

DELAYS.

We had several delays during the year, the most serious one occurring in December when operations were tied up from the lower levels in the Pascoe Shaft for fourteen shifts.

DELAYS		
DATE	DURATION	CAUSE
Jan. 30,	3	Main Air Line frozen,
Apr. 9-10,	24	Main Air Line broken,
Jun. 28,	2	Top Tram car out of order,
Jul. 6,	8	Severe rain storm flooded Pascoe Shaft,
Aug. 22,	2	Skip out of order,
Aug. 31,	10	Transmission Line trouble,
Nov. 13,	8	Floor of main stope came in causing air blast,
Nov. 16,	2½	Fire in North Lake Power House cut off power,
Dec. 6 to Dec. 13,		Shaft wreck shut off lower levels Pascoe Shaft.

The last delay was the most serious of the year as it caused a loss of production of from 2,000 to 2,200 tons. The Pascoe Shaft is timbered from the 2050' to the 2270' Level. From that point down, the shaft hanging was considered strong enough to stand without timbering. In a few places sets of timber were put in wherever same were considered necessary. The lift from the 2270' to the 2370' Level was sunk four years ago, and since that time, an inspection of the shaft is made once a week. The timber foreman never considered any additional timbering necessary until the latter part of November, when two sets were put in just above the 2370' Level. At noon on December 6th, a large slab of rock from 4 feet to 5 feet thick and 15 feet to 20 feet long let loose and fell down the skip-road to the bottom of the shaft. One skip was demolished and the plats on the 2570' and 2670' Levels practically wrecked. Three eight-hour shifts were worked for the next seven days repairing the damage.

The shaft was carefully examined after the accident by the General Superintendent and although the hanging of the shaft looked secure from the 2270' to the 2370' Level, we decided to timber this lift up anyway and this was done. Furthermore, we decided to timber up the shaft from the 2570' to the 2670' Level also.

LABOR & WAGES.

The wage scale at the Republic Mine was changed once during the year, an increase in wages becoming effective May 1st.

The labor situation was generally satisfactory with the exception that we were short of trammers the last half of the year.

COSTS.

The cost of production and the cost on cars can not fairly be compared between the years 1922 and 1923, because in the former year, we operated but three single shifts a week for five months, and naturally, when the mine operates part time, the cost on cars runs higher than the average, due to over-head expense.

The product for 1923 was also considerably below the average for full time operation which tends to increase the cost on cars.

Furthermore, our extensive development campaign was started which means driving rock drifts in Republic Jasper which is a tremendously expensive operation.

However, we felt that there is a considerable stretch of territory favorably located that should be explored, regardless of cost, and if the past history of the mine repeats itself and new ore bodies discovered, the cost of production in the future can be considerably lowered.

A detailed explanation of the labor and supply costs under various headings is shown later in this report.

DIAMOND DRILLING.

Following were the holes drilled for the year:-

NO. OF HOLE	LOCATION	DEPTH	FOOTAGE OF ORE
510	2470' Level	407	No ore
511	2370' "	93	66 feet
512	2570' "	139	22 "
513	2070' "	127	No ore
514	" "	118	" "
515	" "	56	" "
516	1710' "	113	23 feet
517	" "	205	15 "
518	2670' "	99	48 "
519	" "	56	35 "
520	" "	94	9 "
521	1570' "	208	65 "
522	1710' "	113	14 "
523	" "	135	7 "
524	2470' "	121	No ore
525	" "	74	" "
526	" "	290	5 feet
527	" "	41	16 "
528	2570' "	249	2 "
529	" "	48	12 "
530	2170' "	219	17 "
531	" "	198	13 "
532	1710' "	100	5 "
533	" "	252	5 "
534	" "	283	3 "
535	2670' "	171	37 "
536	1850' "	120	47 "
537	" "	138	11 "
538	1710' "	19	2 "
539	1850' "	187	11 "

The total footage drilled for the year was 4,325 feet and of that footage, 490 feet was in ore, which is the largest ore footage drilled by far in recent years. The total cost of operating the drill was \$13,825.31 or \$3.196 per foot.

TABLE OF DIAMOND DRILLING COSTS.

YEAR	FEET DRILLED	COST PER FOOT
1920	3,621	4.963
1921	2,531	4.11
1922	2,367	3.57
1923	4,325	3.196

You will note that the cost per foot is lower in 1923 than previous years regardless of wage increases compared with 1921 and 1922, due to the larger ore footage drilled.

The ore drills much faster than either Jasper or Quartzite and so naturally lowers the cost per foot for the year.

SHAFT SINKING.

The Pascoe Shaft which had been sunk about half way to the 2670' Level in 1922 was completed as far as the 2670' Plat. Then the plat was cut and sinking resumed to the next level. At the end of the year, the shaft was down about 40 feet below the 2670' Level.

We hesitated somewhat before sinking was resumed, due to the fact that on the 2670' Level plat the shaft is entirely surrounded by ore. We considered sinking a winze in the footwall back of the ore bodies, this winze to connect with the new main motor haulage drift to be driven over to No. 9 Shaft, but as the time element is the controlling factor, we decided to open up the 2770' Level in the shortest time possible. That meant sinking the Pascoe Shaft another lift.

The total expenditure for shaft sinking was \$18,208.96 in 1923, or a unit cost of .172 per ton of ore hoisted. The cost per foot ran very high and we hope in 1924 to reduce this by using an electric hoist for hoisting the rock from the shaft, instead of the old air puffer used for the last twenty or twenty-five years. The new hoist will speed up the mucking operation.

ROCK DRIFTING.

In 1922 the total expenditure for rock drifting was only \$10,188.01, compared with \$22,843.44 for 1923. In 1922, the mine operated but three single shifts a week for the first five months in the year, while full time operations were carried on in 1923. The cost per foot for 1922 averaged \$19.26. For 1923, it ran \$26.98 per foot.

Some of this is due to the increased wage scale paid in 1923, the average for 1923 being \$4.58 compared with \$4.11 for 1922. Some of the increase is also due to the difference in the character of the rock drifted through, but the largest single factor is the fact that being short of trammers, the bosses naturally employ what trammers they had in the stopes and the miners working in the rock drifts had to tram their own dirt to the shaft. These miners never are able to tram the equivalent number of cars that the regular trammers are capable of doing, and so the work drags increasing the cost.

We have great hopes of over-coming this in 1924 by using scrapers and loading slides. A complete set of equipment was built late in 1923 and we hope to have the scrapers successfully operating early in 1924.

ORE DEVELOPMENT.

In 1923, 21,128 tons were broken in development work compared with 16,163 tons in 1922. The unit cost for the two years was \$1.28 and \$1.36, respectively, showing a small decrease for 1923. The increased tonnage broken for 1923 is due to the fact that operations were conducted only part time in 1922, the mine not resuming full time operations until June 1st, 1922.

STOPING.

Stoping was limited to seven stopes during the year. On the 1570' and 1710' levels, Pascoe Shaft, stoping was carried on on both levels in the same ore body.

On the 1950' level, one stope was worked as was also one on the 2570' Level, there being only one ore body developed to date on that level.

On the 2670' Level, the ore body was split into three sections and two of these ore bodies could only be opened up on the sill floor, no stoping above the level being advisable for fear of wrecking the Pascoe Shaft.

The unit cost for stoping in 1922 was .731 and in 1923, 0.972 per ton. Some of this increase is due to increased wages paid miners in 1923. The cost per ton for supplies for the two years was .214 and .222 or very little change. The increased labor cost is due to the smaller combined cross-sectional area of the stopes worked during the year, compared with the previous years.

It requires more miners to break a given tonnage in a number of small stopes than in two or three large stopes, and the only large stope we had in 1923 on the 2570' Level, Pascoe Shaft, could not be mined out as one unit, but two pillars had to be left in the stope to support the Pascoe Shaft, and the miners were actually breaking ore in three separate areas.

TIMBERING.

We expended \$8,062.44 for timbering in 1922, compared with \$9,214.98 for 1923, so that the unit costs for the two years are almost identical. The timber costs vary directly with the number of new ore bodies developed and their size. If the ore lenses are long and narrow, the unit cost for timbering will be more than if the ore bodies found are wider, because in the latter case, no attempt is made to carry the weight of the broken ore on the timber, but a drift is usually carried around back in the footwall and cross-cuts driven to draw off the broken ore. In the case of the narrow lenses, it would be too expensive to drive a parallel drift in the footwall for the quantity of ore developed and so the stull method of timbering is used.

The quality of the timber furnished by timber jobbers is much inferior to that bought a few years ago. It is almost impossible to buy good Tamarack or Pine timber in the Republic District and as a result, hardwood is mostly used. The latter timber rots quickly and in three or four years has to be replaced.

TRAMMING.

The ore was trammed at a cost of .333 per ton in 1922, while in 1923, it cost us .430 per ton. As all the ore on the levels except on the motor haulage level, is handled by contract trammers, the cost would vary directly as the scale of wages fluctuates. On the motor haulage level, however, the cost of operating the storage battery locomotives, the wages of skip-tenders, pocket-men and the loaders or chute-men at the Pascoe Shaft storage pocket, has to be absorbed by the daily product. The daily hoist for 1923 averaged 356 tons per day compared with 411 for 1922, so that the fixed tramming expense per ton would be approximately 15% higher for 1923, if the wage scale were identical for the two years.

The following table shows the cars filled per trammer per day:-

YEAR	CARS PER TRAMMER PER DAY
1916	12.2
1917	13.1
1918	15.1
1919	18.2
1920	20.5
1921	21.8
1922	16.7
1923	18.6

You will note an increase in the number of cars filled daily by the trammers over last year.

PUMPING.

The cost of handling the water in the mine rose but little during the year and the small increase is due entirely to the increase in wages.

There is but little in-coming water to pump at the Republic Mine, the average for the past two years being only about 75 gallons per minute.

The total amount of water pumped in 1923 was 37,204,860 gallons.

In the Spring of the year during the break-up for two weeks, our pumps are kept busy in both No. 9 and Pascoe Shafts, but during the rest of the year, one set of pumps can easily handle the water, pumping only about ten hours a day.

COMPRESSORS & AIR PIPES.

This account shows a large increase over previous years due entirely to the drought and generally dry conditions prevailing during the Summer and Fall of the year. It is hard to compare the 1923 costs with either the 1921 or 1922 costs, because the mine operated only part time in those two years. The following table shows the air made at the Republic Water Power Plant and with the steam compressor, indicating clearly that a larger percentage of air was made with the steam compressor than for any period previous for a number of years.

YEAR	AIR CONSUMED M. CU. FT.		
	AIR MADE BY STEAM	PER CENT OF TOTAL	AIR FROM WATER POWER PLANT
1919	268,229,000	21.9%	959,973,000
1920	328,509,000	24.4%	1,018,620,000
1921	119,993,000	12.58%	834,249,000
1922	139,674,000	12.52%	973,114,000
1923	370,502,000	28.65%	919,356,000

The cost per 1000 cu. ft. of air compressed for the year was 0.008.

UNDERGROUND SUPERINTENDENCE.

The underground foremen for the major portion of the year consisted of a Captain, two shift bosses and a timber boss. About October 1st, we added a trammer boss on each shift whose duty it was to look after the cars only and see that the trammers filled them to capacity.

MAINTENANCE.

COMPRESSORS & POWER DRILLS.

No new drilling machines for mining operations had been purchased since 1920 until we decided to sink the Pascoe Shaft another lift. Four new #248 machines were purchased from the Ingersoll-Rand Company for the shaft miners.

TRAMMING EQUIPMENT.

Only the usual supplies necessary such as car wheels and bushings and track material were purchased in 1923.

The storage battery locomotives gave us no trouble and no storage batteries were purchased during the year, although it will be necessary to replace the small 13-plate battery with a 48 MV-15 plate battery soon.

