500' SUB LEVEL.

Mining here is also in the central or main ore body between the foot wall and #2 dike, with the supporting pillar the Western limit. When the tenth level was completed in 1920, the gangs dropped down their respective raises and began to develop at this elevation. With the exception of a few slices along the foot wall, the only work in 1920 was of a development nature. It was decided to divide this area into sections in a Northwest-Southeast direction with the drift, connecting the tops of the raises from the eleventh level, in the middle of each section. By this means the territory which is large can be stepped down as each section is worked out, instead of mining the entire area at once with the increased crushing effect. During the present year the Eastern half or foot wall section has been stoped out from #208-A to #214 raise. In the Western half of the foot wall section, mining is now in progress from #208-A to #202 raises. The next section, operated from the drift connecting #227 with #232 raises, is one step behind the foot wall section, as stoping was not started until the latter part of the year.

To the Southwest under the hanging development only is in progress in the widening ore body Northwest of #2 dike - but the ground is quite dense, requiring considerably more powder.

During December there were ten contracts in the foot wall section stoping, six in the second section stoping, and six under the hanging near #251 raise developing.

ELEVENTH LEVEL.

The development of this level was continued this year in #3, #4 and #5 crosscuts.

No. 3 crosscut advanced to the North, while #5 was continued to the Northwest driving toward #3. Both drifts encountered jasper hanging and later holed. No. 3 being then advanced until it intersected #6 crosscut near the Maas boundary.

No. 4 crosscut which is a back switch to the Southwest from #3 crosscut was driven 200' during the year. It will be continued 150' farther.

RAISES.

Five raises were put up during the year as follows:-

No. 5 crosscut:-

No. 261 raise, 110 feet high; material, ore.

" 263 " 110 " " " " .

" 264 " 90 " " " " .

" 265 " 75 " " " " .

No. 11 crosscut:-

No. 227-A raise, 100' high; material, 0' to 56' jasper; 56' to 100' ore.

In December there were two contracts working on this level, one at #272 raise in #11 crosscut, the other drifting in #4 crosscut.

UNDERGROUND IN GENERAL.

Mining will continue the coming year in areas where work is now in progress. If an increased production is desired, some of the territory abandoned will have to be reopened. I refer particularly to the #2 shaft pillar and to the area between the ninth and tenth levels on the North foot wall. Raises extend to these sections and development can be started without delay.

The development of the eleventh level is nearly completed. There still remains raising at several places and the finishing of #4 crosscut to the Southwest.

Nothing was done in #1 shaft pillar during the year. As was mentioned in the report for 1920, I would recommend that this be left for the time being as there is plenty of ground available to tax the shaft capacity without opening this territory. There is also apt to be some hazard when this territory is opened, as it is full of old rooms which are caved and probably full of sand. The mine is not being harmed in any manner by leaving these pillars until later as the rock drifts through which this ore will be taken will remain open until the mine is exhausted.

In a short time the shaft should be sunk to the thirteenth level and the twelfth level developed. An excellent time to sink the shaft would be when the mine is operating on the present schedule as this work could go on without interference with the hoisting.

WATER.

The average number of gallons per minute pumped during the year as compared with 1920 is as follows:-

	1921	1920
January	871	991
February	974	1045
March	885	1000
April	883	858
May	852	1034
June	932	978
July	972	948
August	913	922
September	933	961
October	897	950
November	917	934
December	896	955
Average -	910	965

The average pumping for the year was 55 gallons per minute less than in 1920 and 104 gallons per minute less than in 1919.

GRADING PRODUCT.

The division in product between grades was 11% Bessemer and 89% Negaunee.

The Bessemer grade showed phosphorous between .044 and .048%.

The Negaunee grade has shown a gradual increase in phosphorous, however, by changing the Bessemer grading from .060 to .048, the non-bessemer grade has been getting the benefit of all stopes averaging between these limits. While this has lowered the percentage of the Bessemer product, it has helped maintain a lower phosphorous on our non-bessemer ore.

MAYNE LOADER.

In April 1920 a new mechanical loading device for loading sub level cars was placed in commission. In the contracts where this machine was used, the product was greatly increased. This machine operated throughout the present year and a second more powerful machine of the same design was built and installed. Both are operating successfully.

The machine was invented and patented by John Mayne, one of our Negaunee miners.

BULKHEADS.

During the year concrete walls were placed on the sides of the main level crosscut 300' North of the shaft on the eleventh and twelfth levels. These are arranged with slots so that 8 by 10 timbers can be used to dam off the water in case of flood. By means of the twelfth level bulkhead, the entire level can be used for storage purposes in case of an emergency.

SURFACE.

PERMANENT TRESTLE.

Early in the spring before any ore was removed from the stockpiles, a crew was set at work finishing the painting of the trestle which was started in 1920.

About 50% of the ties in the stocking trestle were renewed during the year. The balance will have to be installed during the coming season. This is a slow, tedious job, as each tie has to be bolted.

During the past year very little ore was taken from the stockpiles, however, there was sufficient to permit the stocking of our present product throughout this season or until navigation opens in the spring.

ESTIMATE OF PROBABLE ORE IN NEGAUNEE MINE DECEMBER 31, 1921.

On North Foot above 9th level - - - -	102,424 tons,
No. 1 Shaft Pillar - - - - - - -	1,148,660 "
No. 2 Shaft Pillar - - - - - - -	113,902 "
Total above 9th level - - - - - -	1,364,986 tons.
Total between 9th & 10th levels - -	1,335,663 tons,
Total between 10th & 11th levels - -	2,607,350 tons,
Total above 11th level - - - - - -	5,308,007 tons.

Percentage of Bessemer = 11%.

GRADED AS FOLLOWS:

Bessemer Ore	Trade Name	Tons
Developed	Negaunee-Bessemer	583,881
Non-Bessemer Ore		
Developed	Negaunee	4,724,126
Total Bessemer and Non-Bessemer - - -		5,308,007

ASSUMPTION:

12 cu. ft. equals one ton. 10% Deduction for Rock.
10% " " Loss in Mining.

ESTIMATED ANALYSIS.

	IRON	PHOS.	SILICA	ALUM.	MANG.	LIME	MAG.	SUL.	IGNI.	MOIST
Negaunee:										
Dried 212°	59.10	.100	7.70	2.64	.324	.900	.306	.009	3.10	
Natural	52.00	.088	6.78	2.32	.285	.792	.269	.008	2.73	12.00
Negaunee-Bessemer:										
Dried 212°	60.00	.048	7.04	2.72	.237	.644	.307	.009	2.07	
Natural	52.80	.042	6.20	2.39	.209	.567	.270	.008	1.82	12.00

NEGAUNEE MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1921.

GRADE	IRON	PHOS.	SILICA
Negaunee Bessemer,	62.51	.047	5.34
Negaunee,	59.94	.095	7.27

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1921.

	Mine		Lake Erie	
GRADE	IRON	PHOS.	IRON	MOIST.
Negaunee Bessemer,	(All Mixed).			
Negaunee,	59.24	.106	59.30	11.25

ORE STATEMENT - DECEMBER 31ST, 1921.

	NEGAUNEE BESSEMER	NEGAUNEE	TOTAL	TOTAL LAST YEAR
On hand January 1, 1921,	3,324	144,724	148,048	143,737
Output for Year,	28,373	228,262	256,635	554,609
Transferred,	14,081	14,081		
Total,	45,778	358,905	404,683	698,346
Shipments,	30,821	153,402	184,223	550,298
Balance on Hand,	14,957	205,503	220,460	148,048
Decrease in Output,			297,974	
Increase in Ore on Hand,			72,412	

1921 -- 1-8 Hour Shift, 6 days per week, Jan. 1st to March 25th, 1921.
1-8 Hour Shift, 5 days per week, March 25th to May 17th, 1921.
1-4 Hour Shift, 6 days per week, May 17th to Dec. 31st, 1921.

1920 -- 1-8 Hour Shift for Year.

PRODUCTION

Month	Bessemer	Negaunee	Total	Rock
January	2,528	34,813	37,341	640
February	1,780	27,164	28,944	
March	3,388	29,189	32,577	216
April	2,620	22,826	25,446	312
May	3,409	19,350	22,759	260
June	2,116	14,470	16,586	196
July	1,690	14,214	15,904	204
August	2,715	13,700	16,415	76
September	2,446	13,086	15,532	116
October	2,109	13,615	15,724	196
November	1,732	12,021	13,753	92
December	1,840	13,814	15,654	12
Total	28,373	228,262	256,635	2,320
Transferred to	14,081 from	14,081		
Total	42,454	214,181	256,635	2,320

ANALYSIS OF PRODUCTION AND COSTS.

Production of	1920	554,609 tons,			
"	1921	256,635 "			
Decrease	1921	297,974 tons.			
Cost of production	1920	$885,289.79	- Cost per ton	$1.596	
" " "	1921	402,581.71		1.569	
Decrease	1921	$482,708.08	Decrease	$ .027	

DETAIL OF COST OF PRODUCTION

	TOTAL COST				COST PER TON		
	LABOR	%	SUPPLIES	%	LABOR	SUPPLIES	TOTAL
1920 -	$628,499.20	70.9	$256,790.59	29.1	$1.133	$.463	$1.596
1921 -	254,378.65	63.2	148,203.06	36.8	.991	.578	1.569
	$374,120.55 Decr.		$108,587.50 Decr.		$ .142 Decr.	$.115 Incr.	$ .027 Decr.

The decrease in labor cost per ton was due to the reduction in wages; supply increase was due principally to electric current for pumping being the same as if mine operated full time, and to increase in cost of timber.

During the year 1921 the mine operated as follows:-

On January 15th the product was cut from 48,000 tons per month to 30,000 tons per month and about 30% of force laid off. This schedule continued until March 26th when the number of working days in a week were cut from six to five, Saturdays idle. The mine operated at this rate until May 17th when the mine began working six half shifts a week only and continued on this schedule for the remainder of the year.

During the year 1921 the mine worked one 8-hour shift for 104 days and one 4-hour shift for 191 days. The average number of men employed during the year was 222 for a total of 47,247 days. In 1920 an average of 334 men were employed for a total of 100,212 days. A decrease in labor for 1921 of 112 men and 52,965 days.

During the year of 1921 the following decreases in wages were effective:-

February 1st, 15%; August 1st, 12½%; and October 1st, 10%. In 1920 there was one increase of 10% effective February 1st.

The average tons per man underground in 1921 was 6.51 or a decrease of .12 tons per man over 1920 when the average tons per man per day was 6.63. The total tons per man in 1921 was 5.43 while in 1920 it was 5.53, a decrease of .10 tons per man.

On January 1st, 1921 a revised card of accounts was adopted, therefore, in making comparisons between costs for 1921 and 1920, it has been necessary to rearrange certain accounts. In a few instances the accounts have been so changed as to make it difficult to assemble them for comparison. In such cases notations have been made of items of expense which were excluded or included in the revised accounts.

UNDERGROUND COSTS:

Development in Rock, (Old account Rock Drifting).

1921 Amount	$3,473.11	- Cost per ton	$.014
1920	17,352.91		.031
Decrease	$13,879.80	Decrease	$.017

Number feet rock work 1921, 544' @ $6.38 per ft.
" " " " 1920, 2971' @ 5.84
Decrease 2427'

Comparison of cost per ton means nothing here. There was five times as much rock drifting in 1920 as in 1921 while the product which controls the cost per ton was about twice as large in 1920 as in 1921. The increase in the cost per foot for rock drifting in 1921 was due to main level drifting, where 1920 was main level and sub level.

Development in Ore) (Old account Breaking Ore).
Stoping)

1921 Amount	$149,877.16	- Cost per ton	$584
1920	384,431.50		.693
Decrease	$234,554.34	Decrease	$.109

Detail.

	Labor		Supplies	
1920	$326,659.55	85.0%	$57,772.04	15.0%
1921	123,781.01	82.6%	26,096.13	17.4%
Decr.	$102,878.54		$31,675.91	

	Cost per ton		
	Labor	Supplies	Total
1920	$.589	$.104	$.693
1921	.482	.102	.584
Decr.	$.107	$.002	$.109

Explosives.

	1921	1920
Total lbs. powder	94,800	216,900
Average price per lb.	.1975	.1948
Total Amount	18,726.98	42,245.46
Fuse, Caps, etc.	2,667.50	7,200.81
Grand Total	21,394.48	49,446.27
Lbs. powder per ton of ore	.3694	.3911
Cost per ton for powder	.0730	.0762
" " " All explosives	.0834	.0892

Decrease cost per ton due to decreases to labor.

Timbering,

1921 Amount	$75,222.89	- Cost per ton	$.293
1920	149,431.26		.269
Decrease	$74,208.37	Decr.	$.024

	1921	1920
Timber Cost	15,093.21	21,462.14
Lagging, Poles & Cover Bds.	12,192.40	15,472.05
Total	27,285.61	36,934.19
Ft. Timber per ton of ore	.5973	.5052
Ft. lagging "	2.3156	2.4635
Cost per ton for timber	.0588	.0387
Do. Lagging & Cover Boards	.0334	.0218
" Poles	.0141	.0061
" Tbr. Lagg, Cover Bds. & Poles	.1063	.0666

The increased cost per ton for timber in 1921 was due to an increase in amount of timber used and increased price. The timber cost for 1921 over 1920 was 28.6%, and for poles and lagging 30.2%. Sub levels must be kept open twice as long account of half time. The replacements in main levels are the same as if the mine were working full time.

Tramming,

1921 Amount	$20,505.88 -	Cost per ton	$.080
1920	59,747.48		.108
Decrease	$39,241.60	Decrease	$.028

The cost of cleaning tracks is now charged to this account, formerly charged to Main Line Tracks. The Decrease in the cost per ton is due to less development work and therefore fewer trammers necessary, also decreases in wages.

Ventilation,

1921 Amount	$ 9.98 -	Cost per ton	$.000
1920	155.75		.000

Less repairs on ventilation system.

Pumping,

1921 Amount	$37,926.78 -	Cost per ton	$.148
1920	40,955.10		.074
Decrease	$3,028.32	Increase	$.074

	1921	1920
Total Gals. water pumped	474,243,420	508,169,060
Gals. pumped per minute	902	963

A decrease of 33,925,640 gallons of water pumped and 61 gallons per minute.

Increase cost per ton due to product less than 50% of last year.

Compressors & Air Pipes, (Old accounts Air Pipes, Compressor).

1921 Amount	$15,761.01	- Cost per ton	$.061
1920	35,593.09		.065
Decrease	$19,832.08	Decrease	$.004

	Compressor	Air Pipes
1921	$12,666.56	$3,094.45
1920	27,511.05	8,082.04
Decrease	$14,844.49	$4,987.59

Total Cu. ft. air used	1921 -	306,315,000
Do.	1920 -	898,920,000
Decrease -		592,605,000

Back Filling,

1921 Amount	$3,149.03	- Cost per ton	$.012
1920	8,203.01		.015
Decrease	$5,053.98	Decrease	$.013

Underground Superintendence, (Old Account Captain & Bosses).

