosphorus. The ore on the South footwall, on the other hand, has run higher in Phosphorus, but not high enough to prevent these two ores when mixed from coming within the Franport limit in Phosphorus.

As a result of the diamond drill work, it has been possible to make fairly accurate cross-sections of the ore body below the 5th level, and to estimate the tonnage within fairly accurate limits. As this territory has now been drilled at several points it was considered advisable to include the ore below the 5th level in this estimate. The total tonnage on the property is still below the figures of tonnage used by the Tax Commission.

The work of 1918 showed that the enrichment of the ore body was not uniform and that the ore occurs as an enrichment of a ferruginous slate. This imperfect enrichment has resulted in the elimination of large areas where the iron runs from 48.00 to 55.00%. In some localities the ore has only been drift-wide, which has materially increased the cost per ton. This condition of imperfect enrichment has also made it extremely difficult to keep the grade of the product up to 56.50 Iron. As mining is progressing to greater depth the enrichment appears to be more uniform, with the result that it is expected that it will soon be less difficult to maintain the grade. However, considerable additional expense is constantly being incurred in picking rock from the ore underground. The rock is either lean ore or masses of ferruginous slate, which are found throughout the ore body.

I regret to report that as a result of the past years work there is apparently no chance of an extension of the Francis ore body beyond the limits already determined. At the present rate of production, viz: approximately 85,000 tons per year, there is actually less than three years ore in sight. Every effort will be made to increase the available tonnage, but at the present time it does not seem likely that sufficient ore will be developed to permit of this property being continued in operation much beyond three years, or until the end of 1922. The work in detail for the year was as follows:

THIRD LEVEL.

During the past year a raise was put up from the 4th level to the elevation of the 3rd level and drifting has now been in progress for several months from the top of this raise, the ore being followed to the East. This work is being done in order to gain an idea as to the size of the ore body on the 3rd level. It is also planned to extend this drift to the neighborhood of No. 2 diamond drill hole from surface, which showed a great thickness of high grade ore above the 3rd level. The ore in hole #2 is probably too near to surface to mine, but it is thought that perhaps a downward extension of this ore might be found near the 3rd level where it may be possible to do some mining. This drift on 3rd level will also disclose the fact whether there is any water coming in to the ore at this elevation. By the end of the year the drift had been driven for a distance of approximately 115 feet; two cross-cuts have shown the average width of the ore to be less than fifteen feet, practically the same as on the 4th level. If mining were done at the elevation of the 3rd level and above, the 60-ft. pillar left between the 4th and 3rd level, viz: from the 40-ft. sub above the 4th up to the 3rd, would have to be left and mining started again above the 3rd level. If the deposit does not widen out above its dimensions on the 4th level, it is extremely doubtful whether it would pay to open the 3rd level. By the middle of 1920 it will be possible to have sufficient information available to decide this question.

SUBS ABOVE 4TH LEVEL.

40-FT. SUB OR 4TH SUB:

This sub level was mined out in 1918 except at the East end where work was still under way. Work was continued at the East end of this sub level until in July, 1919. The work done here in 1919 was largely in the nature of an exploration. The footwall had flattened in this territory, and the drift followed the seam of ore lying between the foot and hanging, the ore being from five to eight feet in thickness. The drift was advanced some distance out under Johnson Lake, as it was thought that there was a chance of finding a body of ore in this direction. Conditions did not show any change for the better, in fact, they finally grew worse, so that it was not deemed advisable to con-

FRANCIS MINE:

tinue exploratory work any longer in this direction.

3RD SUB ABOVE 4TH LEVEL.

This sub level was opened in September, 1918. There were six gangs working here in January, 1919. As fully 70% of the ore had been mined out on this sub level in 1918, work was rapidly completed here except at the East end where work was not started until the exploration drift on the sub above was completed in July, 1919. In other words, the ore on this sub-level, which has a length of approximately 750 feet, was all mined out early in 1919, except at the East end of the mine, where work was still under way at the end of the year.

2ND SUB ABOVE 4TH LEVEL:

This sub-level was opened the latter part of November, 1918, and mining of the ore body above 4th level completed in the early part of 1919, except at the East end of the deposit, where mining at this elevation was only started in November.

1ST SUB ABOVE 4TH LEVEL:

This is the sub-level directly above the back of the 4th level. Mining was completed on this sub-level by the end of 1919, except at the extreme East and the extreme West end of the ore body. The greater part of the ore body has been mined out at this elevation.

FOURTH LEVEL.

The opening of the 4th level was practically completed in 1918. Some rock drifting was done in 1919, but this was mainly for the purpose^{of} providing a way to bring in supplies to the contracts. The rock footwall drift, which was not quite completed in 1918, was finished in May, 1919. Mining was started at the elevation of the 4th level in January, beneath that portion of the ore body which had been mined out down to the back of the 4th level, and continued throughout the year. By the end of the year 80 % of the ore body had been mined. The ore body lying between the shaft and No. 1 cross-cut, which is considerably wider than at any other point along the footwall, is now being mined on the 4th level. In order to provide a way of getting timber in to the contracts, working in this territory, a rock drift was driven in the hanging, connecting the raises from 5th level. Cross-cuts were also driven through the hanging over to the ore body. Timber and other supplies are now taken through No. 1 cross-

FRANCIS MINE:

cut, and hence by this new hanging wall drift and cross-cuts in to the contracts.

SUBS BELOW FOURTH LEVEL ON NORTH FOOTWALL.

There has been so many sub levels opened in this territory and at so many different elevations that it is not deemed advisable to attempt to report the work on each individual sub. In a general way mining has progressed fastest in the center of the deposit on the North footwall where the ore body is narrowest. At the East end of this ore body mining is still in progress above the 4th level; at the West end mining has just been started on the sill floor of the 4th. The area mined out below the 4th is approximately 200 feet in length; the average width of the ore body is only about twelve feet. Conditions will not show any material improvement in the territory where mining has been done below the 4th until these mining operations reach a point about half way between the 4th and 5th level. At this point the trough flattens out, with the result that the ore body increases in width.