The cost of operating the electric haulage plant for the last few years is as follows:-

	COST PER CAR			
	1923	1922	1921	1920
Cost of operating Labor,	.065	.057	.102	.170
" " " Supplies,	.007	.008	.009	.007
Maintenance Cost,	.015	.030	.052	.027
Total,	.087	.095	.163	.204
Cost per ton,	.054	.063	.105	.131

The low costs in 1923 are due to the exceptionally low maintenance cost on the batteries and locomotives.

PUMPS.

The only unusual expenses in connection with the pumps was the purchase of a new belt, 95 feet long, for the Pascoe Shaft 1223' Level pump.

On the 2670' Level, Pascoe Shaft, a pump-house and sump were cut out and we are now ready to install an electric pump at present on surface to lift the water to the electric pump on the 2470' Level.

HOISTS & EQUIPMENT.

The unit cost for hoisting and maintenance will run .352 per ton compared with .329 for 1922, and .468 for 1921. The small increase is mostly due to slightly higher wage scale paid in 1923. The detailed costs for the last four years follow, the years: 1920 and 1923, representing full time operations, and the other two only part time.

	COST PER TON			
	1923	1922	1921	1920
Maintenance,	.074	.062	.136	.060
Operating Labor,	.104	.099	.149	.101
Oil, Waste & Packing,	.004	.005	.005	.006
Tools & Miscellaneous Supplies,	.001	.001	.001	.001
Electric Light,	.002	.004	.006	.004
Heating,	.002	.003	.003	.001
Prop. Boiler House Expense,	.083	.079	.088	.132
Electric Power,	.078	.076	.080	.050
Total Maintenance & Operating,	.352	.329	.468	.355
Average depth hoisted,	2372	2346	2334	2090

The maintenance expense for 1923 is slightly higher than last year, due to putting on a new 3,000 ft. 1 $\frac{1}{4}$ " hoisting rope in No. 9 Shaft. The Boiler House expense also runs slightly higher due to charging out coal at \$7.23 per ton, average for the year, whereas the rate for 1922 ran \$6.21 per ton.

STOCKING ORE.

There is but little difference in the total expenditure under this heading for this year and last, as the unit costs run .087 and .094, the expense being actually lower in 1923. The reason for this lies in the fact that last year we were compelled to stock Crushed ore during the entire year, as no sales of Republic Crushed ore were made. In 1923, however, all of the product from the shaft was loaded out during the shipping season.

SCREENING - CRUSHING PLANT.

This past year was the first since 1920 that the old Crushing & Screening Plant was operated. The ore from No. 9 Shaft instead of going through the 6' x 12' Revolving Screen installed in 1920, was diverted to the storage pockets in the old plant and there separated. The reason for this was due to the necessity of re-screening the stockpile lump ore, and as the old Screening Plant had to be operated for that purpose, we found it cheaper to also run the ore from the shaft through the same plant, as it involved but little extra labor.

DRY HOUSE.

Extensive repairs were made on the No. 9 Shaft Dry. The old Dry was in such a deplorable condition that it meant a new Dry or extensive repairs to the old one. Acting under a suggestion made by the General Superintendent, it was decided to gunite the building, put in a concrete floor and put a cement foundation under the walls. The Dry was to be equipped with steel lockers, shower baths, toilets, etc., which were to be removed from the old Pascoe Shaft Dry.

In 1919, we contemplated building a new brick Dry about the same size as the old Dry, the building to house the Pascoe Shaft Dry equipment including the heating boiler. This Dry was planned and bids received for its erection on E. & A. #376. The lowest bid covering the building with cement floor was \$15,900.00. The estimated cost of the building complete based on the price bid was approximately \$18,850.00. The total expended on the remodeled Dry to date is but \$5,712.00, and as we have a building that meets the needs of the mine for years to come, we have saved approximately \$13,150.00 by repairing the old Dry.

In repairing the Dry we first put a concrete foundation under the walls. Then an addition of 20 feet was added onto the North end for a shift bosses' room and a place for toilets and shower baths. The entire building inside and out was then covered with expanded metal lath and gunited, three coats being applied. We secured the best results using only finely screened mortar sand mixed in a concrete mixer with cement in the proportion of three bags of sand to one bag of cement. The cement was also screened to take out the lumps.

After a few days when the men became familiar with the operation of the Guniting Machine, we found we could cover from 800 to 1000 sq. ft. a shift of nine hours.

Following is the detailed cost of guniting the walls of the Dry. Area gunited 10,178 sq. ft.

Metal Lath,	\$280.24
264 Sacks Cement,	263.39
2 Kegs Staples,	15.94
50 ft. Material Hose,	68.14
Miscellaneous Supplies,	24.36
	652.07
Teaming & Labor,	648.80
Total,	\$1300.87
Cost per sq. ft.,	12.78¢

Following is the complete cost to date of rebuilding the Dry together with the probable cost of erecting an entirely new Dry if we had proceeded with our original plans. The comparison will not be exact, as the wage scale in 1919 when the new Dry was bid on was 15% higher than that prevailing when the old building was remodeled, but a large saving is obvious as shown in the table.

COMPLETE COST OF REBUILDING OLD DRY.			
	LABOR	SUPPLIES	TOTAL
Guniting,	\$648.80	\$652.07	\$1300.87
Foundation,	409.05	261.74	670.79
Floor,	668.89	306.94	975.83
Piping,	419.19	185.74	604.93
Roof,	132.94	225.47	358.41
Wiring,	94.02	183.58	277.60
Doors & Windows,	217.06	250.48	467.54
Lockers,	432.63	30.48	463.11
Building Addition,	172.59	30.60	203.19
Ventilators,	44.50		44.50
Miscellaneous,			345.32
Total,			\$5712.09

COMPLETE COST OF BUILDING & FURNISHING NEW DRY.	
	TOTAL COST
Building complete as bid,	\$15,900.00
Piping,	600.00
Sewer Line,	300.00
Wiring,	300.00
Water Line,	100.00
Lockers,	465.00
Showers,	200.00
Ventilators,	500.00
Heating Plant,	500.00
Total,	\$18,865.00

The decreased expenditure as shown is about \$13,150.00.

SHAFT.

The cost of repairing and maintaining the hoisting shafts was approximately \$5835.00 or considerably more than last year. The greater portion of this money was put into the Pascoe Shaft and the most of it from the motor haulage level down to the 2670' Level.

The storage pockets on the motor haulage level were practically rebuilt during the year. Considerable new timbering and also some re-timbering was done between the 2050' & 2470' Levels, Pascoe Shaft. Then the shaft wreck as explained previously in this report required considerable timber and labor.

The shaft will have to be timbered from the 2570' to the 2670' Level, and additional lining sets put in from the 2070' to the 2270' Level.

TOP TRAM EQUIPMENT.

The largest single item in keeping the top trams in proper shape is the expense for 5/8" and 3/4" rope. Due to the sharp curves the ropes wear out very quickly.

DOCKS, TRETTLES & POCKETS.

The costs under this head were much less than last year because of the heavy expense last season laying new sollar plank at the No. 9 Shaft Lump ore stocking area.

We are faced, however, with the necessity of building new pockets at the No. 9 Screening Plant, or providing a new Crushed ore pocket, so as to be able to load the fine ore from the revolving screen in the No. 9 Shaft House into railway cars.

ENGINEERING.

The Surveying & Mapping and Construction work at the Republic Mine is handled by engineers from the Central Office.

ANALYSIS.

It required \$1,132.17 to run the Laboratory during the year at a cost of .273 per determination.

PERSONAL INJURIES.

We reported forty-seven accidents in 1923, none of which were of a severe nature. The majority of our accidents are minor cuts or bruises, due to fingers getting caught between chunks of ore. A few years ago, the trammers and car-pickers were provided with gloves in the hope of reducing these accidents, but the scheme was not practical.

SAFETY DEVICES.

Five new Fire Fighting Helmets were purchased during the year, as the old Draeger apparatus was out of date.

TRANSMISSION LINE.

The transmission line had not been brushed out since it was built until November, 1923, when we put a crew of men to work to clean out the line and fell the trees along the right-of-way that might topple over and break the wires. The line from Republic to the Barnes-Hecker Mine is approximately thirteen miles long and it was brushed out at a cost of \$46.00 per mile.

FARM.

We had the best crop of hay this past year from the Company's farm near the Water Power Plant that we cut in years.

SUPPLIES.

EXPLOSIVES.

The following statement shows the explosives used for breaking ore.

KIND	QUANTITY	AVERAGE PRICE	AMOUNT	
			1923	1922
50% Powder,	120,620	.155	18,680.97	17,896.20
Fuse,	151,000	6.366	957.93	1,003.48
Caps,	37,100	11.265	417.92	303.76
Miscellaneous,			56.79	58.31
Total,			20,113.61	19,261.75
Product broken,			119,190	98,588
Pounds powder per ton of ore,			1.02	1.09
Cost per ton for powder,			.1567	.1815
Cost per ton for all explosives,			.1688	.1953
Average price per lb. for powder,			.1550	.1653

The total amount of explosives used not only for breaking ore but rock drifting and shaft sinking was \$29,741.15 or .248 per ton of product, compared with .232 last year.

GENERAL SUPPLIES.

The expenditure under this head was higher for the year than in 1922, due to rebuilding No. 9 Dry, putting on a new 1½" hoisting rope, and due to larger carbon loss in operating the Diamond Drill.

IRON & STEEL.

The consumption of iron and steel was only about two-thirds of last year, notwithstanding that the mine did not operate full time in 1922. Very little new drill steel was made up in 1923.

OIL & GREASE.

The oil burning forges in the new drill sharpening shop burn engine distillate and naturally the expense for oil and grease will show an increase for 1923 compared with previous years.

MACHINERY SUPPLIES.

This item shows an increase for 1923 over 1922 largely due to repair parts for drilling machines. We also purchased an I. R. Double Drum Tugger hoist for slushing or scraping purposes.

LUMBER & TIMBER.

The consumption of lumber and timber for the past two years is practically the same.

FUEL.

The cost for fuel will show a large increase over last year, being practically doubled. This is due to the operation of the steam compressor, which was largely eliminated in 1922, due to working only part time, thereby allowing the head of water to accumulate and also due to the decreased precipitation in 1923.

ELECTRIC POWER.

Electric power consumption will show an increase over 1922, due to operating full time in the past year.

UNDERGROUND OPERATIONS.

1570' LEVEL:-

A rock drift was started at the extreme South-West end of this level, the course of the drift being approximately along Diamond Drill hole #508. After drifting a short distance in Jasper, the ore was encountered. This ore body about the end of the year had been opened up for a length of approximately 100 feet, the average width being about 35 feet. This ore body is a continuation of the ore body originally discovered on the 1850' Level. On the 1710' Level, we drifted in to mine out the upward extension of the same ore body and found the area of the ore at this elevation very small. Above the 1710' Level, it widened out and has been gradually increasing in length as the stope is carried up above the sill floor of the level. When mining had proceeded within 25 feet of the 1570' Level, we left a floor pillar to support the level above. Present indications are that the ore on the 1570' Level will aggregate a larger cross-sectional area than any level below, with the exception of a short distance above the 1850' Level.

At the close of the year, the breast of the stope was still in ore and timber was being put in at the shaft end of the stope preparatory to mining out the back.

1710' LEVEL:-

At the extreme South end of the level, mining was continued in the stope until a point about 25 feet below the 1570' Level was reached, as mentioned above.

There is also some ore in the back of the stope on the 200 West co-ordinate line which we plan on exploring further to see whether or not the ore body will increase in size.

A number of drill holes were drilled on this level during the year both towards the hanging and back in the foot-wall.

We discovered some leaders of ore in these holes but none of them were large enough to warrant drifting for. I am still of the opinion that there are good chances of developing additional ore bodies at this elevation in the direction of the West Republic trough, and for that reason we are planning to drill more holes to the West.