1921 Amount	$11,035.23	- Cost per ton	$.043
1920	20,209.65		.036
Decrease	$ 9,174.42	Increase	$.007

Increase cost per ton due to more bosses in proportion to tonnage than when mine is operating full time.

MAINTENANCE ACCOUNTS:

Compressor & Power Drills,

1921 Amount	$244.56	- Cost per ton	$.001
1920	818.66		.001
Decrease	$574.10		.000

All cost in both years due to repairs to compressor. No power drills purchased. Decrease due to less repairs.

Hand Tramming Equipment, (Old account Underground Tracks & Cars).

1921 Amount	$2,375.33	- Cost per ton	$.009
1920	6,731.97		.012
Decrease	$4,356.64		$.003

Few new buggies built in 1921.

Electric Tram Equipment, (Old account Electric Tram Plant).

1921 Amount $11,118.06 - Cost per ton $.044

1920 33,914.26 .061

Decrease $22,796.20 Decrease $.017

	Sub Division		
	Eng.&Motor	Locomotives	Wiring
1921	161.23	3,404.95	1,244.75
1920	40.12	5,753.86	4,053.25
Incr.	121.11	Decr. 2,348.91	Decr. 2,808.50

	M. L. Tracks	M. L. Cars
1921	4,254.35	2,052.78
1920	18,310.26	5,756.77
Decr.	14,055.91	Decr. 3,703.99

Increase in Engine & Motor due to more charges to generator set.

Decrease in Locomotives due to less repairs to motors, account of working only half time.

Decrease in Wiring due to no new places to wire and less repairs.

Decrease in M. D. Tracks due to less new rail used, also cost of cleaning tracks, ditches, etc. formerly charged to this account, now charged to the account Tramming.

Decrease in M. L. Cars due to less repairs to cars.

Decrease cost per ton due to decrease to labor and cost of cleaning tracks formerly charged to this account, now charged to Tramming.

Pumping Machinery,

1921 Amount $2,608.28 - Cost per ton $.010

1920 4,208.26 .008

Decrease $1,599.98 Increase $.002

Increase cost per ton due to more papairs in proportion to tonnage.

TOTAL UNDERGROUND COST - 1921 Amount $333,323.68 - Cost per ton $1.299

SURFACE COSTS:

Hoisting,

1921 Amount	$15,923.09	- Cost per ton	$.062
1920	30,321.98		.055
Decrease	$14,398.89	Increase	$.007

Electric Power 1921 - $10,821.00

" " 1920 - 20,718.00

Decr. $ 9,897.00

Increase cost per ton due to heating expense for engine room, etc. being just as great as if mine were operating full time.

Stocking Ore, (Old accounts Stocking Ore, and Top Landing & Tramming).

1921 Amount	$4,370.12	- Cost per ton	$.017
1920	9,733.22		.018
Decrease	$5,363.10	Decrease	$.001

Decrease cost per ton due to decrease in wages.

Dry House,

1921 Amount	$6,254.81	- Cost per ton	$.024
1920	9,470.40		.017
Decr.	$3,216.59	Increase	$.007

Increase cost per ton due to Boiler House charge to Dry being greater in proportion to tonnage.

Coal to Boiler House -	Tons	Cost
1921	837.8	5,772.44
1920	1095.12	7,671.32

General Surface Expense, (Old account Tracks & Yards).

1921 Amount	$4,575.92	- Cost per ton	$.018
1920	2,559.46		.005
Increase	$2,016.46	Increase	$.013

Increase cost per ton due to wages of policemen being transferred to this account from Petty Office.

MAINTENANCE ACCOUNTS:

Hoisting Equipment, (Old account Hoisting Machinery and Skip & Skip Roads).

1921 Amount	$4,816.41	- Cost per ton	$.019
1920	8,662.39		.016
Decrease	$3,845.98	Increase	$.003

	Sub Division.			
	Wire Rope	Machinery Parts		Skip & Skip Roads
1921	909.20	1,872.32		2,034.89
1920	1538.59	1,149.36		5,974.44
Decr.	629.39	Incr. 722.96	Decr.	3,939.55

Decrease in Wire Rope due to two new ropes installed in 1921, North and South skip. In 1920 three new ropes were installed, North and South skip, also counterbalance rope for cage.

Increase in Machinery Parts due to installing Lily hoist control and one 8' bicycle sheave in 1921.

Decrease to Skip & Skip Roads due to cost high in 1920 account of accident to equipment April 8th. North skip out of guides causing much damage to skip road and destroying skip.

Shaft, (Old account Sinking & Shaft Repairs).

1921 Amount	$1,427.17	- Cost per ton	$.006
1920	1,301.29		.002
Increase	$ 125.88	Increase	$.004

Increase due to more repairs to shaft in 1921.

Top Tram Equipment, (Old account Top Tram Engines & Cars).

1921 Amount	$3,474.20	- Cost per ton	$.014
1920	3,092.81		.006
Increase	$ 381.39	Increase	$.008

	Sub Division. General Repairs		Wire Rope
1921	3,050.80		423.40
1920	2,608.09		484.72
Increase	442.71	Decr.	61.32

Increase in General Repairs due to replacing part of top tram ties in 1921.

Decrease in Wire Rope due to difference in price of ropes, one new rope installed each year.

Docks, Trestles & Pockets,

1921 Amount $1,114.10 - Cost per ton $.004

1920 3,497.99 .006

Decrease $2,383.89 Decrease $.002

High in 1921 due to painting part of trestle.

High in 1920 due to replacing trestle stringers, also repairs to trestle.

Mine Buildings,

1921 Amount $798.05 - Cost per ton $.003

1920 2,212.76 .004

Decrease $1,414.71 Decrease $.001

Decrease due to cost of addition to dry house in 1920 for shift bosses room.

Total Surface Costs - 1921 Amount $42,753.87 - Cost per ton $.167

GENERAL MINE ACCOUNTS:

Insurance,

1921 Amount $49.81 - Cost per ton $.000

1920 37.29 .000

Increase $12.52 $.000

Engineering,

1921 Amount $2,239.43 - Cost per ton $.009

1920 3,438.50 .006

Decrease $1,199.07 Increase. $.003

Nearly as much engineering is required when mine operates half time as on full time.

Analysis,

1921 Amount $8,642.21 - Cost per ton $.034

1920 19,513.86 .035

Decrease $10,871.65 Decrease $.001

This includes operating laboratory and sampling in 1921. The total cost for the laboratory was $13,549.97 and the total number of determinations was 107,311. In 1920 the cost was $19,-218.18 and the total determinations 133,938. A decrease in cost of $5,668.21, and in determinations of 26,627.

Cost per determination in 1921 - $.12627

" " " " 1920 - .14350

Decrease - $.01723

Decrease per determination almost wholly due to decrease in supplies.

Personal Injury Expense,

1921 Amount $2,997.44 - Cost per ton $.011

1920 5,762.17 .011

Decrease $2,764.73 $.000

No serious or fatal accidents in 1920 or 1921.

Safety Department Expense, (Formerly carried under #22 Mine Office).

1921 Amount $177.96 - Cost per ton $.001

1920 152.05 .000

Increase $25.91 $.001

Increase due to more charges to supplies.

Telephone & Safety Devices,

1921 Amount $556.27 - Cost per ton $.002

1920 102.51 .000

Increase $463.76 Increase $.002

Increase due to more supplies used and renewal and extensions to safety devices.

Local General Welfare,

1921 Amount $1,473.68 - Cost per ton $.006

New account for 1921.

Special Expense,

1921 Amount $121.27 - Cost per ton $.000

New account in 1921.

Mine Office,

1921 Amount $10,236.09 - Cost per ton $.040

1920 19,364.87 .035

Decrease $ 9,128.78 Increase $.005

	Sub Division	
	Direct Charges	Mine Office
1921	3,643.85	6,592.24
1920	7,676.08	11,688.79
Decrease	4,032.23	5,096.55

Decrease in Direct Charges due to half time operation, making this charge less; also decrease in wages. Decrease in Mine Office due to transferring policemen's wages to General Surface and decrease in wages.

DELAYS - ELECTRICAL.

January 19th 1/2 hour delays account of no current.

June 18th 1 hour delay account of no current.

DELAYS - NON-ELECTRICAL.

December 1st 1¼ hours delay account of armature burnt out on eleventh level motor.

December 8th 1/2 hour delay account of axle broken on eleventh level motor car.

NEGAUNEE MINE

SHIPMENTS FOR YEAR 1921.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Negaunee Bessemer,	13,455	17,366	30,821	35,396
Negaunee,	82,140	71,262	153,402	514,902
Total,	95,595	88,628	184,223	550,298
Total Last Year,	310,457	239,841	550,298	
Decrease,			366,075	

NEGAUNEE MINE

COMPARATIVE MINING COST FOR YEAR

	1921	1920	INCREASE	DECREASE
PRODUCT	256,635	554,609		297,974
Underground Costs	1.299	1.375		.076
Surface Costs	.167	.139	.028	
General Mine Accounts	.103	.080	.023	
Cost of Production	1.569	1.594		.025
Plant Account	.030	.031		.001
Taxes	.659	.293	.366	
Central Office	.084	.048	.036	
Contingent Expense	.012		.012	
Cost Adjustment	.066	.010	.056	
Cost on Stockpile	2.420	1.976	.444	
Loading & Shipping	.017	.052		.035
Misc. Debits & Credits	.016	.001	.017	
Total Cost on Cars	2.453	2.027	.426	
No.Days Operating	294	300		6
No.Shifts & Hours	1-8;1-4	1-8hr		
Average Daily Product	873	1,849		976
COST OF PRODUCTION				
Labor	.991	1.132		.141
Supplies	.578	.462	.116	
Total	1.569	1.594		.025

NEGAUNEE MINE

COMPARATIVE WAGES AND PRODUCT

	1 9 2 1	1 9 2 0	INCREASE	DECREASE
PRODUCT	256,635	554,609		297,974
No.Shifts and Hours	1-8;;-4	1-8hr		
AVERAGE NO.MEN WORKING				
Surface	37	53		16
Underground	189	273		84
Total	226	326		100
AVERAGE WAGES PER DAY				
Surface	4.49	5.42		.93
Underground	5.45	6.53		1.08
Total	5.28	6.34		1.06
WAGES PER MONTH OF 25 DAYS				
Surface	112.25	135.50		23.25
Underground	136.25	173.25		37.00
Total	132.00	158.50		26.50
PRODUCT PER MAN PER DAY				
Surface	30.94	33.60		2.66
Underground	6.59	6.63		.04
Total	5.43	5.53		.10
LABOR COST PER TON				
Surface	.145	.161		.016
Underground	.827	.985		.158
Total	.972	1.146		.174
AVG.PRODUCT BRK'G & TRM'G	10.50	9.92	.58	
" WAGES CONTRACT MINERS	5.56	6.95		1.39
" " " LABOR	5.56	6.95		1.39
TOTAL NUMBER OF DAYS				
Surface	8,294¼	16,503½		8,209¼
Underground	38,952¾	83,708½		44,755¾
Total	47,247	100,212		52,965
AMOUNT FOR LABOR				
Surface	37234.12	89418.37		52184.25
Underground	212340.62	546377.52		334036.90
Total	249574.74	635795.89		386221.15

Proportion Surface to Underground Men;

1921 - 1 to 5.11
1920 - 1 to 5.15
1919 - 1 to 5.35
1918 - 1 to 5.10
1917 - 1 to 5.20

1-8hr 6 days a week to Mar.26
1-8hr 5 " " " May 17;
1-4hr 6 " " Dec.31st.

NEGAUNEE MINE.

TIMBER STATEMENT FOR THE YEAR ENDING DECEMBER 31, 1921.

KIND	LINEAL FEET	AVG.PRICE PER FOOT	AMOUNT 1 9 2 1	AMOUNT 1 9 2 0
4" to 6" Timber	1,046	.01	10.46	57.26
6" to 8" "	33,504	.0433	1,451.92	2,223.85
8" to 10" "	60,668	.0925	5,614.05	10,408.65
10" to 12 "	51,721	.1323	6,844.03	8,384.07
12 to 14 "	6,352	.1846	1,172.75	388.31
Total - 1921	153,291	.0985	15,093.21	
Total - 1920	280,291	.0766		21,462.14
	LINEAL FEET	PER 100'		
7' Lagging	594,270	1.124	6,681.85	12,078.79
Poles	234,962	1.540	3,618.59	3,393.26
Total - 1921	8 29,232	1.242	10,300.44	
Total - 1920	1,621,402	.954		15,472.05
*5/8" Cover Boards(sq ft)	103,011	1.836	1,891.96	

Product	256,635	554,609
Feet of timber per ton of ore	.5973	.5052
Feet of lagging "	2.3156	2.4635
Feet of lagging per foot of timber	3.877	4.876
Cost per ton for timber	.0588	.0387
" lagging	.0260	.0218
" poles	.0141	.0061
" cover boards	.00737	-
" timber, lagging, poles & boards	.10627	.0666
Equivalent of stull timber to bd.measure	261,494	436,929
Feet of bd.measure per ton of ore	1.019	.788

Total cost for timber, lagging,poles & boards -

1921	27285.61
1920	37934.19
1919	35620.73
1918	21403.96
1917	22137.51
1916	21510.67

* These cover boards are used in place of lagging for covering down, reducing our cost of lagging.

During 1921 this mine operated as follows: On Jan.15th the product was cut from about 48,000 tons per month to about 30,000, and about 30% of force laid off. This schedule continued until Mar.26th, when the no.of working days in a week was cut from 6 to 5 - Saturdays idle;mine operated at this rate until May 17th, when it began working 6 half shifts a week only and continued for rest of year.

NEGAUNEE MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICE.	AMOUNT 1921.	AMOUNT 1920
40% Standard Powder	15,750	.1679	2,644.68	15,342.88
50% Gelatin "	50,400	.1977	9,963.13	10,998.07
60% "	28,650	.2136	6,119.17	15,903.01
35% "				1.50
Total Powder	94,800	.1975	18,726.98	
Total Powder - 1920	216,900	.1948		42,245.46
Fuse,	255,000	.7762c	1,979.68	5,353.92
Caps,	42,800	1.401c	599.62	1,647.97
Cap Crimpers,	26	1.00ea	26.00	39.28
Tamping Bags,	19,100	2.181m	41.65	87.20
Connecting Wire,	18#	.444#	7.99	32.39
Electric Exploders,	25	7.20c	1.80	11.05
Powder Bags,	4	1.16ea	4.64	29.00
#8 Caps	300	2.04c	6.12	
Total Fuse, Etc.			2,667.50	7,200.81
Total All Explosives,			21,394.48	49,446.27

Product	256,635	554,609
Pounds Powder per ton Ore	.3694	.3911
Cost per ton for Powder	.0730	.0762
" " Fuse, Caps, Etc.	.0104	.0130
" " All Explosives	.0834	.0892
Avg.Price per Lb. for Powder	.1975	.1948

During the year 1921 this mine operated as follows:

On Jan.15th the product was cut from about 48,000 tons per month to about 30,000, and about 30% of force laid off. This scheme continued until Mar.26th, when the number of working days in a week was cut from 6 to 5 - Saturdays idle. The mine operated at this rate until May 17th, when it began working 6 half-shifts a week only, and continued at this rate for the remaining of the year.