SUBS BELOW FOURTH LEVEL ON SOUTH FOOTWALL.

Fully one-half of the ore hoisted during 1919 came from operations on the South footwall. The work of 1918 in this territory was largely exploratory and preliminary to mining operations. The upward limits of the merchantable ore had to be determined, and as they were found to be irregular and not at a uniform elevation, considerable time and expense was necessary before general mining operations could be started. It was also necessary to decide on a mining limit, as the two ore bodies, viz: the one on the South and the one on the North footwall join together above the elevation of the 5th level, in the center of the Westerly pitching trough. After all these various matters had been decided, mining was started at the top of the ore body on the South footwall. Areas at the top of the ore body were relatively small, and not many contracts worked here during the first few months. As depth was gained, the area of the ore body showed a rapid increase, and during the last half of the year the greater portion of the ore mined came from this territory. At the end of the year mining operations were being largely conducted on the 2nd sub, 22 feet above the 5th level; the average width of the ore body between the South footwall and the limit of mining is now nearly 100

FRANCIS MINE:

feet; the length of the ore body over the area where mining is in progress is approximately 200 feet. The enrichment, although more uniform than was the case in parts of the ore body on the North footwall, has been somewhat irregular. This has led to the elimination of an extensive area on one of the sub-levels where the ore was too lean to be mined. On the next sub-level beneath, it developed there was a small leader of high grade ore extending beneath the territory where mining could not be done on the sub above. This leader has been followed and a small deposit developed which extended upward thirty or more feet above the sub-level. The ore here was harder and was mined without timber.

SUB LEVELS BELOW 4TH LEVEL AT EAST END OF DEPOSIT
IN CENTER OF TROUGH.

Two sub-levels had been opened in this territory in 1918, but no general mining operations had been attempted. The work of the present year proved that there was no ore in the center of the trough at the elevation of the 4th level. The old sub-level, which had been opened twenty feet below the sub level on the South footwall was, therefore, extended in to this territory and late in the year mining operations were started, the ore being removed off the footwall between this sub and the top of the ore body which was at a point about six feet below the elevation of the 4th level. Owing to the flatness of the trough it has been possible to open another sub-level, twenty feet deeper, which is being developed so that the twenty feet of ore between these two subs can be mined. The footwall is so flat that these subs do not come beneath each other, and they are mined most economically by locating the sub-levels 20 feet apart and stoping the ore off the footwall.

FIFTH LEVEL.

The first of the year the work of completing the new haulage drift in the footwall on the 5th level was under-way. This drift was completed the last of May, and provided a location for raises necessary to be put up for mining the West half of the ore body below 4th level on the North footwall. As the drift advanced, rock raises were started, being located 55 feet apart. These raises have been all extended through either to the hanging or to the elevation of the 4th level.

In the early part of 1919, an exploratory drift was driven to the

West a distance of 440 feet. This carried the drift off of the C. & N. W. Lease, Section 27 over on the NE $\frac{1}{4}$ of the NE $\frac{1}{4}$ of Section 28, which land is owned by The Cleveland-Cliffs Iron Company. It was also planned to explore the Wadsworth lands on Section 28 from this drift if it seemed likely ore might be found on these lands. Drifting was completed here in August, the drift having been driven 400 feet beyond the Western limit of the ore body as developed by a cross-cut on the 5th level. No ore was found in any of the drill holes drilled from the above exploratory drift at the elevation of the 5th level, except at one point near the South footwall. It was decided to drift to this ore and then follow it to the West where it is possible it may lead to a larger ore body. This drift was started the latter part of the year, but it has not yet reached the ore.

During the year there was a total of 870 feet of rock drifting on the 5th level, and approximately 700 feet of raising, the grand total of rock raising and drifting amounting to approximately 1570 feet.

RECORD OF DIAMOND DRILLING.

Following is the record of diamond drilling done during the past year on the 5th level of the Francis Mine. Practically all these holes are located in the exploratory drift referred to above, and were all drilled in order to determine the downward extension of the main 5th level ore body, so that future operations at this property could be planned.

Hole No. 6 was located on the boundary line between Sections 27 and 28 at a point about 143 feet South of the West quarter post of Section 27. It was a vertical hole and the material encountered was as follows:

Jasper,	0 to 80
Jasper and Slate,	80 to 86
Slate,	86 to 114

Some low grade material, averaging between 35.00 and 40.00% in Iron was shown up between a depth of 50 and 65 feet.

Hole No. 7 was an incline hole, dipping 30° to the North and was drilled from the same station as Hole No. 6; the material encountered was as follows:

Chert,	0 to 36
Chert and Slate,	36 to 70
Jasper,	70 to 85
Jasper,	85 to 96
Slate and Chert,	96 to 147
Arkose,	147 to 157

This hole did not show any enrichment in the formation, which was quite disappointing in that it had been hoped that the main ore body would be encountered.

Hole No. 8 was drilled from the same station as Nos. 6 and 7. It was an incline hole, dipping 60° to the South. The material encountered was as follows:

Jasper,	0 to 61
Arkose,	61 to 97

Jasper was found in Holes Nos. 6, 7 and 8. This is a new development at this property, as no Jasper has ever been found either under or over the ore body. These three holes proved that the ore body did not extend to the boundary line between Sections 27 and 28; in fact, it indicated that it pinched out some distance to the East.

Hole No. 9 was located half way between the first drill station and the ore body as developed on the 5th level, or approximately 150 feet East.