1850' LEVEL:-

A rock drift was started from the breast of an old drift approximately 2400 North and 250 West of the origin and this drift was run Southwesterly towards the probable upward extension of an ore body discovered on the level below. The breast of the drift encountered ore about the middle of December.

1950' LEVEL:-

The stope South-West of the shaft was mined up to within a few feet of the 1850' Level. There remains a little ore to be taken at the extreme East and West ends of the stope, the central area in the back being all Jasper.

2570' LEVEL:-

The greater portion of the product for the year came from this level. We followed the ore body to the West along the South foot-wall until the breast encountered rock a short distance South-West of the shaft plat. The ore area opened up at this elevation was larger than that encountered on the level up over. We left two pillars of ore to protect the Pascoe Shaft; one of them 50 feet wide is stationed directly under the shaft; the other one, about 30 feet wide, runs from foot to hanging across the main portion of the stope East of the shaft plat. Mining was continued in the main stope up to within 18 or 20 feet of the 2470' Level, and when this point was reached, we stopped mining temporarily and drew off all the broken ore in the stope.

The idea being to get the ore as clean as possible before the floor pillar let loose and allowed the rock from the levels up over to mix with the ore.

A drift was driven in the foot-wall from 25 to 30 feet away from the main foot-wall of the stope and a series of cross-cuts connect this drift with the broken ore in the main stope, through which the bulk of the product from the stope has been drawn.

At the close of the year, the floor pillar underneath the 2470' Level had collapsed and we were tramming what ore we could out of the broken floor pillar. Approximately 80% of the ore body is mined and trammed before the floor pillar comes down. Of the remaining 20%, a considerable tonnage is recovered until finally the quantity of rock becomes too great to handle.

2670' LEVEL:-

The shaft was sunk to this elevation and the level itself opened up during the year 1923. At the elevation of this level, the shaft plat itself is entirely in Jasper; a foot North of the hanging of the shaft, Magnetite was encountered and a large stope of that grade of ore was opened up along the hanging leading to the North-West. Unfortunately, the upward trend of this ore was over the hanging of the Pascoe Shaft, and for that reason, the ore could only be mined out the height of the plat, or about 8 or 10 feet.

Back in the foot-wall we opened up an ore body of Specular Hematite of considerable length and breadth but, as in the case of the Magnetite ore, this ore body could not be mined because it lies under the Pascoe Shaft.

East of the shaft along the main foot-wall, by the end of the year, we had opened up the ore for a distance of 75 feet, the width averaging from 12 to 30 feet. This ore body is the downward extension of the main stope from the level above.

Although the ore area on the 2670' Level is larger than on the level above, still only approximately one-half of the ore developed can be mined, because of the close proximity of the Pascoe Shaft.

Indications are that the main ore body below the 2570' Level has been split into two parts by the horse of Jasper which was encountered in cutting out the shaft plat. Indications are also that the large body of Magnetite ore opened up North-West of the shaft, is the beginning of a new ore body, in which lies our greatest chances for opening up a good size ore body on the 2770' Level.

DEVELOPMENT WORK.

Our plans for the year 1924 included the driving of three rock drifts and the sinking of the Pascoe Shaft another lift.

On the 2570' Level, a drift started North-West of the shaft plat the past year will be continued and driven along the contact between the Jasper hanging and the ore formation. Mr. Smyth, our consulting Geologist, agrees with me that there is a wonderful chance for developing new ore bodies along this contact, which should be explored for 1200 or 1400 feet Northwesterly of the end of the present known ore bodies in the Pascoe Shaft. The last time this area was explored was on the Motor Haulage or 2070' Level. At this particular elevation, however, all of the ore bodies near the Pascoe Shaft, near No. 9 Shaft and near the winze, were small and for the most part lean. Below this elevation, however, in the Pascoe Shaft, we ran into the main stope, which has been the principal source of ore in the Republic Mine for the last four or five years. There is nothing against the possibility of opening up similar ore bodies further along the contact.

On the 2670' Level, we are also planning to continue the drift started during the past year, running along the contact between the Quartzite hanging and the ore formation. This drift should be driven about 600 feet along this contact. This area was last explored on the 2370' Level but nothing encouraging found.

For the last two or three years, we have at various times considered the advisability of connecting the lower levels in the Pascoe Shaft with the main No. 9 hoisting Shaft. We never felt that we had opened up enough new ore in the Pascoe Shaft to warrant this expenditure. The year 1923, however, developed a new set of conditions. We found, for instance, that a great deal of the ore developed on the new level, Pascoe Shaft, was so situated that it could not be mined. Furthermore, the indications were that conditions would be the same or ever worse on the levels below. Furthermore, that we were reaching the limit of the hoisting capacity of the underground electric hoist. We were also experiencing some trouble in the main hoisting shaft and found it cost us considerable money to keep the Pascoe Shaft open. Furthermore, we are now down 600 feet vertically below the main Motor Haulage Level and the men in this portion of the mine have but one outlet to surface. We have tried to make the workings as safe as possible and have provided all the shaft plats with fire protection, but still we are operating these lower levels under quite a hazard, and the Committee on Safety & Fire Prevention strongly recommended the second outlet. Obviously, the most sensible way of providing the second outlet is to get the main shaft down to the elevation of the lower levels in the Pascoe Shaft. In view of all these conditions, we believe it advisable to connect the main hoisting shaft with the 2670' Level workings, and a drift was started from the 2670' Level just about the close of the year.

In view of the fact that it will be difficult to maintain a respectable production from this mine, until the shaft pillar from the 2670' Level up is available for mining, it is absolutely essential to get a new level in the Pascoe Shaft opened up immediately. There is a possibility that the Magnetite ore body discovered on the 2670' Level will swing a considerable distance West of the shaft on the new level, judging from the slope of the hanging and furthermore, it will enable us to drift back in the foot-wall and raise up to the main proposed haulage drift between the Pascoe and No. 9 Shafts, so as to make all of the ore available for mining on the 2770' Level. With that end in view, the shaft was started during the past year and was down about 40 feet below the 2670' Level. As considerable time is spent in hoisting rock with the old shaft puffers, we started to move the No. 9 winze electric hoist at the end of the year in order to handle the dirt from the shaft more quickly.

SUMMARY OF ORE TRAMMED FROM VARIOUS LEVELS:-			
			TONS
1570'	Level,	Pascoe Shaft,	6,225
1710'	"	do.	12,170
1850'	"	"	290
1950'	"	"	22,745
2070'	"	"	145
2470'	"	"	1,740
2570'	"	"	67,845
2670'	"	"	10,895
SHAFT		"	45
Total,			122,100
Less a/c Picking Belt Rock,			4,904
			117,196

NOTE:- You will note that over half of the product from the mine during the year was secured from the 2570' Level.

In the year 1922, 65% of the ore from the mine was trammed from the 2470' and 2570' Levels.

REPUBLIC MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1923.

GRADE	IRON	PHOS.
Republic Bessemer Lump,	(No Production)	
Republic Bessemer Crushed,	62.97	.046
Republic Basic, Run-of-Mine,	57.60	.061
Republic Basic Lump,	65.53	.035
Republic Basic Crushed,	63.03	.036
Republic Pascoe Lump,	(No Production)	
Republic Pascoe Crushed,	54.81	.047

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1923.

GRADE	Mine			Lake Erie	
	IRON	PHOS.	SILICA	IRON	MOIST.
Republic Bessemer Lump,	(No Shipments)				
Republic Bessemer Crushed,	(All Mixed)				
Republic Basic, Run-of-Mine,	(All Mixed)				
Republic Basic Lump,	65.48	.037	4.82	65.05	.21
Republic Basic Crushed,	63.21	.037	6.77	63.63	1.14
Republic Pascoe Lump,	(No Shipments)				
Republic Pascoe Crushed,	55.55	.046	-	57.19	1.04

REPUBLIC MINE

ORE STATEMENT - DECEMBER 31ST, 1923.

	RUN-OF-MINE			BESS. LUMP	BASIC LUMP	PASCOE LUMP	BESS. CRUSHED	BASIC CRUSHED	PASCOE CRUSHED	TOTAL	TOTAL LAST YEAR
	BESS.	BASIC	PASCOE								
On hand Jan. 1, 1923,	25,877	11,018	10,240	-	9,862	762	7,214	88,029	3,983	156,985	138,355
Output for Year,	-	-	-	-	62,218	-	-	56,636	126	118,980	98,588
Transferred,	16,815	6,963	5,859	245	502	762	5,271	18,896	6,489	-	-
Stockpile Shortage,	9,062	4,055	-	-	-	-	-	-	-	13,117	415
Total,	-	-	4,381	245	71,578	-	12,485	163,561	10,598	262,848	237,006
Shipments,	-	-	-	245	66,041	-	335	94,306	8,087	169,014	80,021
Balance on Hand,	-	-	4,381	-	5,537	-	12,150	69,255	2,511	93,834	156,985
Increase in Output,										7,690	
Decrease in Ore on Hand,										63,151	

1923 -- 2-8 Hour Shifts, Jan. 1st to Dec. 31st, 1923.

1922 -- 1-8 Hour Shift, 3 days per week, Jan. 1st to June 4th, 1922.
2-8 Hour Shifts, 6 days per week, June 5th to Dec. 31st, 1922.

REPUBLIC MINE
SHIPMENTS FOR YEAR-1923.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Republic Bessemer Lump,	208	37	245	180
Republic Basic Lump,	39,107	26,934	66,041	77,072
Republic Pascoe Lump,	-	-	-	1,094
Republic Bessemer Crushed,	-	335	335	-
Republic Basic Crushed,	27,046	67,260	94,306	-
Republic Pascoe Crushed,	-	8,087	8,087	1,675
Total,	66,361	102,653	169,014	80,021
Total Last Year,	25,884	54,137	80,021	
Increase,			88,993	

REPUBLIC MINE

COMPARATIVE MINING COST FOR YEAR

	1923	1922	INCREASE	DECREASE
PRODUCT	105,863	98,173	7,690	
Underground Costs	2.794	1.986	.808	
Surface Costs	.749	.563	.186	
General Mine Accounts	.223	.235		.012
Cost of Production	3.766	2.784	.982	
Plant Account	.091	.120		.029
Equipment		.010		.010
Taxes	.273	.289		.016
Central Office	.171	.159	.012	
Contingent Expense	.111	.123		.012
Cost Adjustment	.024	.029		.005
Cost on Stockpile	4.436	3.514	.922	
Loading & Shipping	.083	.037	.046	
Total Cost on Cars	4.519	3.551	.968	
No. Days Operating	297	239	58	
No. Shifts & Hours	2-8	1-8-65 2-8-174		
Avg. Daily Product	356	411		55
<u>COST OF PRODUCTION</u>				
Labor	2.776	1.968	.808	
Supplies	.990	.816	.174	
Total	3.766	2.784	.982	

REPUBLIC MINE

COMPARATIVE WAGES AND PRODUCT

	1 9 2 3	1 9 2 2	INCREASE	DECREASE
PRODUCT	105,863	98,173	7,690	
No.Shifts & Hours	2-8hr	1-8;2-8		
AVG.NO.MEN WORKING				
Surface	62	54	8	
Underground	154	124	30	
Total	216	178	38	
AVG.WAGES PER DAY				
Surface	4.44	4.04	.40- 9%	
Underground	4.63	4.14	.49-10.6	
Total	4.58	4.11	.47-10.2	
WAGES PER MO.OF 25 DAYS				
Surface	111.00	101.00	10.00	
Underground	115.75	103.50	12.25	
Total	114.50	102.75	11.75	
PRODUCT PER MAN PER DAY				
Surface	5.74	6.91		1.17
Underground	2.32	3.10		.78
Total	1.65	2.14		.49
LABOR COST PER TON				
Surface	.773	.584	.189	
Underground	1.997	1.336	.661	
Total	2.770	1.920	.850	
AVG.PRODUCT BRK'G & TRM'G	5.14	7.23		2.11
" WAGES CONTRACT MINERS	4.67	4.25	.42	
" " " TRAMMERS	6.34	5.16	1.18	
" " " LABOR	5.01	4.46	.55	
TOTAL NO.OF DAYS				
Surface	18,425	14,206 $\frac{1}{4}$	4,218-3/4	
Underground	45,632 $\frac{1}{4}$	31,679 $\frac{1}{4}$	13,953	
Total	64,057 $\frac{1}{4}$	45,885 $\frac{1}{2}$	18,171-3/4	
AMOUNT FOR LABOR				
Surface	81812.36	57359.55	24,452.81	
Underground	211441.94	131177.71	80,264.23	
Total	293254.30	188537.26	104,717.04	

Proportion Surface to Underground Men:

1923 - 1 to 2.48
 1922 - 1 to 2.30
 1921 - 1 to 2.51
 1920 - 1 to 2.67
 1919 - 1 to 2.81

REPUBLIC MINE.