NEGAUNEE MINE,

MAAS MINE - 1921.

The product for the year by grades was as follows:-

Bessemer,	61,471 tons,
Maas,	146,817 "
Total,	208,288 "
Rock,	3,276 "

This product of 208,288 tons was 126,933 tons less than for the year 1920. This reduction was due to curtailment in our operations. The mine worked full time but day shift only from January 1st to March 26th, on five days per week from March 26th to May 17th, and from the latter date until the end of the year on one-half shift per day six days per week.

The ore came from the same territories that we have been mining during the past several years, i.e., from the East end of the mine toward the Negaunee boundary, between the first and third levels and in the South end near the Negaunee boundary between the third and fourth levels. As in the past few years, most of the Bessemer ore came from this latter territory. The product for the year by grades was 70.5% Maas and 29.5% Bessemer, as against 76.2% Maas and 23.8% Bessemer for the year 1920. The increase in Bessemer was due to more places working under the hanging between the third and fourth levels.

UNDERGROUND.

SUBLEVELS BETWEEN FIRST AND SECOND LEVELS.

645' SUB LEVEL.

This was started in 1920. The two pillars North of #67 raise ware mined during the year, completing the mining on this sub level to a point 60' West of the raise. The ore remaining on the sub level consists in small pillars in the Western end of the ore body along the foot side and will be taken out from the 630' sub level during the coming year. The mining was principally in the Roman Catholic Cemetery tract.

630' SUB LEVEL.

Development on this sub level was started in 1920. During the present year mining has been in progress in the Cleveland-Cliffs Iron Company strip and the Roman Catholic Cemetery Tract. There still remains a large area to be mined which at the present production will require all of the coming year. This sub level is in the Eastern section of the mine along the Negaunee boundary.

618' SUB LEVEL.

This sub level was originally opened in 1919 as a traveling way from the first level to the Negaunee Mine. Active development was started early this year along the Negaunee boundary in the American Mining Company strip and in the area adjacent between the dike and the foot wall.

In the Western end #42-A raise from the second level holed to this elevation and was carried up to the 630' sub. This was in the Roman Catholic Cemetery Tract.

565' SUB LEVEL.

This sub level was opened five or six years ago in the Eastern end of the mine near the Negaunee boundary where the territory is very much cut up with dikes which run nearly East and West. During the year the drifts on this sub level were repaired. A test hole drilled toward the foot wall from the North drift found ore beyond the dike.

No. 44-A raise from the second level was holed to this elevation.

550' SUB LEVEL.

This sub level was opened originally seven or eight years ago but no mining was done at that time. In 1920 it was reopened at #70 raise from the new foot wall drift. Development and mining has been carried on throughout the year. The ore body extends from the 100' West coordinate line, which has been established as the East limit of mining, to the old stope at the 400' West coordinate line.

During the year a roll in the jasper hanging was penetrated and stoping opened in a small lense of ore South of the main ore body. This lense was discovered in the original development of the mine and was opened by square sets

from the second level.

During December five contracts were employed in stoping on this sub level, three on the foot side, two on the hanging side.

535' SUB LEVEL.

The development of this sub level has been planned and drifting started at #70 raise.

SECOND LEVEL.

The only work on this main level was the cutting of a place for timber storage opposite #67 raise.

No. 75 raise, in the new foot wall drift, has been started and on December 1st had reached the height of 30' above the rail of the level. The top of the raise being in ore. In December raising was still in progress here and repairing in #42-A and #68-A raises.

All of the work on this level was to the East of the main shaft crosscut.

SUBS BETWEEN THE SECOND AND THIRD LEVELS.

335' SUB LEVEL.

The work at this elevation is in two sections, which we have termed for convenience, the East and West ends, respectively:-

East End.

This sub level was started in 1918 between the 200' South coordinate line and the hanging near the Negaunee boundary. At the beginning of the present year a few large pillars remained between F and I crosscuts. These were mined during the year, completing the mining on this end of the sub level.

West End.

At the beginning of the year there were three pillars remaining North of #92 raise which were mined during the year; completing the mining at that point. On the West end of this section, the remaining pillars were mined during the year with the exception of one pillar left to support #82 raise. In December there was one contract engaged in mining this remaining pillar.

345' SUB LEVEL.

This sub level in the extreme Eastern end of the mine along the Negaunee

boundary was opened in 1919 East of H crosscut and South of the 200' South co-ordinate line. Mining was carried on throughout 1920 and 1921. A few pillars remain in the vicinity of #106 and #108 raises. In December two contracts were engaged in extracting these pillars.

335' SUB LEVEL.

The mining at this elevation was in two distinct areas, namely, the East and West ends.

EAST END.

This territory lies between F crosscut on the West, the Negaunee boundary line to the Southeast, the limit of mining to the North and the hanging on the South. It was opened from the third level raises but during the year #1-E and #2-E raises from the new tramming sub level (245' sub level) reached this elevation and development was also started from them.

Stoping and development is still in progress between F and I crosscuts. Along the Negaunee boundary three contracts are engaged in mining in the American Mining Company and the Cleveland-Cliffs Iron Company strips.

WEST END.

This area was opened from the winze raise and from #5-W raise from the 245' transfer sub. Development has been carried on throughout the year. The main sub level drift is to the East and West from which lateral drifts are planned to extend to the North and South. Stoping has been started under the hanging to the South and West of the winze raise. In December there were four contracts working in this section of the sub level.

THIRD LEVEL.

There was no development on the main level during the year, except in December, when a connecting drift was started from the foot wall drift to hole to the main haulage drift between G and H crosscuts. When this is completed the haulage from this end of the mine will be through the new foot wall drift and will permit the abandonment of the present haulage drift which is crushing badly.

During the year a raise was put up between #107 and #108 raises to the 345' sub level.

SUBS BETWEEN THIRD AND FOURTH LEVELS.

300' SUB LEVEL.

This sub level was opened from #705 raise in 1920 along the Negaunee boundary under the hanging. Development and mining has been carried on throughout the year. In December one contract was engaged in extracting the remaining pillar which is to the Southeast of the raise.

285' SUB LEVEL.

This sub level along the Negaunee boundary was opened in 1919 and mining carried on in 1920 in the vicinity of #425 raise. During 1921 this sub level was opened from #805 raise and development and mining are now in progress. In December four contracts were engaged in stoping and developing.

270' SUB LEVEL.

This sub level was opened in 1918 and 1919 when a development drift was driven due South from #224 raise to test the width of the ore at that point and also to find the position of the hanging. Test raises are being put up at intervals along this drift.

During the present year mining was started in mining area #3 between the South supporting pillar and the Negaunee boundary in the vicinity of #425 raise. An East limit of mining has been established to protect the 285' sub level.

245' SUB LEVEL - TRANSFER SUB LEVEL.

This transfer sub level was planned to reach the ore under the third level which could not be reached from the fourth except through extensive rock raises and rock drifting; the foot wall flattening considerably between the third and fourth levels. The development of the sub level was started in 1920 and extended in that year from the winze Eastward to the limit of ore which is at a point about 150' from the Negaunee line. No. 1 crosscut was driven that year to the Southwest from the main drift 200'. During the year 1921 the main drift was

extended in the jasper to the Negaunee boundary line and along this line to the Northeast in the American Mining Company strip for a distance of 100'. No. 1 crosscut was extended to the Southwest to the jasper a distance of 100', while #2 crosscut, which is 150' beyond #1, was driven to the Southwest a distance of 200'. The breast of this crosscut is now in jasper which will be penetrated later as ore exists behind this barrier.

Raising from this sub level during the year was as follows:-

WEST END.

Raises #3-W, #5-W and #6-W were holed to the 335' sub-a vertical distance of 90' above the sub level, while to the East #1-E and #2-E were also holed to the 335' sub level. Raising is now in progress at #5-E raise which at present is 55' above the rail of the sub level.

A main transfer raise to the fourth level which has two ore compartments and one manway was completed during the year.

240' SUB LEVEL.

SOUTH SIDE.

The only work on this sub level during the year was started in November at #425 raise where a traveling road is being driven to the North into the supporting pillar to connect with the 270' sub level.

230' SUB LEVEL.

This sub level is in the South end of the mine in the Bessemer area and was started in 1920. During 1921 mining was carried on throughout the year, and in December one contract was engaged on the only remaining pillar.

215' SUB LEVEL.

This was opened in 1920 in the South end of the mine below the 230' sub level near the Negaunee boundary, in the Bessemer area. During the year development work was continued, the ore blocked out and mining started. The mining has principally been in the Northeast end of the sub level and along the Negaunee boundary; in the latter place in the American Mining Company and the Cleveland-Cliffs Iron Company strips South and East of #608 raise. In the South-

west end of this sub level mining has also been in the American Mining Company and Cleveland-Cliffs Iron Company strips. In December three contracts were drifting to the Southwest to reach the Western boundary of the ore area. This is making considerably farther Westward than on the 230' sub level above and mining may have to be stopped here, as it is taping the territory along the East end of Main Street, which is covered with houses.

Three raises, #606, #608 and #610 were holed to this sub level during the year from the fourth level.

Ten contracts worked here in December developing and stoping.

200' SUB LEVEL.

This sub level was originally opened prior to 1918 when a development drift was driven from the winze due South to the Negaunee line. During the years 1919 and 1920 some mining was carried on under the jasper hanging to the South of #406 and #408 raises. During the year 1921 mining has continued in the mineable area between the supporting pillars. The ore in this area is exhausted with the exception of two pillars left to support #406 raise. This mining was in the Bessemer area.

185' SUB LEVEL.

This sub level was opened prior to 1918 and mining was carried on in the Western end along the Race Course Tract during 1918. In 1920 there was further development in the mining area between the supporting pillars, which was continued in 1921.

In December two contracts were engaged in stoping the remaining pillars East of #406 raise.

170' SUB LEVEL.

In August 1921 a drift was started and holed from #406 to #404 raises from which point a due South drift was projected. It has advanced about 140' and will shortly effect a holing to the 185' sub level, as a traveling way into the South part of the mine.

FOURTH LEVEL.

During the year 1921 a connection from the main shaft crosscut was holed

to the winze drift along the foot wall. This work was started in 1920.

Timber storage drifts were cut at #406, #602 and #604 raises to facilitate the handling of timber to the sub levels. The main haulage drift along the Negaunee boundary in the American Mining Company strip was continued Northeast and after driving 230' holed to the 500 crosscut. The drift in the American Mining Company strip to the Northeast of this point was also continued 45'.

UNDERGROUND IN GENERAL.

Comparatively little development work was done on the main levels during 1921, much less than in previous years. There was practically nothing done on the first, second and third levels, and the fourth level extensions I have just mentioned above. The principal development was on the new transfer sub (245' sub level) which is tapping the area below the third level in the Northeast end of the mine. Here several raises are already being used in transferring ore from the third level and points above to this new tramming drift. Electric haulage went into commission here in August.

WATER.

The water pumped for the year averaged 983 gallons per minute as compared with 967 gallons per minute for the year 1920.

FOURTH LEVEL PILLARS.

As has been mentioned in the last three yearly reports, pillars are being left above the fourth level to support the surface. The tonnage in these pillars December 31st, 1921 was estimated at 1,501,425 tons, all of which is temporarily unavailable for mining. These pillars are left to support the surface in what is known as the Race Course property which adjoins the Maas Mine to the West and which is under lease to the Oliver Iron Mining Company. No ore can be removed from these pillars which bottom on the fourth level, nor can any ore be removed below the fourth level until the houses on the Race Course Tract have been removed. The total ore in the mine East of the Baldwin-Kiln road, available for mining above the fourth level as shown December 31st, 1921 was 4,018,500 tons. If the estimated yearly product is to be maintained, something

should be done toward removing the houses on the Race Course property, if not, in a period of a few years the yearly product will have to be diminished, as practically all of the available ore between the third and fourth levels will have been mined and the only mineable territory remaining will be above the third level, which will be too small to accomodate contracts for a yearly product of 500,000 tons per year.

FATAL ACCIDENTS.

We were unfortunate in having two fatal accidents at the mine during the year.

Edward Spencer - Accident Report #289.

On March 14th at 9 o'clock A.M. Edward Spencer, cage rider, was instantly killed by falling from the cage, at a point 40' below the third level to the bottom of the shaft, a distance of about 240'.

Spencer had placed an empty timber truck on the bottom deck of the cage at the fourth level plat and failed to place the dogs in position to prevent the truck from shifting. He stepped on the cage with the truck and gave the signal to hoist to the third level. As the cage was ascending, the truck shifted its position and at a point 40' below the third level, the drawhead struck one of the shaft wall plates and Spencer was thrown off of the cage into the shaft.

Spencer was at fault in not properly securing the truck on the timber deck and he violated the Company rules by riding on this deck with the truck. The cage was equipped with a man-deck that is provided with doors, which would have prevented his falling into the shaft even if the cage was severely jarred.

The investigating committee found the accident was due to his carelessness.

Alfred Francine - Accident Report #299.

On the morning of September 8th at 7:45 o'clock Alfred Francine, a timberman, was instantly killed by falling into the pocket at the third level.

Francine was one of the second cage load of men that had been lowered into the mine. When they reached the third level plat the electric light in

front of the cage compartment was burning, also the light in the pump station nearby. Francine filled his carbide lamp with water, lit it and crossed in front of the shaft in the direction of the ore dump pocket twelve feet distant. The lights over this pocket were not burning. There is a space between the track and the side of the pocket about fifteen inches in width. Francine evidently did not watch where he was walking and stepped into this opening, falling a distance of thirteen feet, fracturing his skull.

SURFACE.

HEATING PLANT.

In the fall of 1920 a 26' addition was added to the East end of the change house, to house a heating plant for the dry when the main boiler house went out of commission due to shutting down the steam turbine; the engine house equipment having all been electrified. A fifty horsepower locomotive boiler was received in January and the boiler plant placed in commission on March 21st. The building was completed in April. The boiler is placed below the surface of the ground so that the returns from the dry will reach it by gravity. On the ground floor of this addition has been provided an oil room with storage tanks and also a room for the hose cart for fire protection. The boiler is used only for heating the dry house.

OFFICE.

During the year an asbestos roof was placed on the office building, replacing the shingle roof which was leaking badly.

In the Northwest corner of the building an excavation was made last fall for a furnace room. A steam plant for heating the office has since been installed in this room.

SHOP BUILDING.

Heretofore the shops had been heating by steam from the mine boiler plant. With the shutting down of this plant it was necessary to provide other means, consequently a chimney was built and a large stove purchased for this building.

ENGINE AND BOILER HOUSE.

A new roof of gypsum blocks was placed on the engine and boiler house early in the summer, making this building absolutely fire-proof. A furnace was set up in the basement of the engine house in August to supply heat for this building when the turbine is not operating. With the completion of the roof, the walls and floor of the engine house were painted and it now presents a very neat appearance.

MINE BOILER PLANT.

The steam turbine was shut down March 19th, the fires were pulled March 21st in the main boiler plant and it has not operated since that date. On account of the curtailed production it is unlikely that the turbine will operate this winter. This boiler plant from now on will be used exclusively for operating the steam turbine.