It was a vertical hole, the material encountered being as follows:

Jasper,	0 to 50
Ore,	50 to 65
Jasper,	65 to 68
Arkose,	68 to 95

Hole No. 10 was drilled from the same station as Hole No. 9; it was an incline hole, dipping 45° to the North; the material encountered being as follows:

Jasper,	0 to 75
Arkose,	75 to 87
Slate & Chert,	87 to 101

Hole No. 11 was then drilled from the same station, dipping 45° to the South; the material encountered was as follows:

Slate,	0 to 15
Jasper,	15 to 50
Lean Ore,	50 to 60
Ore,	60 to 85
Jasper,	85 to 91
Arkose,	91 to 148

From the above record of the holes drilled at the second drill station it will be noted that there was fifteen feet of ore found in the vertical hole and twenty-five feet in the incline hole to the South. There is undoubtedly an extension of the 5th level ore body to this point, which is 150 feet beyond its limits on the 5th level. The exploratory drift showed that the axis of the trough has a North-west trend, while diamond drilling done here showed that the ore below the level extended in a south-westerly direction from its present known limits. In explanation of this it may be said that probably the South side of the trough has flattened out and may possibly have rolled over near this point, and that the ore developed by diamond drilling here has followed the direction of this roll rather than the axis of the main trough.

Hole No. 12 was located in the ore body and was drilled to prove up the depth of the main ore body below 5th level to permit of more accurate cross-sections being made, so that reliable figures could be obtained of the probable tonnage below 5th level. This hole showed up 35 feet of ore and was stopped in arkose. The drill was then moved back to the station where

holes Nos. 9, 10 and 11 were drilled, and Hole No. 13 was drilled horizontally to the South; the following material was encountered in this hole:

Jasper,	0 to 8'
Slate,	8' " 25'
Jasper and Slate,	25' " 30'
Jasper,	30' " 60'
Lean Ore,	60' to 65'
Ore,	65' " 70'
Lean Ore,	70' " 75'
Jasper,	75' " 80'
Lean Ore,	80' " 90'
Ore,	90' " 100'
Lean Ore,	100' " 109'
Arkose,	109' " 170'

The analyses of Hole No. 13 is as follows:

	<u>IRON.</u>	<u>PHOS.</u>	<u>SULPHUR.</u>
60 - 65	54.70	.116	.151
65 - 70	57.10	.065	.138
70 - 75	54.90	.055	.186
75 - 80	49.25	.065	.282
80 - 85	50.45	.065	.186
85 - 90	53.80	.062	.275
90 - 95	58.30	.057	.144
95 -100	56.00	.055	.186
100 -105	54.75	.061	
105 -109	34.60	-	-

There was sufficient ore proven up in Hole #13 to warrant driving a drift in to this territory to develop this ore. With the completion of Hole #13, drilling was stopped temporarily. It is planned to do a small amount of additional drilling early in 1920, in order to more fully test the territory to the West.

FRANCIS SURFACE.

The work of enclosing the shaft house was started in 1918 and completed early in 1919. There has been absolutely no trouble on the landing since this work was completed. Even in the severe winter weather, early in December, it was possible to operate the top tram with two men, an engineer and lander.

A second top tram unit was installed at the Francis in February. The rock and lean ore was handled by this unit, the other unit handled only ore. The hoist from the 5th level had increased to such an extent the latter part of the year that it became advisable to hoist ore in both skips and also to re-arrange the top tram service so that both units could be used for stocking ore. As only a small amount of ore was shipped from stockpile in 1919, it had become necessary to prepare new stockpile grounds and put up another stocking trestle. The second top tram unit was changed over to operate on this new trestle; it now operates a top tram car to either this trestle or out on the rock trestle. It has been possible to increase the product with this arrangement, as there are now no delays either underground or on surface.

A new stocking ground was prepared by making a sollar out of lean ore. Sufficient sollar was made to stock about 30,000 tons of ore; if shipments are not made in 1920, the sollar can be extended nearly 800 feet further. Four permanent and twelve temporary stocking bents were erected late in the fall on the new stocking grounds.

FATAL ACCIDENT - FRANCIS MINE.

I regret to report that a fatal accident occurred at 1:10 P.M., October 29th, at the Francis Mine, James Morlini being instantly killed by falling down the shaft off the cage from a point near the 5th level. Morlini was a single man, age 31, his only relative in this country being a married sister living at the North Lake Location.

There were no witnesses to the accident, and the manner in which he met his death can only be surmised. William Dabb, shift boss, was on the 4th level with the sample picker, James Garfield. They heard the cage rider give the signal to hoist the cage from the 5th to the 4th level. Shortly after the cage started to move they heard a noise in the shaft, and when the cage reached the 4th level it stopped, and on looking in it they saw that the cage rider was not there. There was a timber truck on the cage which was not fastened by the safety dog which is on the cage and is used to prevent the truck from moving. They went down the ladder to the 5th level, and not finding the cage rider, went on down to the bottom of the shaft, where they found him lying dead.

I went down on the cage and examined the steel set at the back of the 5th level to find out if Morlini had struck this set in falling. There is no clearance in the shaft to permit a man to fall down the shaft between levels, and it necessarily followed that he must have fallen out of the cage while it was in motion between the floor of the 5th level and the back. There were no marks on the steel set at this point, but on the opposite side of the shaft there was a divider running across about four feet above the level, and on this divider were marks showing that the timber truck had caught here. The accident may have happened in either one of two ways: It is probable that Morlini gave the signal to hoist and did not bother to throw in the catches; he may have seated himself on the truck to ride up to the 4th level, and when the truck struck the steel divider, the end on which he was sitting would naturally be thrown upward, throwing him out of the cage, against the gate on the level. The other way in which the accident may have happened would have been for Morlini to

stoop down to throw the dogs which prevent the truck from moving on the cage, and while doing this, the truck caught on the divider and in rebounding it struck him and knocked him off the cage.

The accident is clearly due to his own carelessness. The rules for cage riders call for these safety dogs on the cage to be thrown in at the time the truck is put on the cage. He did not do this, and in some unknown manner, this caused his death.

I regret this accident very much, as the Francis Mine had never had a fatal accident up to this time.

FRANCIS MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1919.

GRADE	IRON	PHOS.	SILICA	MANG.
Franport,	57.20	.371	6.37	.584
Franwood,	54.50	.991	10.99	.606

(Cargoes all Mixed).

ORE STATEMENT - DECEMBER 31ST, 1919.