SPIES-VIRGIL MINES.

The following report covers the deepening of the Spies Mine Shaft and other operations incident to the shaft sinking for the year 1923.

SURFACE.

ENGINE HOUSE:-

A new brick engine house located 10 feet West of the site of the old boiler house was completed during the year. The building was planned large enough to take care of two standard 7' x 10' hoists with 400 H. P. motors. There is also plenty of floor space to accommodate two air compressors. The motor generator set for the underground haulage will be placed in the pump house 1200 feet below surface, which is an unusual departure from the common practice of having it in the engine house. The purpose of this is to save the cost of installing a direct current cable in the shaft.

The engine house site was cleared early in the Spring. About half of the old coal dock was also torn down to make room for the building. Test pits sunk in the centre of the engine house area showed but four feet of muck and swampy material, but after the foundation area was excavated, we found it necessary to dig an extra three feet of material to get down to hard pan in the North-West corner.

All of the interior area of the engine house was also excavated and later filled with rock up to within 6" of the top of the floor line.

The hoist and switch-board were installed in short order. We secured the services of electricians from Ishpeming and Negaunee and with additional help from the Hard Ore Shops, were able to hurry this work along.

The hoist was put into commission on October 9th.

The air compressor was moved from the old engine house to the new building in four days. While this work was in progress the men in the shaft removed the pentice in the skip-road and put in ladder sollars and lining planks.

BLACKSMITH & MACHINE SHOP:-

As soon as the compressor was removed from the old engine house, the old electric hoist was dismantled and the floor area cleared so as to provide room for the Blacksmith Shop and Machine Shop equipment. The old engine house provides at least twice more floor area and also makes it unnecessary to run steam so far away from the heating boiler.

We have also partitioned off a small area in the North-West corner of the building for oil and grease.

The entire building was covered outside with building paper and expanded metal preparatory to guniting the structure next Spring.

The electric wiring will be put in conduit pipe and the interior of the building given a coat of mill white or cold water paint.

DRY:-

The exterior of the Dry was covered with building paper and expanded metal lath. It is our intention to gunite the outer walls of the building next Spring.

TOP TRAM BUILDING:-

A new building for housing the top tram equipment was constructed. The old building was of frame construction and too small for our needs. The Committee on Fire Prevention decided that inasmuch as the Spies property had only one opening to surface, that all inflammable material ought to be removed from the collar of the shaft and the shaft house made as fire proof as possible.

With that end in view, we decided to gunite the interior and exterior of the Crusher building and construct a new top tram building.

The new building is 20' x 12' in size and built with steel angles in each corner onto which is fastened Hy-Rib. The walls are made of cement 3" thick. The roof is also concrete. Large window openings were left in all four sides so as to give the landers a good view of the top landing and rock and ore trestles.

A new top tram plant consisting of a drum, belt driven by an electric motor and a clutch designed for a gravity tram was installed. An endless rope plant is not practicable at this mine because no stocking trestles are erected, as the pile is fanned out with an end dump car. The new top tram, however, runs at too high a speed and we are now changing this to a slower speed operation.

GROUNDS:-

The area surrounding the mine buildings was fenced in and grading was started. A large ditch was dug along the South end of the stockpile area joining with the main ditch running North and South between the Dry and Office. This ditch was covered over with planks and will be further covered with earth and graded.

Considerable work remains to be done, however, but we hope by next season to have a very creditable looking surface plant.

WATER SUPPLY TANK:-

The main water supply storage tank was moved to a point South of the Dry. We also elevated the tank so as to provide water pressure without using a pump. The tank in its old position was placed on sills resting directly on the ground.

PIPING & FIRE PROTECTION:-

All of the old piping was completely changed. We first put in a new heating line running from the heating boiler in the Dry to the office and then to the old engine house.

This pipe is elevated and covered with pipe covering and then boxed in to prevent condensation. A new line also runs over to the new engine house. Steam traps were placed in each building and the condensation returned to a hot well built in the corner of the Dry. The hot water from this well is pumped by means of a small electric driven plunger pump into the heating boiler.

A new 6" air line was run over to the shaft in the same ditch with an 8" discharge line from the pumps together with a 4" line for fire protection. All of these pipe lines are buried.

A standard two-way fire hydrant was installed near the hose house together with another hose connection near the shaft house. 350 feet of new 2½" fire hose with standard thread were purchased and a duplex fire pump from the Republic Mine was installed in the new engine house. A fire drill was held in the presence of the Superintendent late in the year when this new equipment was given a good test.

MINE LOCATION:-

All of the houses in the location were repaired and painted. These dwellings were in very poor condition. As none of the houses have cellars, being set on post foundations, we put a double sheathing of flooring below the floor line with building paper placed between the boards. Then the siding was repaired and replaced where necessary, and the doors and windows given attention. Some new doors and window casings were purchased. The porches were in bad shape and roofs repaired. In some cases the chimneys had to be gone over with cement plaster. All of the dwellings and sheds were painted.

UNDERGROUND.

The shaft was sunk a distance of 572½ feet during the year 1923.

Jan., 1923,	92 feet sunk,
Feb., "	65 " "
Mar., "	69½ " "
Apr., "	53 " "
May, "	cutting 4th level plat,
Jun., "	" " " "
Jul., "	46½ feet sunk,
Aug., "	67 " "
Sep., "	71 " "
Oct., "	68 " "
Nov., "	40½ " "
Dec., "	cutting plats.
Total,	572½

The following table shows the depth of the shaft and the elevation of the various levels:-

ELEVATION

Shaft Collar,	000
First Level,	200 ft. below surface,
Second "	300 " " "
Third "	398 " " "
Fourth "	950 " " "
Fifth "	1198 " " "
Bottom of skip-pit,	1251 " " "

The following table shows the time consumed in the various operations in the shaft:-

	TOTAL HOURS CONSUMED	PERCENTAGE OF TOTAL TIME
Drilling,	1491.95	28.5%
Blasting,	309.25	5.9%
Mucking,	2087.50	39.9%
Timbering,	754.25	14.4%
Piping,	41.75	0.8%
Delays from smoke,	164.60	3.1%
Cleaning down sets,	226.00	4.2%
Delays,	168.35	3.2%
Total,	5243.65	100.0%

You will note the large proportion of time spent drilling the cuts due to the hard nature of the ground encountered in the shaft.

DRILLING:-

The standard cut in the shaft consisted of thirty-six holes, spaced in six rows, six holes in each row. The cut holes consisted of the two centre rows and were blasted first. The outer four rows were blasted after the cut was mucked.

When the shaft sinking was started in October, 1922, the material was Graphictic Slate and it took an average of approximately 7.60 hours to drill the thirty-six holes. All of the sinking in 1923 was carried down through gray slate banded with chert and progress was retarded as shown by the following table:-

CUT NO.	MONTH	AVE. HOURS DRILLING PER CUT	MATERIAL SUNK THROUGH
1- 27	Oct.- Nov.10, 1922	7.56	Graphictic Slate
28- 45	Nov.10-Dec.19, 1922	12.43	Graphictic & Gray Slate Mixed
46- 49	Dec.20-Dec.31, 1922	10.87	" " " " " "
50- 66	January, 1923,	10.88	Gray Slate
67- 80	February, 1923,	12.32	" "
81- 98	March, 1923,	14.33	Gray Slate & Chert
99-112	April, 1923,	15.32	" " " "
113-141	July & August, 1923	11.83	Gray Slate
142-156	Spetember, 1923	11.86	" "
157-170	October, 1923	12.58	Gray Slate & Chert

You will note that on December 20th the time spent drilling cuts decreased which was due to the use of the new D.C.R.23 Sinking machines used after that date. Along sometime in August we also changed drill steel, using 1" hexagon instead of 7/8" hexagon. That change also increased our drilling speed because we lost fewer holes in the shaft.

While using the 7/8" steel, we sometimes had to start three holes before getting one down to the proper depth. The 1" steel was not so flexible and the holes went straighter and there was less whip in the steel.

All of the drilling was done with a double taper cross-bit. We started each hole with a 2 1/4" bit and finished by 1/8" changes with a 1-5/8" bit.

After each blast the machines were taken to the shop and looked over and oiled. We used soft graphite grease for a lubricant and it seemed to work perfectly.

We experimented with four types of machines in the shaft using the I.R.430; the Sullivan D.P.33; the Cleveland 44 and the I.R.D.C.R.23, and finally adopted the latter machine, due to its superior rotation and drilling speed.

The Cleveland 44 would have given us good results if the machine had been properly equipped to blow out the sludge and keep the hollow steel from getting blocked.

BLASTING.

We were practically free from all blasting troubles for the entire year. Du Pont Delay Action Fuzes were used in connection with duplex leading wire. The latter was always coiled on a reel and after each blast was taken into the engine house in order to keep the wires dry.

The fuzes were always prepared in advance by the top landers. They were wrapped with tape and then dipped in a compound furnished by the Du Pont Company for that purpose.

We had an occasional missed hole but in each case found the trouble due to defective leading wire.

The blasting was done from the surface until the shaft was 600 or 700 feet deep and then the leading wire was connected into the lamp circuit on the 3rd Level.

The blasting caps were connected in parallel on a 110 volt circuit.

MUCKING.

During the entire year we used the mucking boxes as explained in last year's Annual Report. There is no question but what these saved us a great deal of time, especially when the shaft became so deep that it took from seven to eight minutes for the cage to return to the bottom of the shaft with the empty car. The following table shows the cars mucked per hour before and after the introduction of the mucking boxes:-

MONTH	CARS LOADED	HOURS MUCKED	CARS PER HOUR
Oct., 1922,	796	323.	2.46*1
Nov., "	973	297	3.28
Dec., "	818	219.5	3.73*2
Jan., 1923,	1204	293.5	4.11
Feb., "	870	236	3.68
Mar., "	878	280.25	3.13*3
Apr., "	708	244	2.90*3
Aug., "	955	273.25	3.50
Sep., "	914	264.5	3.44
Oct., "	781	258.4	3.02

*1 - Without mucking boxes.
*2 - With mucking boxes.
*3 - Labor shortage.

The mucking in October, 1922, was done without the boxes. In December, 1922, after the introduction of them, the cars mucked per hour increased 50%. The peak was reached in January, 1923, after which the mucking speed decreased due to shortage of men. In August, 1923, we had our crews fairly well filled again. Towards the close of the year, as the shaft was getting deeper, the cars hoisted per hour showed a decrease due to the longer time necessary to hoist the rock.

TIMBERING.

The shaft was timbered up usually on Sunday, but in case the ground was bad and the timber had to be kept close to the bottom, we timbered during the week.

The sets were placed 6 ft. centres and bearers put in every 100 feet. The outer walls of the shaft were lined with 2" Tamarack and split cedar lagging used for blocking.

PUMPING.