HEATING PLANT FOR SHAFT AND TOP TRAM.

In October a heating plant in the shape of a diamond drill boiler was set up to the East of the headframe in a house built of expanded metal lathe and plaster. This will furnish steam for thawing out the dump and cars, and also for heaters in the shaft during the extremely cold winter months.

ACCIDENT TO EQUIPMENT.

On the 11th of January the top rail on the South side of the North skip road broke 4' from the bottom as the North skip was going into the dump. The cradle of the skip caught this rail which was pushed through the clamps and rammed against the South head sheave, breaking a piece from this sheave. The South skip rope slipped from the sheave and was cut off, evidently by the sharp edge, permitting the rope to go to the bottom of the shaft. Repairs were made within twenty-four hours with a loss in product of from 1200 to 1300 tons.

On March 21st a two hour delay occurred on account of a rail pulling out of the skip road.

In order to avaid similar accidents the skip, cage and dump supports in the headframe were rebuilt in December. When the old members were dismantled

a number were found to be broken.

SULLIVAN COMPRESSOR.

A temporary structure was built over the dismantled Sullivan compressor in the storage yard.

GROUNDS.

The additions to the engine house and change house required the shifting of some of the shrubs and trees and also rebuilding the road from the entrance of the grounds to the change house. This work was done early in the spring.

MAAS CRUSHER.

The product for the crusher during the year by grades was as follows:-

South Jackson,	4,677 tons,
Lake,	6,553 "
Morris-Lloyd	2,659 "
Athens,	8,732 "
TOTAL -	22,621 tons.

There were 150,464 tons crushed in 1920. The reduction in tonnage was due to the small quantity of ore shipped during the present season.

ESTIMATE OF ORE RESERVES IN MAAS MINE DECEMBER 31, 1921.

Assumption 12 cu. ft. equals one ton.

10% deduction for rock.

10% deduction for loss in mining.

AVAILABLE ORE

Ore reserve above the 2nd level - - - - - - - -	353,497 tons,
Ore reserve between 2nd and 3rd levels - - - - -	1,492,638 "
Ore reserve between 3rd and 4th levels - - - - -	2,172,438 "
Total available - - - - - - - - - -	4,018,573 tons.

NON-AVAILABLE ORE

Between 3rd and 4th levels - - - - - - - - - -	1,501,425 tons.

Percentage of Bessemer equals 10%

BESSEMER ORE	TRADE NAME	TONS
Developed	Maas-Bessemer	401,857
NON BESSEMER ORE		
Developed	Maas	3,616,716
Total Bessemer and Non-Bessemer		4,018,573

ESTIMATED ANALYSIS.

	IRON	PHOS.	SILICA	ALUM.	MANG.	LIME	MAG.	SUL.	IGNI.	MOIST.
Dried 212°										
Maas-Bessemer	61.00	.044	7.50	1.79	.206	.510	.218	.007	1.50	
Natural	53.39	.039	6.56	1.57	.181	.446	.191	.006	1.31	12.50
Dried 212°										
Maas	59.90	.116	7.60	2.34	.280	.820	.256	.009	2.80	
Natural	52.25	.101	6.63	2.04	.244	.715	.224	.008	2.44	12.75

PRODUCTION.

Month	Bessemer	Maas	Total	Rock
January	7,568	19,428	26,996	276
February	6,172	18,484	24,656	348
March	5,296	19,956	25,252	552
April	6,604	14,088	20,692	540
May	6,610	14,258	20,868	716
June	4,324	8,517	12,841	
July	3,957	8,418	12,375	136
August	3,883	9,936	13,819	64
September	3,707	9,206	12,913	112
October	4,486	9,356	13,842	216
November	4,244	7,302	11,546	352
December	4,620	7,868	12,488	16
Total	61,471	146,817	208,288	3,328
Transferred from	106 to	106		
Total	61,365	146,923	208,288	3,328

	1921	1920
Bessemer Ore Shipped	5,669 tons	105,855 tons,
Maas " "	62,558 "	273,277 "
Total ore shipped	68,227 tons.	379,132 tons.
Bessemer Ore on Hand Dec. 31st	65,201 tons,	9,505 tons,
Maas " " " "	187,263 "	102,898 "
Total ore on hand	252,464 tons.	112,403 tons.

ANALYSIS OF PRODUCTION AND COSTS.

Production of	1920	335,221 tons,
"	1921	208,288 "
Decrease	1921	126,933 tons.

Cost of production	1920	$785,213.23	- Cost per ton	$2.343
" " "	1921	427,324.12		2.051
Decrease	1921	$357,889.11	Decrease	$ .292

DETAIL OF COST OF PRODUCTION.

	TOTAL COST				COST PER TON		
	LABOR	%	SUPPLIES	%	LABOR	SUPPLIES	TOTAL
1920 -	$530,809.88	67.6	$254,403.35	32.4	$1.584	$.759	$2.343
1921 -	256,955.53	60.1	170,368.59	39.9	1.233	.818	2.051
	$273,854.35 Decr.		$ 84,034.76 Decr.		$ .351 Decr.	$.059 Incr.	$ .292 Decr.

The mine worked two eight-hour shifts for twelve days in 1921. On January 17th it went on a one 8-hour working basis, there being no curtailment of the force, as the mine was developed to such an extent that all men employed on the two shifts were put on a one 8-hour basis, eliminating the mining of ore on the night shift.

From March 27th, 1921 to June 1st, the mine worked five days per week; on June 1st it went on a six four-hour shift per week schedule and continued so throughout the year.

The average number of men employed during the year was 247 for a total of 49,235 days. In 1920 an average of 287 men were employed for a total of 85,988 days. A decrease in labor in 1921 of 40 men and 36,753 days.

The average tons per man per day underground in 1921 was 5.32 or an increase of .51 tons per man per day over 1920, when the average tons per man was 4.81.

There were three reductions in wages in 1921; 15% effective February 1st, 12½% effective August 1st, and 10% effective October 1st, which made a de-

crease of $1.05 per day against the 1920 costs or 17.2% .

The actual reduction in wages during the year amounts to $51,696.75; which based on the production mined equals $.248 per ton.

In 1921 the total supply cost was $170,368.59 or $.819 per ton, equals to 39.9% of cost of production, which is much higher than the normal proportion.

There was a large decrease in New Construction work in 1921 as compared with 1920.

	Labor	Supplies
1921 -	$3,492.31	$3,352.81
Total 1921 E.&A's	$6,845.12	
" 1920 "	48,072.72	
Decrease -	$41,227.60	

The decrease of $.248 per ton for labor account of reductions in wages, and the increase of .51 tons per man per day, explains largely the $.292 decrease in cost per ton of production.

UNDERGROUND COSTS.

Development in Rock,

1921 Amount	$5,157.48 - Cost per ton	$.025
1920	28,639.18	.085
Decrease	$23,481.70	.060

There was 720' of rock work in 1921 @ $7.16 per foot; and 2726' in 1920 @ $10.51 per foot, a decrease of 2006 feet.

A large amount of the footage in 1920 was for main level drifts on the fourth level; while the small fotage in 1921 was for necessary raises to keep up the production. Decrease in 1921 due to less rock work.

Development in Ore, Stoping

1921 Amount	$8,822.21 - Cost per ton	$.042
1921	129,093.57	.620
Total -	$ 137,915.78 - Cost per ton	$.662
1920	285,727.87	.852
Decrease	147,812.09 Decrease	$.190

Detail.

	Labor		Supplies	
1920	$247,468.31	86.6%	$38,259.56	13.4%
1921	112,889.84	81.8%	25,025.94	18.2%
Decr.	$134,578.47		$13,233.62	

	Cost per ton		
	Labor	Supplies	Total
1920	$.738	$.114	$.852
1921	.542	.119	.661
	$.196	$.005	$.191
	Decr.	Incr.	Decr.

This decrease in cost per ton due to reductions in wages and increase tons per man per day production.

Explosives.

	1921	1920
Total lbs. of powder	89,450	142,050
Avg. price per pound	.1847	.1797
Total Amount	16,524.46	25,524.47
Fuse, Caps, etc.	3,069.74	5,028.48
Grand Total	19,594.20	30,552.95
Lbs. powder per ton of ore	.429	.424
Cost per ton for powder	.0793	.0761
" " " All explosives	.0940	.0911

Timbering,

1921 Amount	$77,990.99	- Cost per ton	$374
1920	109,643.99		.327
Decrease	$31,653.00	Increase	$.047

	1921	1920
Timber Cost	15,509.94	15,220.24
Lagging, Poles, etc.	10,100.10	9,882.88
Total,	25,610.04	25,103.12
Ft. timber per ton of ore	.851	.652
Cost per ton all timber	.1230	.0749

The average price per foot increased 25% over 1920 price. The feet of timber per ton of ore in 1921 increased 30% over 1920. This increase due to a larger amount of timber necessary to keep the mine open.

Tramming,

1921 Amount $24,672.94 - Cost per ton $.117

1920 54,332.60 .162

Decrease $29,659.66 Decrease $.043

Since January 1921, when the new accounts were adopted, the account Tramming has included the cost of cleaning underground tracks, in addition to its previous sub divisions. During 1921 $1,952.16 was expended on cleaning the tracks.

Mine Ventilation,

1920 Amount $35.23 - Cost per ton $.000

1921 - - -

Pumping,

1921 Amount $38,379.98 - Cost per ton $.184

1920 39,281.86 .117

Decrease $901.88 Increase $.067

Gallons water pumped per minute 1921 - 1018

" " " " " 1920 - 967

Increase - 51

Decrease in cost due to reduction in wages. Increase in cost per ton due to smaller production.

Compressors & Air Pipes,

1921 Amount $18,188.53 - Cost per ton $.087

Air Pipes	1920	6,235.62	.019
Compressors	1920	21,207.60	.063
Total -		27,443.22	.082

Decrease $9,254.69 Increase .005

	1921	1920
Air made by Maas steam Comp.		89638659
" " " electric "	373275000	311850000
" " " Negaunee M. "		174780000
Total Cu.ft. used -	373275000	576268659

Back Filling,

1921 Amount $124.54 - Cost per ton $.001

1920 806.45 .002

Decrease $681.91 Decrease $.001

Underground Superintendents,

1921 Amount	$10,558.23	- Cost per ton	$.051
1920	19,583.28		.059
Decrease	9,025.05	Decrease	$.008

During 1920 four bosses were on days and two on nights. In January 1921 one boss was taken off the night shift and in June 1921 another boss was taken off.

MAINTENANCE ACCOUNTS:

Compressors & Powder Drills,

1921 Amount	$845.91	- Cost per ton	$.004
1920	5,535.76		.016
Decrease	$4,689.85	Decrease	$.012

Sub Division.	1921	1920	Decrease
Steam Compressor		98.23	98.23
Electric "	651.69	4666.81	4015.12
Powder Drills	170.00	770.72	600.72

In 1920 the old steam compressor was dismantled and the Rand Compressor was transferred from the temporary building to the main engine house. Also one P.R.E.-2 Rand electric Compressor was transferred from the Lake Mine and installed in the main engine house.

The charges were all transferred from E.&A. #370 to Maintenance.

The 1921 charge include general repairs to the two Rand compressors.

Four No. NA90 Waugh Auger Drills were added to equipment in 1920.

One DP37 Sullivan Auger Drill added in 1921, $170.00.

Hand Tramming Equipment,

1921 Amount	$2,483.52	- Cost per ton	$.012
1920	2,636.61		.008
Decrease	$ 153.09	Increase	$.004

In 1921 nineteen sets of 10" roller bearing trucks were used for sub level cars. This became necessary when the mine was being transferred from two 8-hour shifts to one 8-hour shift; more sub level cars being necessary for the additional gangs going in new contracts.

Electric Tram Equipment,

1921 Amount	$15,836.51	- Cost per ton	$.076
1920	24,485.28		.073
Decrease	$8,648.77	Increase	$.003

	Eng.& Dyn.	Sub Division. Locomotives	Wiring
1921	181.75	4,108.27	1,299.10
1920	436.88	5,413.24	1,752.45
Decr.	255.13	1,304.97	453.35

	M. L. Tracks	M. L. Cars
1921	5,381.65	4,865.74
1920	12,064.81	4,817.90
Decr.	6,683.16	Incr. 48.84

The charge to Engine & Dynamo is for replacing on engine house floor.

The charge to locomotives in 1921 was large due to practically rebuilding an old Westinghouse locomotive received from the Lake Mine, and installed on the 240' transfer sub.

The 1920 Main Line Tracks charge included labor cleaning tracks, which since the new accounts were effective has been charged to tramming. Also there was but a very small amount of new main level work in 1921.

The Main Line Car charge is large due to the

necessity of keeping all our cars in working condition. The ore being all pulled to the shaft in four hours requires all the cars to be in working shape. During 1920 the tramming was not rushed as in 1921, having sixteen hours to pull the product.

Pumping Machinery,

1921 Amount	$6,075.26	- Cost per ton	$.029
1920	11,587.87		.035
Decrease	$5,512.61	Decrease	$.006

Sub Division.

	1921	1920	Incr.	Decr.
Electric Pumps	6064.88	4956.04	1108.84	
Pump House & Sump	10.38	6631.83		6621.45

In 1920 the third and fourth level sumps were cut costing $6,631.83.

The charge in 1921 is large due to one new gear at $1,615.00 was put on the third level Prescott pump. $600.00 was also expended at this time for making an oil pan for the gear.

Total Underground Costs,

1921 Amount	$338,229.67	- Cost per ton	$1.624
1920	609,739.20		1.818
Decrease	$271,509.53	Decrease	$ .194

SURFACE COST:

Hoisting,

1921 Amount	$14,423.97	- Cost per ton	$.069
1920	42,567.04		.127
Decrease	$28,143.07	Decrease	$.058

During 1920 the hoist was working two 8-hour shifts. Since June 1st, 1921 it is on a one 4-hour basis.

Stocking Ore,

1921 Amount		$7,827.02	- Cost per ton	$.038
Top Landing & Tramming	- 1920	8,347.08		.025
Stocking Ore	- 1920	5,969.85		.018
Sorting Ore	- 1920	651.38		.002
	Total	14,968.31		.045
	Decrease	$7,141.29		.007

The 1921 charge is large due to the small amount of ore shipped from the pocket. With the exception of about three weeks in October our total product of 1921 was put on the stockpile; this also necessitated a large amount of labor maintaining the ore trestles.

Dry House,

1921 Amount	$6,096.59	- Cost per ton	$.029
1920	8,178.67		.025
Decrease	$2,082.08	Increase	$.004

In 1920 the dry house was heated from the main boiler plant; in 1921 it was fitted with its own heating system.

General Surface Expense,

1921 Amount	$5,230.15	- Cost per ton	$.025
1920	3,694.13		.011
Increase	$1,536.02		$.014

Since the new accounts were adopted the policemen at the mine are charged to this account; heretofore they were under Mine Office. $2,998.00 being policemen's cost in 1921.