	FRANPORT	FRANWOOD	TOTAL	TOTAL LAST YEAR
Balance on hand Jan. 1st, '19;	12,538		12,538	1,778
Output for year,	80,522	6	80,528	41,535
Total,	93,060	6	93,066	43,313
Shipments,	26,936		26,936	30,775
Balance on hand,	66,124	6	66,130	12,538
Increase in output-94%			38,993	
Increase in ore on hand,			26,455	

1919 - 1-8 Hour Shift
 1918 - 2-8 Hour Shifts - Jan. 1st to Dec. 1st
 1-8 Hour Shift Dec. 1st, to Dec. 31st.

SHIPMENTS FOR YEAR 1919.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Franport,	19,901	7,035	26,939	30,247
Franwood,				528
Total,	19,901	7,035	26,936	30,775
Total last year,	20,763	10,012	30,775	
Decrease-12%			3,839	

FRANCIS MINE.

FRANCIS MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 9.	1 9 1 8.	INCREASE.	DECREASE.
PRODUCT	80,528	41,535	38,993	
General Expense	.256	.300		.044
Maintenance	.329	.335		.006
Mining Expense	1.970	2.580		.610
Cost of Production	2.555	3.215		.660
Exploratory) Ore in Development)	.066	.713		.647
DEPRECIATION.				
Plant Account	.600	.600	-	
Total Depreciation	.600	.600		
Taxes	.049	.017	.032	
Central Office	.077	.124		.047
Supply Inventory	-	.072		.072
Miscellaneous	.005	.007		.002
Sundry Expense	.008	.028		.020
Cost on Stockpile	3.360	4.776		1.416
Loading & Shipping	.055	.121		.066
Cost on Cars	3.415	4.897		1.482
No. Days Operating	299	190	109	
No. Shifts and Hours	1-8hr-299	2-8hr 120 1-8 70		
Avg. Daily Product	269	219	50	
COST OF PRODUCTION.				
Labor	1.826	2.165		.339
Supplies	.729	1.050		.321
Total	2.555	3.215		.660

Mine started on producing basis May 1, 1918.

FRANCIS MINE.

COMPARATIVE WAGES AND PRODUCT.

	1919.	1918.	INCREASE.	DECREASE.
PRODUCT	80,528	41,535	39,993	
No.Shifts and Hours	1-8hr	2-8h-120 1-8h- 70		
AVERAGE NUMBER MEN WORKING:				
Surface	25	25		
Underground	58	55	3	
Total	83	80	3	
AVERAGE WAGES PER DAY				
Surface	4.97	4.57	.40-8.8%	
Underground	6.16	5.61	.55-9.9%	
Total	5.79	5.28	.51-9.6%	
WAGES PER MONTH OF 25 DAYS				
Surface	124.25	114.25	10.00	
Underground	154.00	140.25	14.75	
Total	144.75	132.00	12.75	
PRODUCT PER MAN PER DAY				
Surface	10.50	7.80	2.70	
Underground	4.61	3.61	1.00	
Total	3.21	2.47	.84	
LABOR COST PER TON				
Surface	.473	.586		.113
Underground	1.334	1.556		.222
Total	1.807	2.142		.335
AVERAGE PRODUCT BRK'G & TRM'G	7.70	6.80	.90	
" WAGES CONTRACT MINERS	6.27	5.43	.84	
" " " TRAMMERS	6.93	5.43	.50	
" " " LABOR	6.26			
TOTAL NUMBER OF DAYS				
Surface	7,669	5,325½	2,343½	
Underground	17,454¾	11,523	5,931¾	
Total	25,123¾	16,848½	8,275¼	
AMOUNT FOR LABOR				
Surface	38115.70	24343.61	13772.09	
Underground	107446.71	64645.59	42801.12	
Total	145562.41	88989.20	56573.21	

Proportion Surface to Underground Men:

1919 - 1 to 2.32

1918 - 1 to 2.20

Mine starting on producing basis May 1, 1918.

FRANCIS MINE.

TIMBER STATEMENT FOR YEAR ENDING DECEMBER 31, 1919.

KIND.	LINEAL FEET.	AVG. PRICE	AMOUNT	AMOUNT
		PER FOOT.	1 9 1 9.	1 9 1 8.
4" to 6" Timber	24,304	.0175	425.31	1085.63
6" to 8" "	27,909	.0309	862.79	1245.04
8" to 10" "	33,970	.0432	1468.43	676.15
10" to 12" "	15,502	.0617	956.04	428.40
12" to 14" "	6,496	.0763	495.87	283.36
14" to 16" "	40	.10	4.00	
Total - 1919	108,221	.0389	4212.44	
Total - 1918	124,217	.0299		3718.63
	LINEAL FEET.	PER 100'.		
5' Lagging	155,762	.7104	1106.21	643.23
6' "				765.53
8' "	444,000	.6125	2719.45	
Total Lagging	599,762	.6378	3825.66	1408.76
Poles	9,888	.7994	79.05	83.29
Total - 1919	609,650	.6404	3904.71	
Total - 1918	228,563	.6528		1492.05
Product			80,528	27,665
Feet Timber per ton of ore			1.344	4.49
Feet Lagging "			7.448	7.95
Feet Lagging per foot of Timber			5.54	1.77
Cost per ton for Timber			.0523	.1344
" Lagging			.0475	.0509
" Poles			.0010	.003
" Timber, Lagging & Poles			.1008	.1883
Equivalent of stull timber to Bd. Measure			177,590	181,353
Feet Bd. Measure per ton of ore			2,205	6,555
Total cost for Timber, Lagging & Poles - 1919				8117.15
" " 1918				5210.68

Mine started operating May 1, 1918, and figures for that year cover 8 months.