The water from the shaft between the 3rd and 4th levels was hoisted directly in the car with the rock. We used no pumps at the bottom of the shaft. After the 4th level was reached, an electric pump borrowed from the Gwinn District was installed on the plat and gutters cut around the shaft to catch the water and prevent its running down to the bottom of the shaft. Galvanized iron sheets were also placed over the skip and ladder compartments, leaving a hole large enough for the cage only to pass through to the surface. These sheets caught the drippings from the sets above and made the shaft fairly dry.

When sinking to the 5th level, the water was again hoisted with the rock on the cage. The seepage through the rock walls of the shaft amounted to about one car of water per hour.

VENTILATION.

We ventilated the shaft bottom and took care of the powder smoke by using 10" Vent Tube. This was hung in the shaft from the 3rd level down. Above this point, the cage compartment is strongly up-cast. We inserted two blowers into the tubing by fastening two galvanized iron sections to the tubing, one at the bottom and one half way to the top and running two taps from the air line through the walls of the galvanized sections. When the shaft was bottomed, it took about three-quarters of an hour to clear the shaft of smoke. The blasting was usually arranged to come when the men were eating lunch so that but little time was lost in the shaft due to smoke.

DELAYS.

There were a number of delays during the year mostly due to trouble with the old electric hoist being inadequate to handle the load:-

On January 31st, operations were delayed four and one-half hours, due to trouble with the wrist pin bearings on the air compressor.

On February 26th and 27th, sinking was stopped for approximately thirty hours, due to hoist motor burning out. Electricians had to be called from Ishpeming to repair the trouble.

The brasses on the main crank-pin on the air compressor cracked and new ones had to be put on on March 20th, delaying operations four hours.

On April 10th, several coils on the hoist motor burned out and it required thirty hours of repair work before operations could be resumed.

The bearings on the air compressor ran hot on April 18th and due to repeated trouble with these bearings, we decided that they were not designed properly and we made a change resulting in considerable less trouble.

On June 25th, we had a bad wreck in the shaft and sinking was delayed from June 25th to the 28th. The 7/8" rope on the skip broke allowing the skip to fall from the 2nd level to the pentice below the 3rd level. The Captain reported the skip-rope as looking bad a few days previous to the wreck, and a new rope was shipped to the Spies Mine from Republic the same day the Captain's report was received. We thought that the rope would hold out until the following Sunday when we planned on making the change. On Sunday morning, June 24th, while the men were hoisting the skip up, preparatory to taking the rope off, it broke and the skip dropped about 200 feet.

There was nobody in the shaft at the time, as the shaftmen were on surface waiting for the skip to come up so that they could block it on surface and take the rope off. We have two pentices in the shaft, the first one made of timber and the second one, 10 feet below, made of timber and loaded with rock. This arrangement worked exactly as we planned, as the first pentice broke the fall and we found the skip resting partially on the rock and partly out of the cage-compartment, where some of the runners were broken. It took us three days to repair the runners and shaft timber and rebuild the first pentice.

September 7th, three hours delay due to transmission line trouble.

September 11th, the oil switch on the hoist was out of order and delayed sinking four hours.

On September 17th, transmission line trouble cut off the power for two and one-quarter hours.

On October 3rd, the hoisting engine grids shorted and delayed operations seven and one-half hours.

On October 9th, we were delayed seven and one-half hours while changing the cage rope from the old to the new electric hoist.

No sinking was done on October 17th to 20th inclusive, while the air compressor was being moved from the old to the new engine house.

The balance of the year was free from break-downs.

LABOR.

The labor conditions in 1923 were very bad. We were hampered from February until August by being short of men. In May and June, particularly, we could only operate one of the three eight-hour shifts, and at times even the one shift was short handed. The men kept moving around and drifting from one mine to the other.

The following table shows the number of shifts worked in the shaft compared with the number there would have been had we been full handed:-

MONTH	SHIFTS WORKED BY MINERS		PER CENT OF SHORTAGE
	IF FULL HANDED	ACTUALLY WORKED	
Jan., 1923,	Full crews	Full crews	No shortage
Feb., "	476	462	3%
Mar., "	567	474	16%
Apr., "	511	330	35.4%
May, "	539	188	65.0%
Jun., "	609	283	53.6%
Jul., "	595	509	14.4%
Aug., "	Full crews	Full crews	No shortage
Sep., "	602	553	8.0%
Oct., "	623	526	15.6%
Nov., "	574	516	10.2%
Dec., "	Full crews	Full crews	No shortage

It will be noted that labor conditions were very bad in April, May and June, particularly, and as a result, we did not try to do much sinking during that period, but kept the small crew employed on the 4th level plat. The shortage naturally threw our estimated time schedule all out of line.

PLATS & POCKETS.

The Fourth Level Plat was cut in April, May and June. The plat is opened up full size for a distance of 35 feet South of the shaft. On the North side, a drift was put in opposite the ladder and pipe compartment of the shaft. This drift curves around to the North-West joining the tail track going North from the main plat.

A pocket was put in opposite the South skip compartment, the capacity being a skip load. The ground has been excavated for the North pocket, but we did not build the pocket itself, as it may be some time before the second skip is needed in the shaft.

An electric pump was also temporarily installed on this plat to handle the water coming in the shaft between the 3rd and 4th levels. The distance between these levels is 550 feet.

The Fifth Level Plat was cut out just about the same as the level above, except that the drift North of the pipe compartment was omitted. On this level, all the pipes and wires will come out on the pump house side of the shaft.

In cutting out the plat and pump house, we are following a detailed plan laid out that provides for a pump house East of the shaft. It is planned to have two 500 gallon pumps and the motor generator haulage set and switch board in the pump house. The sump will be 10 feet below the pump house and the pump suction concreted in so that in case of a heavy flow of water, the pump house can be sealed off and pumps continue to run without being flooded. The sump will hold the incoming water for six hours in case of transmission line trouble.

At the bottom of the shaft we drove a drift South of the shaft for 20 feet. This provides a way to clean the skip-pit as a car can be run from the cage to the mouth of a chute placed in the skip compartment. At the South end of the drift a 45° incline raise will be put up to the East, which will hole underneath the pump suction providing a way to clean the mud out of the sump.

E. & A. #429.

All of the work described in this report is being done under E. & A. #429. Several of the items on this E. & A. over-run due to wage increases granted the men since the Estimate was made, and also due to the change in the ground in the shaft from black or Graphitic Slate to gray slate and Chert.

In making out the estimated cost of sinking, the Spies Shaft an additional 800 feet; driving two rock drifts; cutting two plats; etc., we were guided by the cost of sinking the same shaft from surface to the 3rd level and driving the old rock drifts on the 1st, 2nd and 3rd levels.

Allowances were made for the difference in wages prevailing in 1916 and 1917 when E. & A. #274 was completed. We assumed also that the same rate of progress would be made in the shaft. From surface to the bottom of the skip-pit below the 3rd level, the only rock encountered in the Spies shaft was black slate. The three rock drifts on the main levels were also largely in black or Graphitic Slate. We had no drill holes in the vicinity of the shaft to show us the identity or kind of ground we would sink through, but as the footwall of the mines in this vicinity is black slate, we based our figures for cost and speed on the assumption that all the work would be done in black slate.

The various accounts in detail follow but no explanation will be made in cases where the work is only partially completed.

MAINTENANCE

This account estimated at \$700.00 over-ran approximately \$3050.00 for two reasons. When we planned on sinking the shaft, the E. & A. #429 provided for one skip compartment as in the old shaft the cage and skip to run in balance. Then came the idea that perhaps it would be advisable to plan two skip-roads in case the production desired from the shaft should be increased some time in the future. That idea meant that the present North skip-road now used for ladders and pipes from the surface to the 3rd level would become the new skip-road, and so in order to be in shape at some future time to increase production, the pipes and ladders from the 3rd level to the bottom were placed in a new compartment cut off of the North side of the old cage compartment. The new air line and water column and cables will be hung from surface to the bottom in the new compartment. The ladder road for the present will be left in the North skip compartment from surface to the 3rd level. Narrowing up the cage compartment necessitated moving the cage guides and we actually found it advisable to put in new guides from surface to the 3rd level.

This work all had to be charged to maintenance.

Then furthermore we had a shaft wreck that destroyed one skip beyond repair and required considerable re-timbering in the shaft. This expense was also charged to maintenance.

SHAFT SINKING:-

As explained before, E. & A. #429 was based on the sinking previously done in the shaft on E. & A. #274. The cost per foot for sinking in black slate to the skip-pit below the 3rd level in 1916 was \$72.80 per foot. Due to the difference in wage scales prevailing in 1916 and 1922, and furthermore, due to the fact that the hoisting of the rock from the shaft would be done by electricity instead of steam, the cost per foot for the 800 feet additional sinking was estimated at \$80.00 per foot.

In November, 1922, after the sinking crews were filled up and well organized, we sunk 91 feet at a total cost of \$7961.24 or \$87.60 per foot. That was the nearest approach we ever got to our estimate, because in December the shaft ran into hard gray slate and later Chert, slowing us down very materially. Then came the labor shortage which threw our costs way out of line.

The detailed cost of sinking 572½ feet of shaft in 1923 was as follows:-

SINKING:-	TOTAL COST	COST PER FOOT
General Supplies,	\$931.76	\$1.63
Iron & Steel,	905.43	1.58
Oil & Grease,	77.89	.14
Machinery Supplies,	1,623.44	2.83
Explosives,	3,351.22	5.85
Sundries,	435.56	.76
Miscellaneous Expense (Engine House, Boiler House, Top Landing, etc.,)	7,702.84	13.45
Total,	15,028.14	26.24
Labor,	35,467.27	61.95
Total Sinking,	50,495.41	88.19

TIMBERING:-	TOTAL COST	COST PER FOOT
General Supplies,	\$214.05	\$0.37
Iron & Steel,	617.51	1.08
Lumber & Timber,	10,445.08	18.24
Sundries,	274.56	.48
Miscellaneous Expense (Engine House, Boiler House, Dry, etc.)	2,414.33	4.22
Total,	13,965.53	24.39
Labor,	9,337.93	16.31
Total Timbering,	23,303.46	40.70
GRAND TOTAL,	\$73,798.87	\$128.89

The cost per foot for the entire 797 feet sunk in 1922 and 1923 was \$119.802.

You will note that the cost for November, 1922, sinking in black slate was \$87.60 per foot, compared with the estimate of \$80.00. The cost for 1923 sinking in gray slate and chert was \$128.89 per foot, but as we had no way of foreseeing what material the shaft would encounter, the estimate was too small. The 10% added for contingencies in the Superintendent's Division actually brings the \$80.00 per foot estimated to \$88.00 compared with \$87.60 cost per foot sunk in November 1922, so that I feel we would have come within the estimated figures if the sinking had all been in black slate.

PLATS & POCKETS:-

The cost of cutting out the 4th and 5th level plats is going to over-run the estimate due to the nature of the ground encountered. The Fifth Level Plat particularly is in very hard cherty slate, and we are now using #248 I.R. machines to drill the holes. It frequently takes two shifts to drill a round of holes.

All of the work on the 1st, 2nd and 3rd level plats was done with the light B.C.R.W. 430 drilling machines. The estimate was based on the assumption that we would have similar conditions.

Instead of that, we are compelled to use the same type of drills commonly used in the Republic and Cliffs Shaft Mines for hard rock drilling.

POWER HOUSE:-

The Power House is complete with the exception of the cement floor and we probably will get that in without over-running the estimate.

TOP TRAM ENGINE HOUSE:-

Nothing was provided for a new top tram engine house in the E. & A., but as the Committee on Fire Prevention recommended a fire proof structure, it was built accordingly.

CHANGE HOUSE:-

The addition built onto the Dry to house the heating boiler over-ran the estimate a little, due to the higher cost of materials and labor than those existing when the estimate was made.

PULLEY STANDS:-

The old pulley stands at the Lake Mine were dismantled and shipped to the Spies property. It was originally planned to have but two stands, but the Chief Mechanical Engineer later decided that three would make better operating conditions, and for that reason we over-ran our estimate.