MAINTENANCE ACCOUNTS:

Hoisting Equipment,

1921 Amount		$7,103.84	- Cost per ton	$.034
Hoisting Machinery	- 1920	41,789.32		.125
Skip & Skip Roads	- 1920	3,943.56		.012
	Total -	45,732.88		.137
	Decrease	38,629.04	Decrease	$.102

Sub Division.

	1921	1920	Decr.
Electric Hoists	3350.39	38240.77	34890.38
Wire Rope	921.67	2345.27	1423.60
Skip & Skip Roads	2831.78	3943.56	1111.78
Steam Hoist		1203.28	1203.28

The old steam cage hoist and skip hoist were replaced during 1920 by new electric hoists.

The charge to skip & skip roads for 1921 is large due to 60 feet of the skip road in shaft house renewed in December 1921.

Shaft,

1921 Amount $550.28 - Cost per ton $.003

1920 1,916.08 .006

Decrease $1,365.80 Decrease $.003

The charge in both years is for repairs made to loading pockets.

Top Tram Equipment,

1921 Amount $2,863.38 - Cost per ton $.014

1920 5,250.65 .016

Decrease $2,387.27 Decrease $.002

The 1920 charge included cost of electric rock tram.

Sub Division of 1921.

Engine & Motors	$21.26
Tracks and Cars	2,395.03
Wire Rope	181.13
Sheaves, Rollers, etc.	265.96

During 1921 one new side dump car was made, and extensive repairs made on two other top tram cars.

Docks, Trestles & Pockets,

1921 Amount $609.07 - Cost per ton $.003

1920 2,922.01 .009

Decrease $1,312.94 Decrease $.006

A skip dump chute in shaft house was renewed in December 1921.

In 1920 decking plank was renewed on the Bessemer trestle and a new rock trestle was erected.

Mine Buildings,

1921 Amount	$8,831.67	- Cost per ton	$.042
1920	6,762.19		.020
Increase	$2,069.48	Increase	$.022

Both years charges have been large due to the new construction work.

The 1921 charge included closing off of E.&A. #394 Heating Plant $6,700.00; also new Brook Brand roof put on mine office.

Shop Machinery,	1920 Amount	$ 244.81	- Cost per ton	$.001
Boilers,	1920 Amount	2,182.04	Do.	.006
Fire Expense and Dammage	1920 Amount	41.61	"	.000
	Total -	$2,468.46	"	.007

(The new accounts have absorbed these three accounts in different captions)

Total Surface Costs -	1921 Amount	$53,535.97	- Cost per ton	$.257
	1920	134,460.42		.401
	Decrease	$80,924.45	Decrease	$.144

GENERAL MINE ACCOUNTS:

Insurance,

1921 Amount	$205.88	- Cost per ton	$.001
1920	217.48		.001
Decrease	$11.60		$.000

Engineering,

1921 Amount	$3,206.57	- Cost per ton	$.015
1920	3,542.83		.011
Decrease	$336.26	Increase	$.004

Analysis,

1921 Amount	$9,256.91	- Cost per ton	$.044
1920	12,563.12		.037
Decrease	$3,306.21	Increase,	$.007

This includes the operating laboratory charge. In 1921 the total number of determinations was 43,620 at $.12608 per determination, or a total of $5,499.77.

In 1920, 39530 determinations were worked at $.1431 per determination, or a total of $5,658.26.

The large decrease in production accounts for the increasedcost per ton. The decreased cost per determination due to decreased cost in supplies.

Personal Injury Expense,

1921 Amount	$9,819.00	- Cost per ton	$.047
1920	4,417.33		.013
Increase	$5,401.67	Increase	$.034

There was one fatal accident in 1920, John Kusisto fatally injured June 1920; and two fatals in 1921. Edward Spencer fatally injured March 14, 1921; Alfred Franzen fatally injured September 8, 1921. In addition to the two fatals in 1921, there were two accidents occuring in 1920 carried throughout 1921 for weekly payments, John Heiskonen, arm injury in December 1920, still idle; and John Russo, back injury in December 1920, still idle.

Safety Department Expense,

1921 Amount	$186.05	- Cost per ton	$.00k
1920	85.11		.000
Increase	$100.94		

Telephones and Safety Devices,					
	1921 Amount	$708.01	- Cost per ton	$.003	
	1920	1,166.98		.003	
	Decrease	$458.97		$.000	
Local General Welfare,					
	1921 Amount	$1,229.03	- Cost per ton	$.006	
Special Expense -	1921	91.84		.001	
Mine Office -	1921	10,845.14		.052	
	Total -	$12,166.01		$.059	
Mine Office -	1920	19,030.76		.057	
	Decrease	$7,854.75	Increase	$.002	
Total General Mine Accounts:	1921 Amount	$35,548.43	- Cost per ton	$.170	
	1920	41,013.61		.124	
	Decrease	$ 5,465.18	Increase	$.046	

DELAYS - ELECTRICAL.

January 19th	1/2 hour delay account of no current.
June 18th	1 hour delay account of no current.

DELAYS - NON-ELECTRICAL.

January 11th	Rope broke on South skip at 4:45 P.M. No hoisting on night shift.
January 12th	8 hours delaysday shift account of accident January 11th.
March 14th	Mine idle four hours day shift account of funeral of Edward Spencer.
March 21st	Two hours delay day shift account of rail pulled out in skip road.
September 23rd	No hoisting from fourth level due to water in skip pit.
December 24th	1 1/2 hours delay account of ice in shaft.
December 27th	1 1/2 Do.

MAAS MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1921.

GRADE	IRON	PHOS.	SILICA
Maas Bessemer,	61.37	.049	7.77
Maas,	59.51	.121	8.09

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1921.

	Mine		Lake Erie	
GRADE	IRON	PHOS.	IRON	MOIST.
Maas Bessemer,	(All Mixed)			
Maas,	59.37	.101	59.40	11.60

ORE STATEMENT - DECEMBER 31ST, 1921.

	MAAS BESSEMER	MAAS	TOTAL	TOTAL LAST YEAR
On hand January 1, 1921,	9,505	102,898	112,403	156,314
Output for year,	61,471	146,817	208,288	335,221
Transferred,	106	106		
Total,	70,870	249,821	320,691	491,535
Shipments,	5,669	62,558	68,227	379,132
Balance on Hand,	65,201	187,263	252,464	112,403
Decrease in Output,			126,933	
Increase in Ore on Hand,			140,061	

1921 -- 1-8 Hour Shift, 6 days per week, Jan. 1st to March 25th, 1921.
1-8 Hour Shift, 5 days per week, March 25th to June 1st, 1921.
1-4 Hour Shift, 6 days per week, June 1st to Dec. 31st, 1921.

1920 -- 2-8 Hour Shifts for Year.

MAAS MINE

SHIPMENTS FOR YEAR 1921.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Maas Bessemer,	4,013	1,656	5,669	105,855
Maas,	23,451	39,107	62,558	273,277
Total,	27,464	40,763	68,227	379,132
Total Last Year,	177,025	202,107	379,132	
Decrease,			310,905	

MAAS MINE

COMPARATIVE MINING COST FOR YEAR

	1 9 2 1	1 9 2 0	INCREASE	DECREASE
PRODUCT	208,288	335,221		126,933
Underground Costs	1.624	1.822		.198
Surface Costs	.257	.409		.152
General Mine Accounts	.170	.112	.058	
Cost of Production	2.051	2.343		.292
Original Cost	.073	.066	.007	
Plant Account	.256	.251	.004	
Equipment	.002	.006		.004
Taxes	.363	.249	.114	
Central Office	.089	.074	.015	
Contingent Expense	.010		.010	
Cost Adjustment	.085	.025	.060	
Cost on stockpile	2.929	3.014		.085
Loading & Shipping	.009	.067		.058
Total Cost on Cars	2.938	3.081		.143
No.Days Operating	292	303		11
No.Shifts & Hours	1-8;104	2-8hr		
Average Daily Product	713	1.106		.393
COST OF PRODUCTION				
Labor	1.233	1.584		.251
Supplies	.818	.759	.059	
Total	2.051	2.343		.292

MAAS MINE.

MAAS MINE

COMPARATIVE WAGES AND PRODUCT

	1 9 2 1	1 9 2 0	INCREASE	DECREASE
PRODUCT	208,288	335,221		128,742
No.Shifts and Hours	1-8;1-4	2-8hr		
AVERAGE NO.MEN WORKING				
Surface	41	50		9
Underground	188	228		40
Total	229	278		49
AVERAGE WAGES PER DAY				
Surface	4.53	5.50		.97
Underground	5.21	6.27		1.06
Total	5.07	6.12		1.05
WAGES PER MONTH OF 25 DAYS				
Surface	113.25	137.50		24.25
Underground	130.25	156.75		26.50
Total	126.75	153.00		27.25
PRODUCT PER MAN PER DAY				
Surface	20.70	20.50	.20	
Underground	5.32	4.81	.51	
Total	4.23	3.90	.33	
LABOR COST PER TON				
Surface	.219	.268		.049
Underground	.979	1.303		.324
Total	1.198	1.571		.373
AVG. PRODUCT BRK'G & TRM'G	8.61	7.31	1.30	
" WAGES CONTRACT MINERS	5.40	6.50		1.10
" " " LABOR	5.40	6.50		1.10
TOTAL NUMBER OF DAYS				
Surface	10,060½	16,351		6,290½
Underground	39,175¾	69,637		30,461¼
Total	49,235¾	85,988		36,752¼
AMOUNT FOR LABOR				
Surface	45561.69	89939.41		44377.72
Underground	204022.62	436666.00		232643.38
Total	249584.31	526605.41		277021.10

Proportion Surface to Underground Men:

1921 - 1 to 4.58
1920 - 1 to 4.56
1919 - 1 to 4.23
1918 - 1 to 4.08
1917 - 1 to 4.50

1-8hr 6 days a week to Mar.26;
1-8hr 5 " " Mar.28 to May 31;
1-4hr 6 " " June 1 to Dec.31.

MAAS MINE.

TIMBER STATEMENT FOR THE YEAR ENDING DECEMBER 31, 1921.

KIND.	LINEAL FEET	AVG. PRICE PER FOOT	AMOUNT 1 9 2 1	AMOUNT 1 9 2 0
6" to 8" Timber	88,842	.0499	4,429.45	4,531.07
8" to 10" "	53,648	.1128	6,051.69	6,168.58
10 to 12 "	27,136	.1364	3,702.45	2,740.89
12 to 14 "	7,628	.1739	1,326.35	1,779.70
Total - 1921	177,254	.0875	15,509.94	
Total - 1920	218,404	.0697		15,220.24
	LINEAL FEET	PER 100'		
7' Lagging	690,754	1.15	7,963.99	9,559.62
Poles	22,980	1.11	256.07	323.26
Total - 1921	713,734	1.15	8,220.06	
Total - 1920	1,049,997	.941		9,882.88
Covering Boards(sq ft)	99,200	1.895	1,880.04	

Product	208,288	335,221
Feet of timber per ton of ore	.851	.652
Feet of lagging "	3.32	3.04
Feet of Lagging per foot of timber	3.89	4.66
Cost per ton for timber	.0745	.0454
" " lagging	.0382	.0285
" " covering boards	.0091	
" " poles	.0012	.001
" " all timber	.1230	.0749
Equivalent of stull timber to bd.measure	279,967	349,739
Feet of bd.measure per ton of ore	1.34	1.04

Total cost for timber, lagging & poles	1921	25610.04
	1920	25103.12
	1919	27284.08
	1918	17426.96
	1917	14762.71

The average price per ft. for timber increased 25% over 1920 prices.
The feet of timber per ton of ore in 1921 increased 30% over 1920. This increase due to larger amount of timber being necessary to keep the mine open. During 1920 the mine was operated two 8-hr shifts, and since June 1st it has been operated one 8hr.shift.

MAAS MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE

KIND.	QUANTITY.	AVERAGE PRICE.	AMOUNT 1921	AMOUNT 1920
40% Powder	55,450	.1664	9,225.01	20,097.02
60% "	34,000	.2147	7,299.45	5,354.25
80% "				73.20
Total Powder	89,450	.1847	16,524.46	
Total Powder - 1920	142,050	.1797		25,524.47
Fuse	284,100		2,208.09	3,757.36
Caps	58,400		818.19	1,232.89
Cap Crimpers	44		43.46	38.23
Total Fuse, Etc.			3,069.74	5,028.48
Total All Explosives			19,594.20	30,552.95
Product			208,288	335,221
Pounds of Powder per ton of Ore			.429	.424
Cost per ton for Powder			.0793	.0761
" " Fuse, Caps, Etc.			.0147	.015
" " All Explosives			.0940	.0911
AVG.price per lb. for Powder			.1847	.1797

Mine worked 5 days per week from Mar.27th to June 1st. On June 1st the mine went on 6 four-hour shifts per week.

MAAS MINE.

ATHENS MINE - 1921.

The production for the year was as follows:-

Athens Ore,	176,077 tons,
Rock,	972 "

The ore from the various leases was as follows:-

Athens,	165,373 tons,
Mitchell Lease,	10,232 "
Corbit Lease,	472 "

The product for the year was 23,013 tons less than for 1920 due to curtailment. The mine operated full time from January 1st to March 26th, then changed to a five day per week schedule for one month or until April 26th. On this date a further curtailment was made limiting our product to 800 tons per day. This meant letting out forty men, the mine operating day shift only. On May 17th a further curtailment was made to one-half shift per day for six days per week, this making the daily product about 375 tons.

The product came from the mining areas on the South foot above the fourth level; in the territory between the vertical dike and the hanging, between the fourth and sixth levels; and in the territory immediately above and below the eighth level near the Bunker Hill line in the extreme Western end of the deposit. All these areas were opened previous to 1921. A small quantity of ore came from the development in Corbit Lease on Lot #13 above the fourth level.

The Mitchell ore came from the development of the sixth level and the territory above the South foot on the fourth level and was shipped and stocked separately as the lease provides.

The principal development during the year was the extension of #3 crosscut on the sixth level to the Southwest until it holed to the drift started in 1920. This drift is to the Southeast of and parallel to the vertical dike which cuts the formation. The ore to the North of this dike, which extends to

the fourth level, is being worked down as rapidly as possible. On the 515' sub a test drift showed ore formation on the Southeast side of the dike. Raises from this new sixth level drift will tap this territory which we expect to find very wet as the dike acts as a dam. It is necessary, however, to develop here before the mining on the Northwest side of the dike reaches this elevation.

In the West end of the mine above and below the eighth level the mining is going on as planned. The ore remaining above the eighth level is practically all being handled through the ninth level raises.

A pillar of ore is being left against the Bunker Hill line as the lease provides.

UNDERGROUND.

SUBS ABOVE THE FOURTH LEVEL.

Work here was in two areas; one in the extreme Eastern end of the Lease on Corbit Lot #13 where the top of the ore was explored to test for high sulphur, the other was on the South side on Lots #9 and #10 where regular mining operations were conducted throughout the year. Here practically all of the Mitchell Lease ore mined during the year was obtained.

170' SUB LEVEL.

NORTH SIDE.