FRANCIS MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICE.	AMOUNT 1 9 1 9 .	AMOUNT 1 9 1 8 .
40% Powder, Red Cross,	25,112½	.167	4196.95	1685.29
40% " Gelatin,	850	.2015	171.27	386.08
60% " "	1,200	.2062	247.80	25.65
Total Powder,	27,162½	.1699	4616.02	2097.02
Fuse,	106,680	8.83	942.87	343.93
Caps,	19,589	1.40	274.57	106.19
Cap Crimpers,	13	.467	6.07	3.01
Tamping Bags,	16,100	1.775	28.58	11.56
Connecting Wire,	3	.55	1.65	
Total Fuse, Etc.			1253.74	464.74
Total Explosives,			5869.76	2561.76
Product,			80,528	27,665
Pounds Powder per ton of Ore,			.337	.407
Cost per Ton for Powder,			.0573	.076
" Fuse, Caps, Etc.			.0156	.017
" All Explosives,			.0729	.093
Avg. Price per Lb. for Powder,			.1699	.1864

Mine began operating May 1, 1918, and figures for 1918 are for 8 months.

GARDNER-MACKINAW MINES

Work has been continued at these mines during the year 1919. They went on an operating basis July 1st; the hoist has shown a gradual increase, until at the close of the year it was averaging nearly 12,000 tons per month. The product from the two properties for the year was as follows:

Gardner Ore, or Low Sulphur,	2,913 tons	
Gardner High Sulphur,	<u>16,245</u> "	
TOTAL,		19,158 tons
Mackinaw Ore, or Low Sulphur,	28,560 "	
Mackinaw High Sulphur,	<u>21,608</u> "	
TOTAL,		<u>50,168</u> "
GRAND TOTAL,		69,326 "
Rock, Gardner-Mackinaw Mines,		<u>25,607</u> "
GRAND TOTAL ORE AND ROCK,		94,933 "

In my Annual Report for the year 1918 I stated that after Sulphur was found in these ores, the general plan of operation at these properties was as follows: To develop the ore body as rapidly as possible on the 4th level, also to raise and develop the ore on its upward extension to the 3rd level; to repeat this operation again on the 3rd level, on the 2nd and also on the 1st level, in order that the entire ore body above the 4th level might be opened and definite information obtained as to the Sulphur content within the shortest possible time. This program was underway during the latter months of 1918 and has been carried on throughout the year 1919. The ore body has now been fully developed from the 4th to 2nd level, and developed for nearly its entire length on the 2nd. No information has as yet been obtained, however, of the Sulphur content of the ore above the 2nd level. This territory, however, will be entirely developed during the year 1920.

The following is a brief description of the method of mining followed at these properties. It is a modification of the shrinkage stope method. As first planned, raises ten feet square were put up in every third stope the entire distance between levels and at intervals of 28 feet on the incline drifts were driven on the footwall through the pillar over to the line of the next stope. The stopes on each side were then put up as raises for a distance of 28 feet and connections made to this drift, which provided

an outlet to the raise. Mining was then started in these stopes, all the ore being removed to the hanging. Other sections of the stope were then put up and connections made to the traveling raise every 28 feet; these operations being repeated until the stope had been finished. On completing the stopes on each side of the raise it was then possible to make a stope out of the raise. This system was later modified and all stopes were started as raises and put through to the next level before stoping was started. Under this system of mining the men all enter their own stope from the level above, and the stope being outlined by a raise it is possible to keep the pillars more uniform in size between the stopes. After stoping is once started it is continued without interruption until the stope is completed. About 33-1/3% of the ore broken in stoping is drawn out to make room for the miners to work. It is planned to maintain this reserve of broken ore in the stopes during the winter, drawing off only sufficient ore to maintain a product of approximately 12,000 tons per month. The large reserve of broken ore will be available for hoisting when shipping starts in the Summer. At the close of the year it was estimated that there were in excess of 20,000 tons of ore in the stopes on these two properties.

Some Mackinaw ore was shipped in 1919, but there has been no shipments of Gardner ore. Railroad tracks have not yet been installed to the Gardner shaft. The rock obtained from sinking operations was used for filling around the shaft; there was not, however, sufficient of this rock to complete the fill. The C. & N. W. Ry. Company has made a number of surveys and estimates of the cost of the work remaining to be done, but this work has not yet been undertaken. They, however, put in a loading track to the stockpile late in the Summer, but there was no ore shipped from the Gardner property in 1919.

When the mine was opened in 1918, it was decided to try the shrinkage stope method of mining the ore on both the Gardner and Mackinaw properties. This method has been followed during the past year, and a large number of stopes opened between the 4th and 3rd and 3rd and 2nd levels. This method has proven successful and has practically done away with shoveling and the use of timber. The stopes are dry; water Leyners and other types of water

drills are used in drilling so that there is no dust, and from the labor standpoint this is considered a very desirable mine to work in. There is only one possible draw-back to the system of mining, and it is extremely doubtful whether the increased cost of the regular sub-level system of mining would off-set this disadvantage. Under the present system of mining it is not always possible to make two grades of ore, based on Sulphur content; this is due to the fact that the Sulphur does not exist in uniform quantities from foot to hanging. In certain stopes there may be a seam of ore running low in Sulphur which, under the present system of mining, is mixed with the High Sulphur Ore. In my opinion, however, it is extremely doubtful whether any sub level system would permit the recovery of this Low Sulphur Ore, except at a prohibitive cost. Certain areas of the ore body seem to grade low enough in Sulphur from foot to hanging to permit of the entire product from the stope to grade as Low Sulphur. Several such stopes were found between the 4th and 3rd level; unfortunately, the upward extension of these stopes between the 3rd and 2nd did not yield Low Sulphur Ore. During the last six months of the year there has been only a very small output of Low Sulphur Ore. It is impossible to make any predictions as to the grade of the ore due to the fact that all mining operations are being conducted in unknown territory. In other words, the stope is started and completed before any definite idea can be gained of the average Sulphur content of the ore in the stope. From diamond drilling and other indications there is reason to suppose that the ore above the 2nd level will run lower in Sulphur than was the case between the 3rd and 2nd level.

The most gratifying feature of the work of 1919 was the increased tonnage proven up on the property as compared with the probable tonnage of a year ago. The cost of production also, owing to the increase in the width of the ore body, will soon show a decided decrease. At the end of the year it was estimated that there were in excess of 20,000 tons of broken ore in the stopes. The stopes opened in 1918 above the 4th level showed the ore to be only ten feet thick between the foot and hanging. The stopes opened in 1919, however, between the 4th and 3rd, as well as between the 3rd and 2nd, have shown the ore to be from 30 to 60 feet in width between the foot and hanging.