HOISTING & COMPRESSOR PLANT:-

Both of these accounts in the Chief Mechanical Engineer's Division over-ran due to higher price for materials than were estimated. The hoist is a duplicate of those at the Barnes-Hecker Mine, and that was taken as a basis in making the estimate.

PUMPING PLANT:-

The estimate covering the pumps and electrical apparatus was not ample enough to cover the cost due to increased price of machinery and motors similar to the hoisting plant.

HEATING SYSTEM:-

The old heating system at the Spies property involved the use of a large 125 H.P. boiler in the boiler house, and traps were placed in each building. We conceived the idea of using a smaller 50 H.P. boiler placed in the addition to the Dry. When we made the change, we found the old steam lines to the buildings in bad shape, not having been used for two winters. While the mine was idle, the office and engine house were heated with stoves. We were compelled to put in new steam lines and we went a step further and piped all the traps, so as to return the condensed water to a hot well. That made it necessary to buy a small electric driven plunger boiler feed pump. The new piping, hot well and pump were not included in the original estimate, and so we over-ran approximately \$1350.00. The new system, however, will pay for itself quickly, as our records show that the monthly coal consumption runs from ten to fifteen tons less than it did with the old plant, so that the decrease in operating costs should cover the cost of the new system in two years' time.

ORE ESTIMATE.

There is no change in the Spies ore estimate which stands at approximately 50,000 tons of available ore.

The Virgil ore body has been estimated by the Geological Department and appears in their reports at the same figure as last year.

SPIES-VIRGIL MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1923

GRADE	IRON	PHOS.	SILICA
Spies,	(No Production)		
Virgil,	(No Production)		

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1923

GRADE	IRON	Mine PHOS.	SILICA	Lake Erie IRON	MOIST.
Spies,	(No Shipments)				
Virgil,	(No Shipments)				

ORE STATEMENT - DECEMBER 31ST, 1923.

	SPIES	VIRGIL	TOTAL	TOTAL LAST YEAR
On hand January 1, 1923,	2,302	835	3,137	30,760
Output for Year,	-	-	-	-
Stockpile Overrun,	-	-	-	7,500
Total, Shipments,	2,302	835	3,137	38,260
	-	-	-	35,123
Balance on Hand,	2,302	835	3,137	3,137
Decrease in Output,				7,500

1923 -- 3-8 Hour Shifts, Jan. 1st to Dec. 31st, 1923.

1922 -- Mine Idle, Jan. 1st to Oct. 1st, 1922.

3-8 Hour Shifts, 6 days per week, Oct. 1st to Dec. 31st, 1922.

SPIES-VIRGIL MINE

SHIPMENTS FOR YEAR-1923.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Spies,	-	-	-	35,123
Virgil,	-	-	-	-
Total,	-	-	-	35,123
Total Last Year,	-	35,123	35,123	
Decrease,			35,123	

SPIES MINE

COMPARATIVE WAGES AND PRODUCT

	1 9 2 3	1 9 2 2	INCREASE	DECREASE
PRODUCT	-	7,500		7,500
No.Shifts & Hours		2-8;1-8		
AVG.NO.MEN WORKING				
Surface	3	1	2	
Underground	2	3		1
Total	5	4	1	
AVG.WAGES PER DAY				
Surface	3.98	3.02	.96	
Underground	4.32	3.99	.33	
Total	4.12	3.69	.43	
WAGES PER MO.OF 25 DAYS				
Surface	99.50	75.00	24.50	
Underground	108.00	99.75	8.25	
Total	103.00	92.50	10.50	
PRODUCT PER MAN PER DAY				
Surface				
Underground				
Total				
LABOR COST PER TON				
Surface				
Underground				
Total				
AVG.PRODUCT BRK'G & TRM'G				
" WAGES CONTRACT MINERS				
" " " TRAMMERS				
TOTAL NO.OF DAYS				
Surface	1,048 $\frac{1}{4}$	431 $\frac{1}{2}$	616- $\frac{3}{4}$	
Underground	738 $\frac{1}{4}$	977		238- $\frac{3}{4}$
Total	1,786 $\frac{1}{2}$	1,409 $\frac{1}{2}$	377	
AMOUNT FOR LABOR				
Surface	4169.38	1303.96	2865.42	
Underground	3188.60	3894.47		705.87
Total	7357.98	5198.43	2159.55	

Proportion Surface to Underground Men:

1922 - 1 to 3.
 1921 - 1 to 2.8
 1920 - 1 to 3.1
 1919 - 1 to 2.91
 1918 - 1 to 2.86

1922 - not operating.
 1923 " "
 Product 1922 is stockpile overrun.

HILL-TRUMBULL MINE
ANNUAL REPORT FOR 1923

Ore operations at the Hill-Trumbull Mine for the year 1923 were started on May 5th and continued until the 3rd of October. The mine produced 406,915 tons of wash ore, yielding 255,636 tons of concentrates, and 44,723 tons of direct ore, making a total shipment of 300,359 tons. This compares with an output of 529,858 tons of wash ore, yielding 346,931 tons of concentrates, and 3,084 tons of direct ore, or a total shipping grade of 350,015 tons during 1922.

Operations during 1923 were conducted entirely on day shift, whereas we double shifted to some extent during 1922.

The analysis of the crude ore mined from the Hill and Trumbull properties during 1923 was as follows:

	<u>TONS.</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>
Hill Crude Ore-----	299,245	41.90	.045	35.41
Trumbull Crude Ore-----	<u>107,670</u>	<u>43.34</u>	<u>.048</u>	<u>32.81</u>
TOTAL AND AVERAGES-----	406,915	42.28	.046	34.72

Following is the analysis of the concentrates secured from a treatment of the Hill and Trumbull crude ores during 1923:

	<u>TONS.</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>MOIS.</u>
Hill Non-Bessemer Concentrates----	184,234	59.33	.057	8.36	9.74
Trumbull Non-Bessemer Concentrates	<u>71,402</u>	<u>59.15</u>	<u>.062</u>	<u>6.78</u>	<u>8.52</u>
TOTAL AND AVERAGES-----	255,636	59.28	.058	7.92	9.40

The analysis of the direct ore shipped from the Hill property during the past season is shown below:

	<u>TONS</u>	<u>FE.</u>	<u>PHOS.</u>	<u>SIL.</u>	<u>MOIS.</u>
Hill Direct Ore-----	44,723	58.28	.060	10.63	10.99

According to the schedule of operations decided upon by the Directors of the Mesaba-Cliffs Iron Mining Company, the Hill-Trumbull properties are to produce 300,000 tons of shipping ore during the season of 1924. This tonnage can be secured from day shift operations and the tonnage and analysis of the ore to be secured from the Hill and Trumbull properties on this schedule are

estimated as follows:

ESTIMATE OF PRODUCTION - 300,000 TONS

<u>WASH ORE - HILL MINE</u>	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>
Hill Approach Area-----	163,000	50.00	.052	21.00
Rocky Area (North Side Hill Pit)----	13,000	42.00	.026	36.00
Rocky Area (Bottom old Area A)-----	<u>27,000</u>	<u>38.00</u>	<u>.038</u>	<u>40.00</u>
TOTAL- - - - -	203,000	47.88	.048	24.48
<u>WASH ORE - TRUMBULL MINE</u>				
All Ore from Area West of Approach--	<u>250,000</u>	<u>43.31</u>	<u>.059</u>	<u>31.55</u>
GRAND TOTAL- - - - -	453,000	45.36	.054	28.38
<u>SHIPPING GRADE</u>				
Hill Approach Area-----	114,000	61.00	.070	5.15
Hill Rocky Area No. 1-----	7,000	59.00	.050	8.75
Hill Rocky Area No. 2-----	13,000	57.00	.045	12.20
Hill Direct Ore-----	16,000	60.00	.055	9.90
Trumbull Ore-----	<u>150,000</u>	<u>58.62</u>	<u>.074</u>	<u>9.35</u>
TOTAL- - - - -	300,000	59.23	.071	7.89

Our maximum estimate of production from the Hill-Trumbull properties for 1924 is placed at 550,000 tons. It would be necessary to make plans toward this end before the opening of navigation and to operate the properties on double shift throughout the season. The division of the tonnage between concentrates and direct, also between the Hill and Trumbull properties, and the analysis of same, is given below:

ESTIMATE OF PRODUCTION - 550,000 Tons

<u>WASH ORE - HILL MINE</u>	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>
Hill Approach Area-----	163,000	50.00	.052	21.00
Extension Approach Area-----	63,000	48.50	.055	23.00
Rocky Area (North Side Hill Pit)----	13,000	42.00	.026	36.00
Rocky Area (Bottom old Area A)-----	<u>27,000</u>	<u>38.00</u>	<u>.038</u>	<u>40.00</u>
TOTAL- - - - -	266,000	48.03	.050	24.13
<u>WASH ORE - TRUMBULL MINE.</u>				
All Ore from Area West of Approach--	<u>459,000</u>	<u>43.31</u>	<u>.059</u>	<u>31.55</u>
GRAND TOTAL- - - - -	725,000	45.04	.055	28.83
<u>SHIPPING GRADE</u>				
Hill Approach Area-----	114,000	61.00	.070	5.15
Extension Hill Approach Area-----	41,000	59.50	.070	6.95
Hill Rocky Area No. 1-----	7,000	59.00	.050	8.75
Hill Rocky Area No. 2-----	13,000	57.00	.045	12.20
Hill Direct Ore-----	100,000	60.00	.055	9.90
Trumbull Ore-----	<u>275,000</u>	<u>58.62</u>	<u>.074</u>	<u>9.35</u>
TOTAL- - - - -	550,000	59.39	.069	8.46

HILL-TRUMBULL MINE.

The Hill direct ore is all of Non-Bessemer grade and the wash ore to be handled during 1924 contains comparatively little Bessemer grade. While we will be able to secure some Bessemer concentrates, it would take some time to accumulate a cargo and the cost of keeping this ore separate and the car and dock space necessarily held for it, would not be justified. We should be in Bessemer ore on the Trumbull property during 1925 and could produce a substantial tonnage of this grade, if it is desired.

In the case of both the 300,000 and the 550,000 tons estimates, we have figured the recovery in the treatment of Trumbull wash ore at 60% and from the Hill ore at 70%. This is in line with our past experience in these ores. In considering the rocky area along the north side of the Hill pit, we have made a 40% deduction for rock and have figured on a 50% gross recovery on the balance of the material. A 50% deduction for rock was made in the case of the rocky material in the bottom of Area A and we figure on a 50% gross recovery in the treatment of the ore.

HILL-TRUMBULL ORE ESTIMATE OF JANUARY 1ST. 1924

Following is an estimate of the ore in sight at the Hill-Trumbull properties on January 1st., 1923, the tonnage mined during the past year and the estimate of January 1st., 1924.

A factor of 14 cubic feet per ton was used in the direct shipping ore and 18 cubic feet per ton for the wash material.

ORE ESTIMATE OF JANUARY 1ST., 1923.