Work here was exploratory. The North drift started in 1920 was continued approximately 50' until the North foot wall was encountered - the drift passing through a 10' dike 20' South of the foot wall. Three test raises were put up from this drift to determine the position of the hanging and the possible presence of any high sulphur ore.

No. 1 raise which was 10' South of the breast, i.e., between the dike and the breast put up due East at an angle of 70° encountered jasper at 40' where it was stopped. No high sulphur ore was found.

Raise #2, 55' South of the breast put up on a course North 60° East at 80° from the horizontal, had ore to a height of 85', 2' were raised in jasper. The South side of this raise was against the dike. No high sulphur ore was

found here.

Raise #3, 100' South of the brease due East at 75° from the horizontal encountered jasper at 70'. No high sulphur.

The work on the sub level was completed in June and nothing further has been done since this time.

SUBS ABOVE THE SOUTH FOOT.

These subs are on Lots #10 and #11 and are limited in area to the East by the mining limit, to the North and West by the jasper hanging and to the South by the slate foot.

275' SUB LEVEL.

This was nearly all mined in 1920. The small pillars near #433 raise were removed in January and February, completing the sub level.

290' SUB LEVEL.

This was opened in 1920 at raises #431, #433 and #434. During the present year developments and mining continued until June when the sub level was completed.

300' SUB LEVEL.

Work at this elevation was started in May and continued throughout the year. There still remains a small pillar between #432 and #433 raises. During December one contract was engaged in removing this pillar. On this sub level a strip 20' in width by 210' in length was mined on Mitchell Lot #11.

315' SUB LEVEL.

The development of this sub level was started at #434 raise in October. A drift has been driven East 70' to the mining limit then South 30' to South foot. This South drift being on Mitchell Lease Lot #11.

A drift was also driven North from #434 raise to #433 from which in December two drifts were started, one to the East, the other to the North toward #432 raise.

FOURTH LEVEL.

The only work on this level during the year was retimbering. The worst

section was the East drift from the shaft crosscut toward #410 raise which is near the Lucky Star line. The timber in this section showed that the sets were rotting badly and a number had to be replaced. The rotting in this section was not due to dry rot. In other sections lining sets were installed.

SUBS BELOW THE FOURTH LEVEL.

This area was developed from the 515' sub level through small exploratory raises between the hanging and the vertical dike which runs through the ore body to the Northeast and Southwest. The lense on the Northwest side of this dike is very narrow and extends to a height considerably higher than on the Southeast side. A fault evidently occurring along this dike. In 1920 operations started in this territory at the fourth level elevation and subbing has been continued to the present time. During the development period the ore was transferred through the exploratory raises to the 515' sub level and then trammed to the eighth level raises #852 and #853. During the present year raises from the sixth level have reached this territory saving the transfer on the 515' sub level.

445' SUB LEVEL.

This sub level was opened in 1920 at #646 raise. An area 280' long by 45' in width (the distance between the dike and the hanging) was mined through raises #644, #646, #647 and #648. A limit of mining has been established at the Northeast end to protect the traveling road from the 515' sub level to the fourth level. The Southwest end is cut off by the hanging jasper. This sub level was finished in July.

455' SUB LEVEL.

This was opened early in the year at raises #644, #646, #647, #648 and #655 from the sixth level. By the end of the year all of the ore had been removed except pillars around #644 raise where work was in progress during December.

470' SUB LEVEL.

This sub level was started in October at #647 raise and development is

still in progress to the Southwest and Northeast. The width of the ore body at this point averages from 50' at the Southwest end to 80' at the Northeast end, showing that the lense is widening as we approach the 515' sub level.

515' SUB LEVEL.

The only mining here during 1921 was driving a drift from the main traveling road to #655 raise. The sub level was retimbered in several places as it is used as a traveling road between the sixth and fourth levels.

SUBS ABOVE THE SIXTH LEVEL.

The operations here were in the Southwest end of the ore body Northwest of the vertical dike. The section is bounded on the Northwest by the jasper hanging, on the Southwest by the slate foot wall, on the Southeast by the vertical dike and to the Northeast by a limit of mining which was established to protect the mining above the 515' sub level. The territory is small and is located around raises #852 and #853 which extend from the eighth level. During the year, however, practically all of this ore was handled through raises which reached the territory from #4 crosscut West, sixth level.

525' SUB LEVEL.

Mining was in progress here a year ago at #853 and #651 raises. The area mined being a block 120' in length by 50' in width. This sub level was finished in January.

540' SUB LEVEL.

This sub level was originally opened in 1919 at raises #852 and #853 as an exploration above the eighth level. During 1920 raise #651 reached this territory and during the present year raises #650 and #652. Mining continued here until June when the sub level was completed. The area was 130' by 100' or about twice the size of the sub level above.

550' SUB LEVEL.

This was opened during the year at #650, #651 and #652 raises. Work has continued to the present time. The only ore left is the pillar at #651 raise which one contract was working in December. The area was slightly larger than on the 540' sub level.

565' SUB LEVEL.

This was opened in November at #652 raise. Developments are still in progress from this raise to the Northwest, Southwest and Southeast.

SIXTH LEVEL.

The development of this level continued throughout the year.

No. 3 crosscut West started in 1920 continued its course to the Southwest and holed in December to the Southwesterly end which was driven in 1920. Raise #635 has been started from this crosscut to the Northwest toward the vertical dike to test the height of the ore and to drain this area.

No. 5 crosscut West advanced 65' to the Southwest during the year at which point jasper was encountered.

The following two compartment cribbed raises were put up to the Southeast from this crosscut:-

Raise #654 to the elevation of the 515' sub level or about 75' vertically.

Raise #655 to the 455' sub level or 135' vertically.

Raises #656 and #657 to the 515' sub level.

A small traveling road was cut through from #852 raise to #4 crosscut West so that wood pillars could be built in the drift to the Northeast and Southwest of the raise to keep it from crushing.

SUBS ABOVE THE EIGHTH LEVEL.

The ore above the eighth level mined during 1921 was all on the North side of the main shaft crosscut. There are two distinct bodies, one lying to the North alongside the large dike, the other to the South along the foot wall. Between the two there is a jasper barrier. As the eighth level is approached both bodies increase in size, the barrier gradually diminishing in size. It is expected that it entirely disappears about 30' below the eighth level.

745' SUB LEVEL.

SOUTH LENSE.

This was opened in 1919 at raises #861 and #862 along the South foot and mining of this sub level practically completed in that year.

NORTH AREA.

This was opened in 1920 from #820 and #840 crosscuts, South of the main dike which forms the North boundary. It is separated from the foot wall area by a jasper barrier approximately 80' in width. The mining of this North area was completed in 1920 with the exception of a few pillars near #822 and #842 raises, which were removed in January and February of this year.

760' SUB LEVEL.

The ore in this section is in two areas, that to the South along the foot was mined in 1920, the North territory was mined wholly in 1921 from #840 crosscut. The jasper barrier which separated the two deposits here was only 40' in width. The mining limit to the Northeast left to support the seventh level area cuts through this sub level 30' to the Southwest of #820 crosscut.

770' SUB LEVEL.

This sub level to the Northwest of the main shaft crosscut was also mined in two areas, the South along the foot wall in 1920, the North mined during 1921 from #840 crosscut. The barrier between the two deposits here was 25' in width.

EIGHTH LEVEL.

The main level development was in 1918 when the mine was first opened. Mining at this elevation was started in 1920 along the South foot wall and has continued to the present time. All of the ore at this elevation lying West of the line half way between #840 and #860 crosscuts has been mined and handled through raises from the ninth level. In December mining was in progress on both the Southwest and Northwest sides of #840 crosscut between the mining limits, ten gangs being employed.

The jasper barrier which cuts the sub levels above the eighth North of the shaft crosscut into two areas, has nearly disappeared at this elevation.

SUBS BETWEEN THE EIGHTH AND NINTH LEVELS.

800' SUB LEVEL.

This area is in the extreme Western end of the mine near the Bunker

Hill line. The sub level was opened on the South foot between raises #916 and #918 early in the year and completed in September. This sub level was limited on the South by the slate foot wall, on the North and West by jasper, and on the East by the mining limit.

815' SUB LEVEL.

This was opened in September of this year from #916 and #919 raises. Development work was still in progress in December at #919 raise, to the South toward the slate foot, and at #916 raise to the Southeast to the foot and North to the hanging.

NINTH LEVEL.

The North crosscut parallel to the East-West dike which was started in 1920 was continued to the West 320' and stopped six feet from the Bunker Hill line. From this crosscut the following raises were put up to the South:- #924, #925, and #926 to the eighth level. Raise #927 was abandoned at 65' above the ninth level in caving ground. No. 928 raise reached jasper at 80' from the floor of the level.

From the South crosscut the following raises were put up during the year:- #913 and #914 to the South which reached the eighth level; #918 and #919 to the North which reached jasper at 70'; #920 to the South was abandoned at 40' above the level in caving ground.

Several sections of this level were retimbered, one near the junction of the ore with the North dike, where a wooden bulkhead was constructed in the South drift to prevent its caving. At a point 300' West of the junction of the #910 and #920 crosscuts a section of 150' had to be replaced. This retimbering was partly due to crushing but principally to the rotting of the timber caused by fungus growth.

TENTH LEVEL.

The main shaft crosscut on this level was originally timbered from a point about 900' Southwest of the shaft to the Bunker Hill line. During the year it has been necessary to retimber practically the whole drift from this same

point. On December 31st 650' had been retimbered, leaving a balance of about 200' to the Bunker Hill line. Dry-rot and fungus growth were responsible for the rapid rotting of this timber. Most of the sets put in during the year were peeled and creosoted. It is supposed that the fungus growth was increased due to poor circulation, as this level has not been used for mining during the past two years. With improved ventilation, it is hoped this trouble has been remedied.

UNDERGROUND IN GENERAL.

The mine is in good shape and is developed so that 1,000 tons per day can be secured easily if it is desired. The ventilation problem which was extremely serious has been solved. The high timber cost was due to replacing many main level sets which had rotted from fungus growth. Other costs such as pumping, taxes, general office expense, and the like, over which we have no control, made a large cost per ton due to our limited product. The mining expense is considerably less than it was a year ago on account of a reduction in the cost of labor, wages having been reduced three times during the year.

The development above the sixth level on the Southeast side of the dike will be pushed during the coming year as rapidly as possible so as to have this territory in shape for mining when the time comes for a larger production. The mine shows a larger tonnage than was estimated at the time of the drilling.

CORBIT LEASE.

As I have mentioned earlier in the report, the only work on the Corbit Lease Lot #13 was of a development nature in the form of drifts and raises to find the position of the hanging wall and to discover high sulphur if any existed at that point. The development showed no high sulphur and this work was stopped early in the year.

MITCHELL LEASE.

No. 3 crosscut on the sixth level cut through Lots #8 and #9 of the Mitchell Lease. The only other ore from this lease during the year came from Lot #11 above the fourth level, South foot. As the work in this latter territory approaches the fourth level, the sub level will gradually work to the West

of the Mitchell line. Very little ore will come from this lease during the coming year.

VENTILATION.

Following the suspension of work on the night shift, the air became noticeably poor, as there was no longer sufficient movement of skips in the shaft, and motors on the levels to induce enough motion of the air to remove the gases thrown off by the crushing timbers and by the breathing of the men. The heat of the summer air on surface also served to break up any natural circulation in the shaft. After the curtailment on May 17th to half time, the air became rapidly worse. Tests made on June 10th and 13th gave the following averages:- Temperature 50° F., humidity 100%, CO_2 2.5% and oxygen 17.5%. Due to the low oxygen content, a candle would not burn in any part of the mine, although the acetylene lamps still burned well.

On July 1st, a #11 Sturtevant Multivane Blower with a 40 horsepower motor was obtained from the Lake Mine and was at once installed on the tenth level, just South of the storage pockets. Doors to control the flow of air were put in on all levels so that the air was drawn in on the tenth level from the skip compartment, forced through all the workings in the mine and exhausted on the fourth level into the cage compartment. This arrangement did not prove satisfactory, so the doors on the fourth and tenth levels were changed so as to make the cage side downcast. The planking between the cage and skip sides was completed and a decided improvement of the air throughout the mine was immediately apparent. The lower surface temperatures after the end of the summer aided the delivery of air to the suction end of the fan. Tests made in October gave the following results:- Temperature 58° F., humidity 95%, CO_2, less than 0.5%; oxygen 20% plus, practically normal.

The #11 blower has a rated capacity of 41,500 cubic feet per minute against a water guage of three inches. As the motor now driving the fan does not attain sufficient speed, the normal delivery of the fan at the Athens is 39,500 cubic feet per minute. The air exhausted into the shaft at the fourth

level amounts to approximately 30,000 cubic feet per minute, the rest being lost through leakage at the doors. As this volume is more than sufficient for our needs, we have made no attempt to stop these leaks.

Doors were installed at the following points:- On the tenth level, three; ninth level, four; eighth level, four; seventh level, one; sixth level, four; fourth level, two. Doors in the main haulageways are equipped with air cylinders and counterweights for opening and closing and with green lights which show when the door is open.

DECAY OF TIMBER.

Early in the year it was discovered that the timber on our main levels throughout the mine was rotting very fast. About this same time the mine started on a curtailed production. Ever since the mine was opened there has been considerable fungus growth on all of the main level sets. This seemed to increase very rapidly during the past summer requiring the immediate attention on the part of the Captain, who had to employ extra crews to retimber the drifts before they actually broke down. This happened not only on the ninth and tenth levels which were being used very little, but also on the main levels which were being used daily, such as the eighth and sixth. The tenth level drift broke down at the point where it crosses the dike just before reaching the ore formation. It was necessary to retimber this drift from this point to the Southwest toward the Bunker Hill line as practically every set was destroyed. The question of treating timber was discussed and a trip taken to the tie treating plant at Escanaba. Experts from the Bureau of Mines have gone underground and made recommendations. We are now peeling all legs which go into the main level drifts. The idea being to get them properly seasoned before going underground. This was recommended by the Bureau of Mines. We have also studied the problem of creosote and chloride of zinc treatment under pressure as well as open tank methods. The latter is the cheaper of the two but not as effective. We are in hopes that the improved ventilation will retard the fungus growth.

TENTH LEVEL PUMPSTATION.

During the year we still had some trouble with the castings on the

Prescott pumps in our tenth level station. The breaking of the crossheads has been remedied by using a larger casting, but we are still having cracked cylinders due to the tremendous pressure.

The water pumped per minute diminished somewhat during the year so that it is never necessary to run both pumps at one time.

SHAFT PUMP.

The vertical Aldrich pump installed in the shaft at 1085' below the collar or at the bottom of the circular shaft was removed during the year and taken to surface as it was not being used. This pump has a capacity of 100 gallons per minute against a 1,000-foot head.

WATER COLUMN.

There has been a leak in the water column about 300' below the collar of the shaft, the leak occuring between the pipe and the flange. Attempts have been made to weld this electrically but without avail. A section will probably have to be taken out and new sections installed before it can be repaired satisfactorily.

WATER.

The average number of gallons of water pumped per minute was 139 gallons as compared with 157 gallons for the year 1920.

SURFACE.