The estimates of production on these two properties, however, falls short of the estimates made on the original E. & A's. On the Gardner there is almost no opportunity of increasing the estimate. The Mackinaw has opportunities for a large increase if the ore body is found to continue down on its dip, provided the Sulphur content does not increase to such an extent with depth as to render it inadvisable to continue mining operations. Although these two properties are operated as one mine, owing to the fact that they represent separate leases, each mine will be reported separately.

MACKINAW MINE.

The product for 1919 was as follows:

Mackinaw Low Sulphur,	28,560 tons	
" High "	21,608 "	
TOTAL ORE,		50,168 tons
Rock,		12,693 "
TOTAL ORE AND ROCK,		62,861 "

The ore shipped during 1919 and balance of ore in stock are as follows:

	<u>SHIPMENTS:</u>	<u>BALANCE OF ORE IN STOCK:</u>
Mackinaw Low Sulphur,	28,634 tons	2,289 tons
" High "	3,598 "	17,910 "
TOTAL,	32,232 "	20,199 "

The following is an estimate of the ore above 4th level, as well as prospective ore below the 4th:

	<u>MACKINAW LOW SUL.</u>	<u>MACKINAW HIGH SUL.</u>	<u>TOTAL</u>
Ore, 4th to 3rd levels,	14,776	29,554	44,330
" 3rd to 2nd "	6,641	13,282	19,923
TOTAL DEVELOPED,	21,417	42,836	64,253
Prospective Ore below 4th level,	98,822	197,644	296,466
" " above 2nd "	7,973	15,947	23,920
GRAND TOTAL,	128,212	256,427	384,639

The work in detail for the year was as follows:

SECOND LEVEL.

Work was started on this level in February 1919. The plat was first

cut, ground excavated for loading pocket at the shaft and pocket installed, after which drifting was started towards the ore body. The ore was reached in August, the total length of the rock drift from shaft to the ore body on this level being 440 feet. The drift has been extended along the foot, following the ore, until in December when the full breast of rock was struck. The drift was then driven a short distance to the South in to the hanging, after which it was decided to postpone further work at this point and to widen the drift in ore in preparation for opening shrinkage stopes. The total length of the ore body developed on the Mackinaw property on this level is 130 feet. By the end of the year the drift had been widened out and timber was being installed in preparation for starting stopes.

A careful examination made of the rock at the point where the ore was cut off indicates that the ore was cut off here on account of a fold in the foot. It is probable that by drifting ahead along the general strike of the formation ore will again be encountered beyond this sharp fold. As soon as stoping is under way on this level, drifting will be resumed here.

THIRD LEVEL.

The work of opening the 3rd level from the shaft was started in 1918 in which year the plat was cut, pocket installed and a drift started towards the ore body. Drifting was continued in 1919 and the ore reached early in June. In the meantime the 3rd level had been opened in the ore from raises put up from the 4th level, so that when the drift from the shaft reached the ore body it holed in to an ore drift along the footwall, which had already been driven. The work of preparing for opening stopes was pushed as rapidly as possible; it was necessary to complete this work and install timber for the chutes before it was possible to put motor haulage into operation. This work was completed and electric haulage was started in Sept. Stopes were opened as rapidly as possible and by the end of the year there were four contracts working in stopes above the 3rd level on the Mackinaw property.

The main haulage drift had not reached the limit of the ore body, and after stopes were opened to a point near the breast, drifting was re-

sumed and additional stopes will be opened as the drift advances. From the development work on the 4th level during the last month it was probable that the 3rd level drift can be extended about 100 feet, which will permit of opening two additional stopes.

FOURTH LEVEL

The 4th level was opened in 1918 to the ore body, and a drift driven along the footwall in ore for a distance of 260 feet. Drifting in ore was continued in 1919 until in May, when it was decided to temporarily stop further drifting. For some distance the drift along the foot had been in lean ore running from 1% to 2% in Sulphur. As the footwall drift advanced some shrinkage stopes had been opened. In order to prove out this system of mining one stope was put through from the 4th to the 3rd level. It happened that this stope was opened at a point where the ore had the least thickness between the foot and hanging. The ore at this point also happened to run quite low in Sulphur. This method of mining seemed well adapted to this ore body, and it was decided to follow this system at both the Gardner and Mackinaw Mines. Preparations were made for opening additional stopes as rapidly as possible, and more miners were taken on as soon as places could be provided. During the year there has been thirteen stopes started on the 4th level, Mackinaw, of which number five have been completed. Work is still underway in eight stopes. All of the first stopes opened happened to be located in the thinnest part of the ore body, i.e., where it had the least thickness between the foot and hanging. The stopes opened later in the year above the 4th level showed a remarkable gain in thickness between the foot and hanging; so that while the first stopes opened were completed in practically two months, some of the later stopes opened will require from six to nine months to complete.

For a considerable time after opening the footwall drift in lean High Sulphur Ore, it was not considered likely that any ore in this part of the mine would be of a grade that could be mined. Later in the year a crosscut was driven from this footwall drift over to the hanging, which showed the ore to be 35 feet in width and at this particular point the average under .5 in Sulphur. A remarkable change was noticed in the physical structure of

the ore body. All the ore which had been developed up to this time was a hard hematite ore, ranging from steel ore down to an ordinary hard red hematite. The ore in the crosscut above referred to seemed to be made up of alternate bands of limonite and hematite. It is considerably softer than any other ore previously developed, so that it is as yet impossible to state just what system of mining will be adopted, if the conditions disclosed by this crosscut are found to continue for any length along the strike of the ore body.