	TONS
Hill Bessemer Direct Shipping Ore-----	642,000
Hill Non-Bessemer Direct Shipping Ore-----	1,481,000
Hill Bessemer Concentrates-----	1,440,000
Hill Non-Bessemer Concentrates-----	<u>1,029,000</u>
TOTAL HILL ORE IN SIGHT JANUARY 1ST., 1923- - - - -	4,592,000
Trumbull Bessemer Direct Shipping Ore-----	85,000
Trumbull Non-Bessemer Direct Shipping Ore-----	310,000
Trumbull Bessemer Concentrates-----	2,400,000
Trumbull Non-Bessemer Concentrates-----	<u>1,567,000</u>
TOTAL TRUMBULL ORE IN SIGHT JANUARY 1ST., 1923- - - - -	4,362,000
GRAND TOTAL HILL AND TRUMBULL ORE IN SIGHT JANUARY 1ST., 1923-----	8,954,000

ORE MINED DURING 1923

Hill Non-Bessemer Direct Shipping Ore-----	44,723
Hill Non-Bessemer Concentrates-----	<u>184,234</u>
TOTAL HILL ORE MINED DURING 1923- - - - -	228,957
Trumbull Non-Bessemer Concentrates-----	<u>71,402</u>
GRAND TOTAL HILL AND TRUMBULL ORE MINED DURING 1923- - - - -	300,359

ORE ESTIMATE OF JANUARY 1ST., 1924

Hill Bessemer Direct Shipping Ore-----	642,000
Hill Non-Bessemer Direct Shipping Ore-----	1,436,000
Hill Bessemer Concentrates-----	1,408,000
Hill Non-Bessemer Concentrates-----	<u>877,000</u>
TOTAL HILL ORE IN SIGHT JANUARY 1ST., 1924- - - - -	4,363,000
Trumbull Bessemer Direct Shipping Ore-----	85,000
Trumbull Non-Bessemer Direct Shipping Ore-----	310,000
Trumbull Bessemer Concentrates-----	2,396,000
Trumbull Non-Bessemer Concentrates-----	<u>1,500,000</u>
TOTAL TRUMBULL ORE IN SIGHT JANUARY 1ST., 1924-- - - - -	4,291,000
GRAND TOTAL HILL AND TRUMBULL ORE IN SIGHT JANUARY 1ST., 1924-----	8,654,000

While we did not ship any Bessemer grade from the Hill-Trumbull properties during the past season, due to the fact that we were only able to secure a relatively small tonnage from day to day, we actually turned out 31,500 tons of Hill Bessemer concentrates and 3,500 tons of Trumbull Bessemer concentrates.

The tonnages used in our January 1st., 1924, estimate are all given as direct shipping, the wash ore being reduced to a concentrated basis. We have used a factor of 60% as our expected gross recovery, this being an average for the entire ore body.

Ore operations during the past season have shown no change from expected conditions, in so far as the tonnage is concerned. Some test-pitting was done on the Trumbull property, and also in the Hill direct ore, to check the old drill records. The result of this work has been such that we have not revised our tonnage estimates of a year ago, otherwise than to reduce the estimate by the tonnage shipped during 1923. Further ore operations to the west of the taconite island tend to confirm our belief that check drilling will be necessary in this locality before the stripping banks are carried any further to the northward. While we have not sufficient information to warrant changing our ore estimates at this time, the drilling of the area in question will no doubt lead to a revision. The drilling may result in reclassifying some of the wash ore as non-washable, but on the other hand, we may show some extension of the wash ore deposit to the eastward. We do not anticipate doing any stripping in this area for the next several years. We have in mind doing some check drilling before starting to strip.

We do not contemplate any exploratory work at the Hill-Trumbull properties during 1924, further than test-pitting to determine grades ahead of our shovel cuts. The outline of the Hill-Trumbull ore deposit is quite well established and we do not anticipate adding to our ore reserves by future explorations.

The average analysis of the ore in the Hill and Trumbull properties on January 1st., 1924, is as follows:

HILL MINE

	<u>TONS.</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>FE.NAT.</u>
Bessemer Direct Shipping-----	642,000	58.00	.045	13.00	53.36
Non-Bessemer Direct Shipping-----	1,436,000	58.00	.055	13.00	53.36
Bessemer Concentrates-----	1,408,000	60.50	.045	7.50	56.00
Non-Bessemer Concentrates-----	<u>877,000</u>	<u>61.00</u>	<u>.059</u>	<u>6.50</u>	<u>56.43</u>
TOTAL AND AVERAGES-----	4,363,000	59.41	.051	9.92	54.83

TRUMBULL MINE

Bessemer Direct Shipping-----	85,000	56.40	.040	12.79	51.32
Non-Bessemer Direct Shipping-----	310,000	58.04	.060	9.85	52.82
Bessemer Concentrates-----	2,396,000	60.00	.043	8.00	55.50
Non-Bessemer Concentrates-----	<u>1,500,000</u>	<u>60.00</u>	<u>.080</u>	<u>8.00</u>	<u>55.50</u>
TOTAL AND AVERAGES-----	4,291,000	59.79	.057	8.23	55.22

STRIPPING

The A. Guthrie Company stripped 1,066,474 cubic yards of overburden from the Hill-Trumbull properties during the past year. The total stripping on this Company's 3,000,000 yard contract, as of January 1st., 1924, amounts to 2,914,877 cubic yards and leaves a balance of 85,123 yards. The Contractor contemplates completing the present cut to the south line of the Trumbull property, so that a new cut may be started next spring at the north side of the Trumbull and the clean up work may be done before the ore season opens and eliminate any congestion as between the A. Guthrie Company and our operations. The Contractor figures on completing the cut about the middle of January. Due to severe weather conditions, progress will be rather slow and we estimate that about 30,000 yards will be moved before work is abandoned. This will leave a balance of about 55,000 yards on the 3,000,000 yard contract, but as the A. Guthrie Company have a new contract for 1,900,000 yards, more or less, the balance on the old contract can be worked in satisfactorily.

The A. Guthrie Company started repair work on their Model 300 shovel on February 20th, 1923. The boom was taken down, loaded onto flat cars and moved to their Hill-Annex shops at Calumet. The shovel was generally overhauled and it was found necessary to make a number of replacements, as well as extensive repairs. Weather conditions were very unfavorable and the repair work was not completed in the time anticipated. In making our ore estimates for 1923, we were assured that stripping would be resumed by March 15th. Due to slow progress on repair work and the delay in receiving new parts from the factory, stripping operations were not started until April 20th. Weather conditions were very bad during the latter part of March and the forepart of April and even had the equipment been in shape, it would have been very difficult for the Contractor to have made any headway before the middle of April.

Stripping operations were slowed up to quite an extent during the early part of the season, due to bank slides, which carried surface material out onto

the tracks and necessitated moving the shovel about, and some hand cleaning. The Contractor was obliged to shut down the big shovel for a time and conduct cleaning operations with a standard machine. The bank slides continued throughout April and the forepart of May and it was not until May 15th that the 300 machine was able to dig to advantage.

The Contractor started the first cut at the south Trumbull line and dug north and east to the taconite island at the north edge of the Hill pit, this cut being completed on October 8th. Part of the bank was blasted and aside from the difficulties encountered with sliding material, good progress was made. There was some congestion with our ore operations during the latter part of the season, but it was not of a serious nature. The Contractor moved the 300 shovel back to the north Trumbull line and spent the balance of the year taking a cut to the southwest, being within approximately 100' of the end of the cut on January 1st. The material in this second cut had all been blasted and their progress was quite satisfactory. The Contractor intends to complete this cut to the south Trumbull line before suspending operations for the winter. They will then dismantle the 300 shovel and replace it with a 350-ton machine for 1924 work. The new shovel will be erected near the north Trumbull line and will take a cut across this property, beginning as early in the season as weather conditions warrant. In the meantime, the clean up work will be undertaken between our present ore cuts and the stripping bank. A sufficient area will be available for ore operations, so that there will be no congestion between the two jobs and we would be able to enlarge our operations to the extent of the 550,000 tons production estimate, provided we started out the season with this end in view.

Although the A. Guthrie Company spent about two months on repair work to the 300 shovel, the machine was not in the best condition and their operations were slowed up throughout the year, due to breakdowns. There were several serious delays during the month of July, one of two days resulting from a broken swinging engine, and another, due to a broken cable, allowed the dipper to drop, twisting the dipper sticks. Fortunately the Company had extra dipper sticks on

hand and there was only a delay of three days while the change was being made. The frequency of breakdowns caused the Contractor to decide on putting a new shovel on this job and taking the old machine to their shops for rebuilding.

While the Contractor suffered some delays from derailments of their trains, their tracks both in the pit and on the dump were maintained in quite satisfactory condition.

For clean up work, the Contractor moved a Model 60 Marion shovel onto the job on July 26th. This machine started operating on July 28th and worked intermittently, loading out the spill from the big shovel until September 1st. The A. Guthrie Company rented our 36 revolving shovel for clean up work along the north side of the Hill pit. This job was started the latter part of October and completed on the 19th of November. This machine loaded out material that had been washed down from the bank during the spring and also the spill from the Contractor's 300 shovel. The completing of this clean up work during 1923 will allow us to start our ore cuts to the west of the approach as soon as the season of navigation opens and there will be no congestion between our operations and those of the Contractor.

We used our revolving shovel to clean up some surface material that had been washed into our Area B ore cut during the spring break-up. We loaded out 5,134 cubic yards on this job.

Due to the sloughing of the stripping bank along the south side of Area A, it was necessary to make a clean up cut in order to prevent the surface material from washing down into the pit. On April 18th our 88-C Bucyrus shovel was taken into the pit and started this clean up work. We had great difficulty in taking this cut, especially at the east end, where a heavy seam of blue gumbo clay kept sloughing out and burying the shovel. We were obliged to abandon our original plans and leave a part of the cut to be accomplished in the fall, when the material was drier. The job was started April 23rd and completed May 1st., 6,096 cubic yards being handled. The frost was not out of the bank on May 1st. and quite a large amount of sloughing occurred subsequently. While we had anticipated only finishing the clean up cut undertaken in the spring, we found that it was necessary to take almost a complete cut along this berm during the fall. When the lean ore operations were completed the latter part of November, the 88-C

HILL-TRUMBULL MINE.

machine was moved to old Area A and made a clean up cut, the job being completed on December 11th. The 88-C machine handled 16,552 yards.

In order to effect good drainage on the east side of our approach tracks and also complete the run-around track in connection with the coaling of locomotives, the 36 revolving shovel took a cut from the south end of Area A to the coal dock. This work was started the last week in November and completed on December 7th, the shovel handling 6,958 yards. It will now be possible to coal locomotives and run the trains down into the pit, connecting with the approach tracks about half way between the coal dock and Area A. Heretofore, we have been obliged to switch back onto the approach tracks at the mouth of the pit.

The following table shows the quantity and cost of the A. Guthrie Company's stripping by months:

<u>MONTH</u>	<u>CUBIC YARDS</u>	<u>COST PER YARD</u>	<u>TOTAL COST</u>
April-----	10,262	\$.3585	\$ 3,678.84
May-----	111,090	.3539	39,313.84
June-----	138,312	.3574	49,430.36
July-----	115,850	.3546	41,074.64
August-----	167,561	.3807	63,784.65
September--	138,592	.3724	51,615.98
October----	113,980	.3528	40,210.05
November---	148,490	.3525	52,346.30
December---	<u>122,337</u>	<u>.3342</u>	<u>40,879.59</u>
TOTAL-----	1,066,474	.3585	\$382,334.25
1922-----	1,033,510	.3216	\$332,394.89

The 1923 increase of \$.0369 per yard over the 1922 yardage was due to the higher price paid for coal and the advanced hourly rate for labor during the year. Considerably more gopherhole blasting was undertaken during 1923 and the rate paid these men was quite high.

We entered into a new contract with the A. Guthrie Company for an additional 1,900,000 yards of stripping to be removed during the years 1924 and 1925. This stripping is all to be done on the Trumbull property.

TRACKS

A crew of 16 men started work on the Area A loading tracks on the 5th of April. The Model 36 shovel was taken into the pit to dig down a track grade in the bottom of Area A. All loading arrangements were made here by the first of May.

The track gang also put in some time before ore operations were started on the main pit approach track. They replaced ties and did some lining and grading along that portion of the track running between Area A and B, where the surface material had been removed and replacement made with lean ore.

During May the crew was engaged in raising the low places along the main line track to the washing plant and doing some alignment work on the lean ore stockpile track.