But little ore was shipped from the stockpile during the year. This necessitated the grading of additional stocking ground to the East of the headframe and also to the Sotheast beyond the present double trestle. In the area to the East of our double trestle, a single trestle was erected to accomodate this winters' production.

CRUSHER.

With the shutting down of the Cleveland Lake Mine there was a demand for Athens ore for charcoal furnaces. In order to satisfy this trade, it was necessary that the ore be crushed. During the latter part of the fall this was done at the crusher North of the Maas Mine, but in order to make winter shipments,

it was necessary to erect a crusher at the Athens. Consequently the plant which had been in operation at the Lake Mine for a number of years was dismantled and erected at the Athens in November. This plant was built to the North of the Athens headframe, is equipped with a #6 McCully crusher. The crusher is operated by a 25 horsepower motor. The installation which was completed on December 7th has been running satisfactorily since that time.

SHEAVES.

During the year a wood lined sheave was placed over the North skip compartment. This has operated successfully, but has not been in use long enough to prove its merit over our regular sheave of cast iron. Last year wood lined idler sheaves were installed between the headframe and the engine house. These, however, were too heavy and did not work out well, requiring constant relining. We are now installing a light cast iron sheave with a rubber lining as an experiment.

ESTIMATE OF ORE RESERVE IN ATHENS MINE DECEMBER 31,1921.

Assumption 12 cu.ft. equals one ton.

10% deduction for rock.

10% deduction for loss in mining.

Percentage of Bessemer equals 0.

DEVELOPED ORE.

Fourth level and above - - - - - - - - - - - -	1,222,106 tons
Fourth level to 6th level, North side of dike -	664,900 "
Sixth level to 660' sub level, North side of dike - - - - - - - - - - - - - - - - - - -	551,644 "
660' sub level to 8th level - - - - - - - -	1,181,731 "
Eighth level to 9th level - - - - - - - - -	674,915 "
Ninth level to 10th level - - - - - - - - -	443,155 "
Below tenth level - - - - - - - - - - - - -	61,130 "
Total developed ore - - - - - - -	4,799,581 tons.

PROSPECTIVE ORE.

Fourth level to 6th level, South side of dike -	2,170,868 tons
Sixth level to 660' level, South side of dike -	497,492 "
Total prospective ore - - - - - -	2,668,360 tons

ESTIMATED ANALYSIS.

	IRON.	PHOS.	SILICA.	ALUM.	MANG.	LIME.	MAG.	SUL.	IGNI.	MOIST.
Dried 212°	59.80	.125	8.45	2.64	.530	.430	.480	.010	1.15	
Natural	52.03	.109	7.35	2.30	.461	.374	.418	.009	1.00	13.00

PRODUCTION.

Month	Athens	Mitchell	Corbit	Total	Rock
January	23,342	2,852	168	26,362	
February	20,984	1,828	68	22,880	136
March	22,757	1,284	176	24,217	64
April	18,751	844	60	19,655	100
May	12,402	572		12,974	28
June	8,756	404		9,160	96
July	9,036	316		9,352	264
August	9,441	584		10,025	276
September	9,274	552		9,826	
October	9,402	504		9,906	24
November	9,910	388		10,298	
December	11,318	104		11,422	
TOTAL -	165,373	10,232	472	176,077	988

ANALYSIS OF PRODUCTION AND COSTS.

Production of	1920	199,090 tons,	
"	1921	176,077 "	
Decrease	1921	23,013 tons.	
Cost of production	1920	$480,474.45 - Cost per ton	$3.413
" " "	1921	307,898.13	1.749
Decrease	1921	$172,576.32 Decrease	$ .664

DETAIL OF COST OF PRODUCTION.

	TOTAL COST				COST PER TON		
	LABOR	%	SUPPLIES	%	LABOR	SUPPLIES	TOTAL
1920 -	$330,300.98	68.7	$150,173.47	31.3	$1.659	$.754	$2.413
1921 -	187,475.56	60.2	119,838.76	39.8	1.065	.684	1.749
	$157,174.58 Decr.		$ 69,665.29 Decr.		$ .594 Decr.	$.070 Decr.	$ .664 Decr.

The decrease in cost per ton was principally due to reduction in wages.

From January 1st to March 26th the mine worked two eight-hour shifts six days a week. On March 26th the mine started working two eight-hour shifts five days per week. On April 26th the schedule changed to one eight-hour shift five days per week and on May 17th to one four-hour shift six days per week.

The average number of men employed during the year was 168, for a total of 34,899 days or 208 days per man, as compared with 1920 of 169 men employed for a total of 51,085 days or 302 days per man; a decrease in labor in 1921 of one man and 16,186 days.

The average tons per man underground in 1921 was 6.41 or an increase of .38 tons per man over 1920, when the average tons per man was 6.03. The total tons per man per day in 1921 was 5.04, while in 1920 the total tons per man was 4.95; an increase of .09 tons per man per day. The increase was due to less development work.

There was a decrease of 15% in wages effective February 1st; a decrease of 12½% effective August 1st; and a decrease of 10% effective October 1st, 1921.

On January 1st, 1921 a revised card of accounts was adopted, therefore, in making comparisons between costs for 1921 and 1920, it has been necessary to rearrange certain accounts. In a few instances the accounts have been so changed as to make it difficult to assemble them for comparison. In such cases notations have been made of items of expense which were excluded or included in the revised accounts.

UNDERGROUND COSTS:

Development in Rock, (In 1920 this account was Rock Drifting)

1921 Amount	$ 312.38	- Cost per ton $.002
1920	35,543.15	.179
Decrease	35,230.77	.177

	Sub Division			
	Drifting	Per ft.	Raising	Per ft.
1921	42'	4.65	none	
1920	2,697'	8.44	255'	6.95
Decr.	2,655	3.79	255'	

Decrease in 1921 due to less rock work and decrease in wages.

Development in Ore & Stoping, (These accounts same as Breaking Ore in 1920)

1921 Amount	$108,224.94	- Cost per ton $.615
1920	183,835.16	.923
Decrease	75,610.22	.308

Detail.

	Labor		Supplies	
1920	$158,958.27	86.5%	$24,876.89	13.5%
1921	89,124.40	82.3%	19,100.54	17.7%
Decrease	$69,833.87		$ 5,776.35	

	Cost per ton		
	Labor	Supplies	Total
1920	$.798	$.125	$.923
1921	.506	.109	.615
Decrease	$.292	$.016	$.308

The decrease is almost wholly due to reduction in wages.

Explosives.

	1921	1920
Total lbs. Powder	70,400	81,250
Avg. price per lb.	.1733	.1788

Total Amount	12,201.18	14,526.38
Fuse, Caps, etc.	2,697.87	3,525.47
Grand total	14,899.05	18,051.95
Lbs. powder per ton of ore	.3998	.4117
Cost per ton for powder	.0693	.0736
Cost per ton All Explosives	.0846	.0915
Decrease 1921,		.0049 per ton.

Timbering,

1921 Amount $56,019.56 - Cost per ton $.318

1920 34,837.49 .175

Increase $21,182.07 Increase $.143

Detail cost of timber.

	1921	1920
Cost of stull timber	14,257.61	14,141.33
" " Lagging & Poles	8,911.58	8,480.82
Total Cost	23,169.19	22,622.15
Ft. timber per ton of ore	.998	1.258
Cost per ton for timber, Lagging and Poles	.1316	.1146

The increase in timbering cost for 1921 is due to retimbering main level drifts where large and expensive timber was used. The above comparison shows more feet of timber per ton of ore in 1920 than in 1921. This was due to a large amount of 6" to 8" timber used in raises in 1920.

Tramming,

1921 Amount $21,721.30 - Cost per ton $.123

1920 34,837.49 .175

Decrease $13,116.29 Decrease $.052

Sub Division.

	1921	1920
Tramming	16,588.34	24,554.81
Skip Tenders & Bellmen	3,542.08	7,387.14
Cleaning Skip Pit	1,590.78	2,958.54

In the revised card of accounts tramming is charged with cleaning main line tracks which was previously charged to maintenance of tracks in Electric Tram Equipment. The amount of $882.46 was charged to tramming account of cleaning tracks in 1921. The decrease in cost per ton in 1921 over 1920 was due to day tramming only, the number of men engaged in this work being reduced.

Ventilation,

1921	Amount $5,272.10	- Cost per ton	$.030
1920	618.85		.003
Increase	$4,653.25	Increase	$.027

A new ventilating system was installed in 1921 which required the purchase of a new ventilating fan and motor; the installation of a number of doors on levels and casing the cage compartment closer than it was before. The fan and motor was purchased from the Lake Mine.

Pumping,

1921	Amount $14,169.91	- Cost per ton	$.080
1920	16,003.45		.081
Decrease	$ 1,833.54	Decrease	$.001

1921 - Gals. of water pumped 73,114,028, gallons per minute 139.

1920 - Gals. water pumped 82,794,824, gallons per minute 157.

Decrease in 1921 of 9,680,796 gallons or 18 gallons per minute.

Compressors & Air Pipes,

1921	Amount $20,059.53	- Cost per ton	$.114
1920	30,200.97		.151
Decrease	$10,141.44	Decrease	$.037

	Sub Division 1921	1920
Compressor	17,306.32	23,194.12
Air Pipes	2,753.21	7,006.85

Cu. ft. air compressed in 1921 was 359,055,000 @ .0481 per M cu. ft.

Cu. ft. air compressed in 1920 was 505,035,000 @ .046 per M cu. ft; a decrease for 1921 of 145,-980,000 cu. ft. and an increase of .0021 per M-cu. ft.

The decrease in Air Pipes in 1921 is due to decrease in development work where larger size air pipes are installed and are permanent.

Underground Superintendence, (This account was formerly Captain and Bosses)

1921 Amount	$ 6,856.28	- Cost per ton	$.039
1920	12,715.15		.064
Decrease	$5,858.87	Decrease	$.025

There were two day and two night shift bosses to April 26th. When the mine started operating one eight-hour shift they were reduced to two.

Compressors & Power Drills,

1921 Amount	$198.20	- Cost per ton	$.001
1920	1,746.77		.009
Decrease	$1,548.57	Decrease	$.008

	Sub Division. Repairing Compressor
1921	$198.20
1920	216.77
1921 Decrease	$ 18.57

Decrease 1921 due to less repair parts for compressor.

	Power Drills.
1921	none
1920	$1,530.00
Decrease	$1,530.00

In 1921 no power drilled were purchased. In 1920 nine BBR130 Ingersoll-Rand air drilled were bought.

Hand Tramming Equipment, (This account was formerly Underground Tracks & Cars)

1921 Amount	$1,495.51	- Cost per ton	$.009
1920	2,936.06		.015
Decrease	$1,440.55	Decrease.	$.006

Decrease in 1921 due to not having to build any new sub level cars.

Electric Tram Equipment,

1921 Amount	$12,619.17	- Cost per ton	$.072
1920	19,397.65		.097
Decrease	$ 6,778.48	Decrease	$.025

Sub Division.

Generator & Dynamo	1921	$99.70
	1920	167.74
	Decrease	$68.04

Decrease in 1921 due to less repairs to generator.

Locomotives.	1921	$1,451.94
	1920	1,785.91
	Decrease	$ 333.97

Decrease in 1921 due to overhauling two of locomotives in 1920.

Wiring	1921	$1,478.40
	1920	4,006.80
	Decrease	$2,528.40

Decrease in 1921 due to their being less development on main levels where electric haulage is used.

Main Line Tracks	1921	$3,579.71
	1920	10,002.68
	Decrease	$6,522.97

In 1920 two new levels were opened and electric haulage tracks installed. This account was also charged with labor cleaning tracks and ditches in 1920, while in 1921 it was charged to Tramming according to the revised card of accounts.

Main Line Cars.	1921	$6,009.42
	1920	3,434.52
	Increase	$2,574.90

Increase in 1921 due to purchasing six new motor cars at a cost of $585.00 each.

Pumping Machinery,

1921	Amount $1,768.01	- Cost per ton	$.010
1920	2,244.32		.011
Decrease	$476.31	Decrease	$.001

Decrease due to decrease in number of pot valves and seats used in 1921 over 1920.

SURFACE COSTS:

Hoisting,

1921	Amount $17,775.11	- Cost per ton	$.101
1920	26,185.00		.132
Decrease	$ 8,409.89	Decrease	.031

In 1921 the tons of ore and rock hoisted were 177,065 at an average depth of 2,194 ft. In 1920 214,601 tons, average depth 2,133 ft. In 1920 hoists operated day and night requiring brakemen on both shifts. In 1921 after April, no hoisting was done on the night shift.

Stocking Ore, (According to revised card of accounts the old account Top Landing is also included in this account).

1921 Amount	$3,059.65	- Cost per ton	$.017
1920	8,336.48		.042
Decrease	$5,276.83	Decrease	$.025

In 1921 very little ore was shipped from stockpile, which made it unnecessary to take down stocking trestle or erect stocking trestle. The stocking trestle was extended but as this was new trestle, the charge was made to docks, trestles and pockets. Decrease also due to decrease in product.

Dry House,

1921 Amount	$3,361.43	- Cost per ton	$.019
1920	3,372.78		.017
Decrease	$ 11.35	Increase	$.002

Heating charge to dry house in 1921 was $2,541.08; in 1920 $1,950.05. In 1920 the same percentages of distribution for heating plant were used for both summer and winter, but in 1921 the percentages of distribution were changed for the summer months and therefore the dry house received a greater percentage of charges during the summer months when fewer places are heated.

General Surface Expense, (This account is the same as the old account Tracks and Yards with the exception that it included the wages of watchmen).

1921 Amount	$4,437.53	- Cost per ton	$.025
1920	2,995.04		.015
Increase	$1,442.49	Increase	$.010

Increase due to wages of watchman or policemen being charged to this account instead of to salaries in mine office account as in 1920.

Hoisting Equipment, (This account includes the old accounts Hoisting Machinery and Skips & Skip Roads).

1921 Amount	$7,899.83	- Cost per ton	$.045
1920	9,335.85		.047
Decrease	$1,436.02	Decrease	$.002

Sub Division.

	Machinery parts.
1921	$4,063.80
1920	3,441.14
Increase	$622.66

During 1921 two Lily hoist controls were purchased for cage and skip hoists and the control for cage hoist installed. A new 8-foot wood lined head sheave at a cost of $350.00 was installed in the place of a cast iron sheave which had worn out. Two extra sheave stands were also built and erected next to power house to reduce vibration of hoisting ropes and keep them from coming off of sheaves.

	Wire Rope
1921	$2,552.68
1920	3,505.08
Decrease	$952.40

In 1921 one 1¼" hoisting rope at a cost of $1,115.32 and one 1 3/8" hoisting rope at a cost of $1,437.36 were used, while in 1920 one 1 1/8" hoisting rope at a cost of $765.46 and two 1 3/8" hoisting ropes at a cost of $2,736.62 were used.

	Skips & Skip Roads
1921	$1,283.35
1920	2,389.63
Decrease	$1,106.28

Decrease due to decrease in repairs to skips and skip roads.