The outline of the past years work on the Mackinaw property, given in preceding paragraphs, shows that the ore body has been opened on the 2nd, 3rd and 4th levels. Stopping is under way between the 4th and 3rd and between the 3rd and 2nd levels; preparations for opening stopes above the 2nd is also under way. Under present existing plans, no connection will be made to the Mackinaw shaft on the 1st level. Connection will be made with the drift to the Gardner shaft on the 1st level, which will provide ventilation. It is planned to transfer the dirt coming from the 1st level Mackinaw thru raises down to the 2nd level. The greater part of the ore body at the elevation of the 1st level is on the Gardner property, and only a small tonnage will be found on the 1st level, Mackinaw.

If sales are made of the ore, and it is decided to continue to operate these properties, it is very desirable that diamond drilling be done on the 4th level, Mackinaw, to determine the Sulphur content and general physical structure of the ore at depth. A drift should be driven in the hanging on 4th level a distance of 300 to 400 feet and a number of holes drilled from the end of this drift. It is recommended that this work be authorized and done during 1920 in order to permit of planning future operations on the Mackinaw property.

GARDNER MINE.

The product for the year was as follows:

Gardner Ore,	2,913 tons
Gardner High Sulphur,	<u>16,245</u> "
TOTAL ORE,	19,158 tons
Rock,	<u>12,914</u> "
TOTAL ORE AND ROCK,	32,072 "

The ore in stock at the end of the year was as follows:

Gardner Ore,	2,913 tons
Gardner High Sulphur,	<u>16,245</u> "
TOTAL,	19,158 "

There were no shipments from this property in 1919. Production was on a very small scale during the early months of the year and it was late in the year before the production showed much of an increase. The estimate of ore in sight is as follows:

	<u>GARDNER LOW SULPHUR</u>	<u>GARDNER HIGH SULPHUR</u>	<u>TOTAL</u>
3rd Level to 2nd,	4,930	9,860	14,790
4th " to 3rd,	<u>7,918</u>	<u>15,838</u>	<u>23,756</u>
Total Developed Ore,	12,848	25,698	38,546
Prospective Ore above 2nd Level,	<u>58,835</u>	<u>117,670</u>	<u>176,505</u>
GRAND TOTAL,	71,683	143,368	215,051

This estimate includes all the developed, as well as all prospective ore. The limit of mining is estimated to be 400 feet below surface, or within 300 feet of the capping. It is barely possible that mining may be carried to a higher elevation, but at this time it is not deemed advisable to assume that it will be possible to mine closer than 300 feet below the sand. There is practically no ore between the 4th and 3rd level on the Gardner property. Above the 3rd the area of the ore body on the Gardner property showed a rapid increase until at the 1st level practically the area of the whole deposit is on the Gardner property. During the year the ore body on the 3rd level has been opened up and connection made to the shaft. The ore on and above the 2nd level, up to the 1st level, will be dumped in

transfer raises and trammed to the shaft on 3rd level. It is planned to open the 1st level Gardner, and drifting to the ore body had been practically completed at the end of the year. With this general outline of the work, the work will now be taken up in detail.

FIRST LEVEL.

The work of opening the 1st level Gardner Mine was started in April. In July the plat had been cut, pocket installed and drifting started to the ore body. Drifting was continued for the balance of the year, and the last of December the drift had reached a point in line with the ore body. There is apparently no enrichment at this point and the haulage drift has been turned to the North-west in which direction it will be continued until ore is encountered. It is expected that ore will be encountered within 100 feet of the present breast. If this is the case, the length of the ore body on the 1st level, Gardner, will be approximately 440 feet, which, under the present stoping system, will permit of opening at least ten stopes.

SECOND LEVEL.

It is not planned to make any connection to the Gardner shaft on the 2nd level. The ore body on the 2nd level has been developed from raises put up from the 3rd level, and has been opened in this manner for a length of 230 feet along the strike. From diamond drill holes it is safe to assume that the undeveloped portion of the ore body at this elevation will probably be 190 feet in length. The ore which will be obtained from stopes opened between the 2nd and 1st level will be handled in motor cars to transfer raises from which point it will then be taken by electric haulage to the shaft on 3rd level, Gardner. A large amount of work remains to be done in order to prepare the 2nd level for opening stopes. Unless additional motors and motor cars are purchased it will not be possible to start stoping here until the stopes are finished on either the 3rd or 4th level. Nevertheless, it is planned to continue work and install timber and start all the stopes so that when operations are completed on one of the lower levels, the equipment can be transferred and work immediately started on the 2nd level.

THIRD LEVEL.

The plat had been cut and pocket installed, and drifting started towards the ore body on the 3rd level, in 1918. At the same time raises had been put up from the 4th to the 3rd level and the ore body was being developed from these raises while the drift was being driven to the ore from the shaft. In April the drift from the shaft connected with the drift which was already driven in the ore body, and in May the work of widening the foot-wall drift in ore was started, preparatory to opening stopes. The work of stripping the ore off the foot, installing timber, building chutes, and getting the motor haulage plant in operation on the 3rd level was completed. As fast as men were available, the work of opening stopes was started, and each month showed an increasing number. There were two working in August, four in September, five in October and November, and six in December.

FOURTH LEVEL.

There has been no work done on the 4th level on Gardner property during 1919. No. 1 stope on the 4th level, Mackinaw, passed over the boundary line on to Gardner property in November. The estimates of ore in sight show only 23,756 tons of ore between the 4th and 3rd levels; about 50% of this must be left in pillars. From No. 1 stope will be obtained all of the available ore between the 4th and 3rd level, on the Gardner property.

GARDNER-MACKINAW SURFACE

The work of enclosing the Mackinaw shaft house, which was started in 1918, was completed during the past year. There has been absolutely no trouble at this shaft from ice, or on the landing in handling the ore, since this work was done. Owing to the uncertainty connected with the future operations of this property, the Gardner shaft house was not enclosed. The cage road was cased up from the collar to the landing and high enough above the landing to permit the cage to be hoisted and material taken off on the landing. The skip roads were also cased from the collar up to the dump, but the main building enclosing the dumps has not yet been constructed. Considerable trouble has been experienced during the severe weather in the early part of December from ice forming in the shaft. This would not be difficult to control if the shaft house were enclosed in the same way as the Mackinaw is now enclosed. If sales of ore are made, and the future of the property is assured, it will be advisable to enclose the Gardner shaft house.

The foundation was put in for an addition to the dry building in the fall of 1918. This addition was started in the spring of 1919 and completed early in the Summer. It provided room for about thirty additional men and also a small room for shift bosses. By the end of the year when additional men had been taken on so that the number of men employed underground was about fifty-five on each shift, the dry was filled to capacity. There is also at this property no hospital room. As soon as warmer weather comes it will be necessary to build another addition to the dry to provide additional change room and also a small room for an emergency hospital room.

A contract had been let in 1918 for the erection of three cottages and seven double houses. Work was started on these and several of them completed in 1918. The balance of the houses were finished in 1919, and by the end of the year they were all occupied.

The extremely dry weather in July caused a number of fires on the plains. These became especially dangerous to the Gardner--Mackinaw

GARDNER MACKINAW MINES (SURFACE)

Locations on July 19th and 20th. On the 20th there were in the neighborhood of 200 men fighting to keep the fire away from the location. Fortunately the wind changed late in the afternoon, which was the only thing that saved the company houses. No rain fell for nearly a week afterwards, and as a protective measure men were kept working around the location extinguishing fires which were smouldering in the burned-over area.

Some trestles had been erected at both the Gardner and Mackinaw in 1918, but there had not been sufficient stockpile ground prepared to take care of the product. At the Gardner, stocking trestles were erected last summer and extended to the limit of the stocking ground. Rock was dumped from these trestles and spread out over the stocking grounds, then levelled off and rolled. Unfortunately there is no lean ore available at these properties for making a sollar, so that in loading ore from stockpile it will be necessary to leave a thin layer of ore on top of the rock. At the Mackinaw, the trestle was extended sufficiently to take care of this winters product, and a sollar made by dumping rock and a small quantity of lean ore. Some plank was obtained for this sollar from the old sollar at Presque Isle, where Lake ore was stocked some years ago.

In 1918 it was decided to build permanent brick dry to provide accommodations for at least 300 men, and also the permanent heating plant, which was planned to be large enough to furnish steam for the new dry and all other mine buildings, as well as the Mackinaw shaft house. The foundations for the heating plant were installed and the boiler delivered to the mine. The uncertainty connected with the future operations of this property, however, caused this work to be dropped in the fall of 1918. In 1919 it was decided to use stoves in the shops, engine house and shaft houses and use the present small temporary heating plant for heating the office and dry, and in this way avoid the expense of erecting a permanent heating plant. Accordingly, storm windows were bought for the engine house, shops and office building, as also beaver board for lining the engine house. It was found possible in the very cold weather of December to keep the mine buildings warm.

Bond

During the past year fences were erected around the greater portion of the houses which have been built since the mine re-opened; this work was not quite completed, however, when winter weather set in.

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ACCIDENTS TO EQUIPMENT.

There has been a number of delays at the mine during the past year due to accidents to the compressor. This has not closed down the property entirely, but has stopped all drilling underground, and although in many cases it did not materially effect the product, it has resulted in a decrease in the amount of ore which would have been broken if the accidents had not occurred. The compressor at these mines is one of the several purchased some years ago from Nordberg & Company, none of which have ever given satisfaction. In the early months of the year the mines were closed down several times due to a shortage of electric current.

GARDNER MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1919.

GRADE	IRON	PHOS.	SILICA	MANG.
Gardner,	59.27	.093	3.55	3.41
Gardner High Sulphur,	59.87	.086	3.12	3.35

(Cargoes all mixed).

ORE STATEMENT - DECEMBER 31ST, 1919.

	GARDNER	GARDNER H.SULPH.	TOTAL	TOTAL LAST YEAR
On hand January 1st, 1919,	42		42	0
Output for year,	2,913	16,245	19,158	42
Total,	2,955	16,245	19,200	42

1919 - 2-8 Hour Shifts

1918 - 3-8 Hour Shifts - Jan. 1st to Dec. 1st
2-8 Hour Shifts Dec. 1st to Dec. 31st.

MACKINAW MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1919.

GRADE	IRON	PHOS.	SILICA	MANG.
Mackinaw,	60.19	.089	3.62	.464
Mackinaw High Sulphur	60.12	.098	3.15	.315

(Cargoes all Mixed).

ORE STATEMENT - DECEMBER 31ST, 1919.

	MACKINAW	MACKINAW H.SUL.	TOTAL	TOTAL LAST YEAR
On hand Jan.1st, 1919,	2,363		2,363	51
Output for Year,	28,560	21,608	50,168	2,312
Total,	30,923	21,608	52,531	2,363
Shipments,	28,634	3,698	32,332	0
Balance on hand,	2,289	17,910	20,199	2,363
Increase in output,			47,856	
Increase in ore on hand,			17,836	

1919 - 2-8 Hour Shifts
 1918 - 3-8 Hour Shifts - Jan. 1st to Dec. 1st
 2-8 Hour Shifts Dec. 1st to Dec. 31st.

SHIPMENTS FOR YEAR 1919.

GRADE	POCKET	STOCKPILE	TOTAL
Mackinaw,	19,391	9,243	28,634
Mackinaw High Sulph.,	1,812	1,886	3,698
Total,	21,203	11,129	32,332
Total last Year,	0	0	0
Increase,			32,332

MACKINAW MINE.

GARDNER-MACKINAW MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 9.
PRODUCT	-
General Expense	.163
Maintenance	.141
Mining Expense	1.920
Cost of Production	2.224
Exploring - Ore in Development	544
DEPRECIATION	-
Taxes	.045
Central Office	.053
Miscellaneous	.005
Sundry Expense	.008
Cost on Stockpile	2.879
Loading & Shipping	.079
Cost on Cars	2.958
No. Days Operating	151
No. Shifts & Hours	2-8hr
Avg. Daily Product	.459
<u>COST OF PRODUCTION.</u>	
Labor	1.493
Supplies	.731
Total	2.224

Mine started on operating basis July, 1, 1919.