Shaft,

1921 Amount	$3,066.74	- Cost per ton	$.017
1920	2,422.92		.012
Increase	$643.82	Increase	$.005

Increase in 1921 due to putting steel plates in tenth level pocket. The timbers in front of pocket were also rotted out and had to be replaced.

Top Tram Equipment,

1921 Amount	$878.91	- Cost per ton	$.005
1920	1,373.06		.007
Decrease	$494.15	Decrease	$.002

Decrease due to general decrease in repairs to entire tram system.

Docks, Trestles & Pockets,

1921 Amount	$3,130.42	- Cost per ton	$.018
1920	1,293.08		.006
Increase	$1,837.34	Increase	$.012

An account of not shipping our stockpile in 1921, additional trestle had to be erected and considerable grading and filling done to prepare stocking grounds.

Mine Buildings,

1921 Amount	$131.81	- Cost per ton	$.001
1920	769.30		.004
Decrease	$637.49	Decrease	$.003

Decrease in 1921 due to building storage shed in storage yard, rewiring dry house and $167.74 repairs to coal dock in 1920.

GENERAL MINE ACCOUNTS:

Insurance,

1921 Amount	$22.44	- Cost per ton	$.000
1920	22.44		.000

Engineering,

1921 Amount $2,304.21 - Cost per ton $.013
1920 3,709.00 .019
Decrease $1,404.79 Decrease $.006

Analysis,

1921 Amount $3,165.72 - Cost per ton $.018
1920 3,989.49 .020
Decrease $ 823.77 Decrease $.002

The Athens samples are worked at the Negaunee Mine laboratory.

1921 18,030 determinations @ $.12483 per determ.
1920 18,236 " " .14295 " "
Decr. 206 " $.01812 " "

Personal Injury Expense,

1921 Amount $2,182.42 - Cost per ton $.012
1920 2,020.18 .010
Increase $ 162.24 Increase $.002

No fatal accidents in either 1921 or 1920. Increase due to petty accidents.

Safety Department Expense,

1921 Amount $267.39 - Cost per ton $.002
1920 280.83 .001
Decrease $13.44 Increase $.001

This account was included in Mine Office on the old card of accounts.

Telephones & Safety Devices,

1921 Amount $893.00 - Cost per ton $.005
1920 901.50 .004
Decrease $8.50 Increase $.001

Special Expense,

1921 Amount $311.00 - Cost per ton $.002

This is a central office expense and was included in Mine Office on old card of accounts.

Mine Office,

1921 Amount	$6,293.73	- Cost per ton	$.036
1920	9,624.75		.048
Decrease	$3,331.02	Decrease	$.012

	Sub Division	
	Direct Charges	Central Office
1921	1,019.97	5,273.76
1920	3,731.31	5,893.44
Decrease	2,711.34	619.68

From mine office on old card of accounts the wages of watchmen have been transferred to General Surface Expense on revised card of accounts. Safety Dept. Expense and Special Expenses have also been taken out of Mine Office and set up as separate accounts on revised card of accounts.

DELAYS - ELECTRICAL.

January 20th Three hours delay account of no current.

June 18th One hour delay account of no current.

DELAYS - NON-ELECTRICAL.

July 12th One hour delay account of ninth level main drift broke down.

ATHENS MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1921.

GRADE	IRON	PHOS.	SILICA
Athens,	60.32	.131	7.47
Athens - Mitchell Lease,	60.51	.166	6.27
Athens - Corbett Lease,	59.71	.131	8.30

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1921.

GRADE	Mine IRON	PHOS.
Athens,	(All Mixed)	
Athens - Mitchell Lease,	(All Mixed)	
Athens - Corbett Lease,	(No Shipments)	

ORE STATEMENT - DECEMBER 31ST, 1921.

	ATHENS	MITCHELL LEASE	CORBETT LEASE	TOTAL	TOTAL LAST YEAR
On hand January 1, 1921,	83,543	5,100	3,406	92,049	81,296
Output for Year,	165,373	10,232	472	176,077	199,090
Total,	248,916	15,332	3,878	268,126	280,386
Shipments,	44,213	600	1,584	46,397	188,337
Balance on Hand,	204,703	14,732	2,294	221,729	92,049
Decrease in Output,				23,013	
Increase in Ore on Hand,				129,680	

1921 -- 2-8 Hour Shifts, 6 days per week, Jan. 1st to March 25th, 1921.
2-8 Hour Shifts, 5 days per week, March 25th to April 25th, 1921.
1-8 Hour Shift, 6 days per week, April 25th to May 17th, 1921.
1-4 Hour Shift, 6 days per week, May 17th to Dec. 31st, 1921.

1920 -- 2-8 Hour Shifts for Year.

ATHENS MINE

SHIPMENTS FOR YEAR 1921.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Athens,	32,421	11,792	44,213	160,416
Athens - Mitchell Lease,	600	0	600	23,630
Athens - Corbett Lease,	0	1,584	1,584	3,973
Athens - Bunker Hill,	0	0	0	318
Total,	33,021	13,376	46,397	188,337
Total Last Year,	103,537	84,800	188,337	
Decrease,			141,940	

ATHENS MINE.

COMPARATIVE MINING COST FOR YEAR.

	1921	1920	INCREASE	DECREASE
PRODUCT	176,077	199,090		23,013
Underground Costs	1.413	2.027		.614
Surface Costs	.248	.294		.046
General Mine Accounts	.088	.092		.004
Cost of Production	1.749	2.413		.664
Uncompleted Construction	.210	.210		
Taxes	.393	.194	.199	
Central Office	.070	.048	.022	
Contingent Expense	.004		.004	
Cost Adjustment	.059	.012	.047	
Cost on Stockpile	2.485	2.877		.392
Loading & Shipping	.009	.073		.064
Misc.Debits & Credits	.002	.037		.039
Total Cost on Cars	2.492	2.987		.495
No.Days Operating	294	302		8
No.Shifts & Hours	2-8;1-8; 1-4	2-8hr		
Average Daily Product	599	659		60
COST OF PRODUCTION				
Labor	1.065	1.659		.594
Supplies	.684	.754		.060
Total	1.749	2.413		.664

ATHENS MINE

COMPARATIVE WAGES AND PRODUCT

	1921	1920	INCREASE	DECREASE
PRODUCT	176,077	199,000		23,013
No.Shifts and Hours	2-8;1-8 1-4	2-8hr		
AVERAGE NO.MEN WORKING				
Surface	32	35		3
Underground	124	134		10
Total	156	169		13
AVERAGE WAGES PER DAY				
Surface	4.61	5.59		.98
Underground	5.42	6.65		1.23
Total	5.25	6.43		1.18
WAGES PER MONTH OF 25 DAYS				
Surface	115.25	139.75		24.50
Underground	135.50	166.25		30.75
Total	131.25	160.75		29.50
PRODUCT PER MAN PER DAY				
Surface	23.69	18.77	4.92	
Underground	6.41	4.92	1.49	
Total	5.05	3.90	1.15	
LABOR COST PER TON				
Surface	.195	.298		.103
Underground	.845	1.353		.508
Total	1.040	1.651		.611
AVG. PRODUCT BRK'G & TRM'G	9.99	7.15	2.84	
" WAGES CONTRACT MINERS	5.85	7.25		1.40
" " " TRAMMERS				
" " " LABOR	5.85	7.25		1.40
TOTAL NUMBER OF DAYS				
Surface	7,430	10,608		3,178
Underground	27,469	40,477		13,008
Total	34,899	51,085		16,186
AMOUNT FOR LABOR				
Surface	34282.88	59259.69		24976.81
Underground	148848.50	269337.09		120488.59
Total	183131.38	328596.78		145465.40

Mine started on operating basis Jan. 1, 1919.

Proportion Surface to Underground Men:

1921 - 1 to 3.88
1920 - 1 to 3.83
1919 - 1 to 3.

2-8hr 6 days a week Jan.1st to Mar.26;
1-8hr 5 " " Mar.27 to May 17;
1-4hr 6 " " May 17 to Dec.31.

ATHENS MINE

TIMBER STATEMENT FOR THE YEAR ENDING DECEMBER 31, 1921.

KIND	LINEAL FEET	AVG. PRICE PER FOOT	AMOUNT 1921	AMOUNT 1920
6" to 8" Timber	76,048	.0549	4,176.73	4,726.85
8" to 10" "	58,297	.1113	6,486.40	6,820.56
10 to 12" "	18,354	.1279	2,347.43	2,086.32
12 to 14 "	7,498	.1663	1,247.05	507.60
Total - 1921	160,197	.089	14,257.61	
Total - 1920	248,343	.0569		14,141.33
	LINEAL FEET	PER 100'		
7' Lagging	531,386	1.1676	6,204.61	7,698.66
Poles	106,140	1.535	1,629.52	782.16
Total - 1921	647,526	1.209	7,834.13	
Total - 1920	822,593	1.031		8,480.82
5/8" Covering Boards(sq Ft)	55,397	1.945	1,077.45	

Product for year	176,077	197,357
Feet timber per ton of ore	.998	1.258
" lagging "	3.018	3.828
" " " foot of timber	3.317	3.042
Cost per ton for timber	.081	.0717
" lagging	.0352	.039
" covering boards	.0061	
" poles	.0093	.004
" timber, lagging, poles & boards	.1316	.1146
Equivalent of stull timber to bd.measure	250,897	352,041
Feet of board measure per ton of ore	1.425	1.784

Total cost for timber, lagging & poles -	1921	23169.19
	1920	22622.15
	1919	19426.86

Covering boards used where lagging would have otherwise been used.
March 26th started operating 5 days a week.
April 26th " " one 8-hour shift.
May 17th " " 4-hour shift per day 6 days per week.

Increase in large sizes of timber due to retimbering main level drifts.

ATHENS MINE

STATEMENT OF EXPLOSIVES USED FOR STOPING & DEVELOPING IN ORE (BREAKING ORE)

KIND	QUANTITY	AVERAGE PRICES	AMOUNT 1921	AMOUNT 1920
40% Powder - - - - - - - -	61,850	.1676	10,366.39	12,222.57
60% " - - - - - - - -	8,400	.2137	1,795.04	2,303.81
80% " - - - - - - - -	150	.2650	39.75	-
Total Powder - -	70,400	.1733	12,201.18	14,526.38
Fuse - - - - - - - - - - -	242,800	8.393	2,037.88	2,706.68
Caps - - - - - - - - - - -	45,400	13.968	634.16	795.03
Cap Crimpers - - - - - - -	48	.538	25.83	20.00
Tamping Bags - - - - - - -	-	-	-	3.76
Total Fuse, Etc. -			2,697.87	3,525.47
Total All Explosives -			14,899.05	18,051.85
Product - - - - - - - -			176,077	197,357
Pounds Powder per ton of Ore			.3998	.4117
Cost per ton for Powder			.0693	.0736
" " " " Fuse, Etc.			.0153	.0179
" " " " All Explosives			.0846	.0915
Avg. Price per Lb. for Powder			.1733	.1788

For operating conditions see "Comparative Wages & Product".

SOUTH JACKSON MINE - 1921.

No mining was done in the South Jackson Pit until September when an order was received early in the month for 400 tons for the Cadillac Furnace. This was made by an all rail shipment. On the 27th of September a further order of from 3,000 to 4,000 tons was received to go forward by lake. This was completed on the 14th of October. The total tonnage for the year was as follows:-

September,	1,655 tons,
October,	3,022 "
Total -	4,677 tons.

This ore was taken from the South side of the pit along the Lucy line by means of steam shovel. The dinky locomotive was used to handle the cars from the pit to the storage track in front of the crusher.

TUNNEL REPAIRS.

After the completion of the work in the pit a few sets which were broken down near the portal of the tunnel were replaced by Captain Nicholls and one helper. The open ditch was also repaired to the Southeast of the mouth of the tunnel through the field.

FUTURE DEVELOPMENT.

I wish to repeat what I stated in my report a year ago. If the operations in this pit warrant it, I would recommend that a shovel of the "merry-go-round" type be used which could advance in a breast cut. This would permit the extension of the present pit through the Lucy shaft to the East. As the pit is extended in this direction, the ore could be loaded directly into railroad cars without rehandling. The greatest cost in our present operation, outside of breaking ground, is the shovel crew. If an electrically driven shovel with caterpillar traction could be secured, several men could be saved daily in the operation of this pit.

ESTIMATE OF ORE RESERVES OF DECEMBER 31, 1921.

Above present pit available by present system of mining:

On Southwest side - - - - - - - - - - - -	30,400 tons,
North of Lucy Pit - - - - - - - - - - - -	10,000 "
South and Southwest of Lucy Pit - - - - - - -	10,000 "
Total -	50,400 tons.

Below present pit and above drainage tunnel available by milling:

West of Crusher - - - - - - - - - - - -	186,000 tons,
Area below bottom present pit by churn drilling - -	160,000 "
Total -	346,000 tons.
GRAND TOTAL -	396,400 tons.

ANALYSIS

	IRON	PHOS.	SUL.	MANG.	MOIST.	SIL.
Natural	36.83	.066	.010	2.00	7.00	31.56

SOUTH JACKSON MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1921.

GRADE	IRON	PHOS.	SILICA	MANG.
So. Jackson,	36.44	.065	35.80	2.65

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1921.

	Mine				Lake Erie		
GRADE	IRON	PHOS.	SILICA	MANG.	IRON	MOIST.	MANG.
So. Jackson,	36.19	.056	35.85	2.64	40.00	8.65	3.22

ORE STATEMENT AND SHIPMENTS FOR YEAR 1921.

	YEAR	LAST YEAR
Output for Year,	4,677	69,222
Shipments,	4,677	69,222
Balance on Hand,	0	0

1921 -- Idle Jan. 1st to Sept. 27th, 1921.
1-10 Hour Shift, Sept. 27th to Oct. 14th, 1921.
Idle Oct. 14th to Dec. 31st, 1921.

1920 -- Idle Jan. 1st to May 3rd, 1920.
1-10 Hour Shift, May 3rd to Oct. 2nd, 1920.
Idle Oct. 2nd to Dec. 31st, 1920.

SOUTH JACKSON MINE

COMPARATIVE MINING COST FOR YEAR

	1 9 2 1	1 9 2 0	INCREASE	DECREASE
Product	4,677	69,222		64,545
Underground Costs	.726	.631	.095	
Surface Costs	-	.020		.020
General Mine Accounts	.054	.023	.031	
Cost of Production	.780	.674	.106	
Original Cost	.803	.803	-	
Plant Account	.046		.046	
Taxes	1.198	.034	1.164	
Central Office	.024	.013	.011	
Contingent Expense	.003		.003	
Cost Adjustment	.167	.019	.048	
Winter Expense	.190	.013	.177	
Cost on Stockpile	3.21[illegible]	1.556	1.655	
Loading & Shipping	-	.001		.001
Total Cost on Cars	3.211	1.557	1.654	
No. Days Operating	12	124		112
No. Shifts & Hours	1-10hr	1-10hr		
Average Daily Product	390	558		168
COST OF PRODUCTION				
Labor	.279	.296		.017
Supplies	.501	.378	.123	
Total	.780	.674	.106	

Mine only operated 12 days with 5 men surface and 7 men in pit.