We found it necessary to maintain a fair sized track gang during the entire season, due to the fact that the cuts were comparatively shallow and we had from three to four shovels in operation. During 1922 practically all of our wash ore was obtained from the operation of one shovel, whereas in 1923, two machines were in constant use and at times three, on this grade of material. It was found necessary to shift tracks very frequently in the Area A operations and the track crew was engaged constantly in the pit, with the exception of a few days from time to time on the lean ore stockpile.

Upon the completion of ore operations, the gang laid a loading track to the south end of Area B, in connection with the moving of the lean ore from the Trumbull property.

The general repair work on the main line tracks to the washing plant started during November and was continued until the 10th of December, when all but a few hundred feet at the east end of the dump had been placed in very good shape. The small job remaining will be undertaken in the spring when weather conditions are favorable. The track gang spent some time during October and November on the waste and lean ore dumps, in connection with the lean ore operations on the Trumbull property.

REPAIR WORK

The work of overhauling the open pit and washing plant equipment was started during December, 1922, and carried on with a small force of men until April, 1923. We have found it advisable to discontinue work during the holidays and in consequence the men were all given a two week's lay-off.

The 88-C Bucyrus shovel was given a very thorough overhauling, as it had handled practically the entire 1922 output of crude ore. The main repairs consisted of the following work; reducing the bearings, replacing worn pinions and bushings, general repair work to the swinging circle, turning the hoisting drum end for end on account of the surface wear, removing and retipping the boiler flues and the cutting out of the water distributing plate in the bottom of the shell. The distributing plate was supposed to create a proper circulation of the feed water, but due to the quantity of sediment collected on it, the boiler could not be properly washed out. The boiler of the shovel was covered with sheet iron to hold the asbestos in place. The plates on the boom were all removed and the repairs made in the blacksmith shop.

The repairs to the 85-C Bucyrus shovel were relatively light, as this machine was only in use a short time and in consequence the wear was light. The old drum on the 85-C machine collapsed and it was necessary to replace it.

The Model 36 shovel was taken into the shops during February and gone over thoroughly. This machine was found to be in pretty fair shape and the repairs were not extensive.

Locomotives Nos. 101, 102 and 103 were put through the shops, the repairs being relatively light. The drivers were removed to permit the changing of tires and all of the bearings were gone over. The cylinders were opened and a careful inspection made of their condition, which was found to be satisfactory in all cases.

Locomotives Nos. 17 and 19 were given a general overhauling during the previous year and only minor repairs were necessary. The cab of locomotive No. 19, which had been wrecked while engaged in stockpile loading at the Boeing Mine,

was replaced. The 19 locomotive was rented to the Great Northern Railway for spotting service at the Boeing Mine.

The 20-yard dump cars were gone over and a number of alterations and replacements were made in the dump rigging. The cars operated considerably better during 1923 as a result of these alterations and the repair work this winter should be comparatively light. We ordered a sand blasting outfit and paint and intended to go over all of the cars. The paint was not received in time, however, to do the work and only two of the cars were cleaned and painted. This work will be done during the present winter.

The doors of the 12-yard cars were straightened and the plates in the bottom renewed. Eight of these 12 cars were sold to the Boeing Mine, the four remaining at the Hill-Trumbull property being used to handle rock and lean material in connection with our wash ore operations.

The washing plant repairs, except for the general overhauling and replacements on the two pan conveyors, were in the nature of general cleaning and greasing of all bearings, relining the chutes and overhauling the various mechanism. The 8' pan conveyor was completely dismantled and taken to the shops, where it was straightened and riveted. Considerable trouble was experienced with the old rivets shearing. Larger rivets were used and they were all countersunk to get away from this trouble.

The job of building up the tailings basin dike, which was started late in the fall of 1922, was completed on January 9th. The Model 28 shovel, belonging to the Crosby Mine, was used for this purpose, a cut being taken along the inside of the dike and the tailings dumped on top. The rains during the early part of 1923 washed the fine tailing material on top of the dike to a considerable extent and it was found necessary to replace this material with sand and gravel during the past summer. For this purpose a horse and small tram cars were used. We feel that the dike is of sufficient height now to take care of the tailings during our 1924 operations, although it will no doubt be necessary to do some repair work from time to time.

The 1923 pit operations were completed on December 11th and the equipment moved to the shops. The work of dismantling the shovels was started first, so as to determine the amount of repair work necessary.

ORE OPERATIONS

Ore operations for the 1923 season were started on May 5th and completed October 3rd.

In making our estimate of production, we figured on shipping 50,000 tons of direct ore during 1923, but owing to the grade, we were only able to work in 44,723 tons of this material. In May the No. 26 shovel was cut into the north Hill bank to the east of the taconite island and took two cuts several hundred feet in length here. In the center of these cuts, there was a small area of direct shipping ore and 11,845 tons of this higher grade material was secured. During June the Model 36 shovel was moved to the east end of the pit and cut into the direct ore. On account of the shortage in the Great Northern car supply and also the fact that we could only work in a limited quantity of this material, loading was quite intermittent and we did not secure the anticipated tonnage.

The analysis of the direct ore produced during 1923 was as follows:

	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>MOIS.</u>
Hill Direct Shipping Ore-----	44,723	58.28	.060	10.63	10.99

We have put down several test-pits in the direct ore area at the east end of the Hill pit and have shown that the material to be handled next season is of higher grade than the 1923 output. If we are called upon to produce 550,000 tons of shipping grade, we could work in 100,000 tons of this direct ore very nicely. On the basis of 300,000 tons output, we will only be able to produce about 16,000 tons here, as it is necessary to forward 150,000 tons of Trumbull and we will secure about 134,000 tons of Hill ore in cutting down on the Hill side to get into the Trumbull and in mining some tonnage of rocky material in the bottom of old Area A and along the north Hill ore bank, in line with the emphatic request of the fee interests.

Wash ore operations were started on May 5th, the No. 26 shovel digging along the north bank of the Hill pit and to the east of the taconite island and the No. 27 machine operating at the east end of Area A. The material handled by the 26 shovel was of very satisfactory grade, but that from the 27 was of very low iron and high silica content and only limited quantities of it could be worked in. The two shovels were engaged in these HILL-TRUMBULL MINE.

places during the month of May, an appreciable part of the material handled by the No. 27 machine being diverted either to the waste dump or the lean ore stockpile. All ore under 25% iron was wasted and part of that running between 25% and 30% iron was placed on the lean ore dump. We secured approximately 1,000 tons of concentrates from the Area A ore, which averaged 50% iron and it took us over two months to work it off.

The No. 26 shovel was moved into Area A early in June and was engaged from then until the 27th of August in taking 10' cuts over the bottom of the 1922 workings. On account of the delay on the part of the contractor in making available the Area B ore, we were obliged to depend on the material from the bottom of Area A to carry the leaner ore from the No. 27 shovel, operating along the south side of Area A. The No. 27 machine secured some fair grade wash ore at the west end of the cuts, but for the most part the Hill ore at the east end of the cuts was quite unsatisfactory and progress here was slow, as trains had to be sampled to determine in many cases whether the material should go to the waste pile, lean ore dump, or to the washing plant.

Operations in Area B were started the latter part of August with the No. 26 shovel. We anticipated and realized a high grade crude ore from the north ends of the Area B cuts, but the rocky material at the south end required some sorting and the grade ran off decidedly. Our experience with this rocky material, together with the results shown in the test pits further south, lead to the decision to remove the top layer along the south end of the Trumbull stripped area and place same either on the waste or lean ore stockpiles. Some of this ore runs down as low as 10% iron and it is impossible to treat it successfully in our washing plant. The test pits show that the ore improves to the west and it was only necessary to remove a depth of 25' and two steam shovel cuts in width. The lean material was removed subsequent to the finish of the ore season.

The Model 60 (Crosby Mine) shovel was taken into the pit and started operating along the rocky area to the east of the taconite island on September 19th. With the exception of three days good loading at the start, the cut was in very rocky material and very slow progress was made. The fee owners have

felt for some time that we should work in at least a limited amount of this rocky ore and they finally became so insistent that we decided to do a small amount of work here during 1923 to appease them. The lean material encountered at the south side of Area A was of such character that we could not do any work in the rocky area earlier. Next season the average grade of our ore should be somewhat better and we will be able to operate along the rocky banks to a somewhat greater extent.

Taken on the whole, our wash ore operations for 1923 were much less satisfactory than during 1922, due to the fact that we were required to move our shovels frequently and the amount of track work was excessive.

While our 1924 operations will not be as satisfactory as those of 1922, still there will be a decided improvement over last season.

The tonnage and analysis of the wash ore produced during 1923 follows:

	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>
Hill Wash Ore-----	299,245	41.90	.045	35.41
Trumbull Wash Ore-----	107,670	43.34	.048	32.81
TOTAL AND AVERAGES-----	406,915	42.28	.046	34.72

LEAN AND WASTE ORES.

According to our lease it is necessary to stock certain lean ores on the property. We encountered some of this character of ore along the south side of Area A and over the Trumbull ore to the west of our approach.

The tonnage of lean and waste ores handled during the season and the analysis of same follows:

	<u>YEAR</u>	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>
Coarse Non-Concentrating Material					
Above 40% - from Hill Mine-----	1923	212	41.91	.032	36.62 (1)
" " " "-----	1921	70	41.53	.039	32.67 (1)
" " " "-----	1920	<u>7245</u>	<u>32.90</u>	<u>.028</u>	<u>42.65</u> (2)
TOTAL AND AVERAGES-----		7527	33.23	.028	42.38

- (1) 1921 and 1923 tonnages stocked in No. 1 stockpile.
 (2) 1920 tonnage stocked in No. 2 stockpile.

<u>Concentrating Material above 25%:</u>		<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>
Hill Mine-----	1923	10,028	27.16	.035	50.47
Trumbull Mine-----	1923	<u>22,980</u>	<u>27.95</u>	<u>.029</u>	<u>53.59</u>
TOTAL AND AVERAGES-----		33,008	27.71	.031	52.64

Waste Ore - Placed on Stripping Dump:

Hill Mine-----	1923	3,192	29.58	---	---
TRUMBULL MINE-----	1923	52,007	19.49	---	---

WASHING PLANT

Washing plant operations were begun May 5th and continued until October 3rd, at which time the season's requirements of 300,000 tons had been shipped.

The average quality of the crude ore treated during 1923 was inferior to that of any season since we have been working at the Hill-Trumbull. While the analysis of the crude ore was not so much lower than for previous year, the proportion of fines was considerably greater and we were not able to secure a clean separation and maintain the previous record of iron content in our concentrates. While we did not handle as much rock as during 1921, we encountered quite a little painty material and we were obliged upon many occasions to cut our feed into the mill down to a minimum. Heretofore, the only occasion for cutting down the mill feed has been due to the large amount of rock and the inability to handle it on the 5' conveyor.

The average crew maintained at the washing plant was larger than for the previous season, due in most part to the character of the crude ore, which required very close attention in order to secure a clean separation. We handled more rock than in 1922 and this added an average of better than one man for the season.

The delays to operations on account of mechanical troubles were very infrequent and none of them were of a serious nature.

The old conveyor belt, which had been in operation since the washing plant started in 1920, and had handled 1,159,592 tons of crude ore, was in very bad shape and we replaced it with our new belt at the beginning of our 1923 operations. The present belt should handle in excess of the tonnage carried on the old belt. The most severe wear on the old belt was at the start of the operations and it was quite badly cut up with the small tonnage handled during 1922.

The Great Northern car service at the Hill-Trumbull washing plant was very much improved in 1923, the total delays, waiting for empties, amounting to only $56\frac{1}{4}$ hours for the entire season. A total of 26 hours was lost due to derail-

ments of cars and engines.

The season's tonnage was secured by operating day shifts only. The total overtime worked during the season amounted to 108 hours.

The outside of the metal covering of the washing plant buildings had become quite rusty by the end of 1922 and a contract was let for painting it. The work was started late in the fall of 1922, but was not completed until the spring of 1923.

The tailings backed up to such an extent at the mouth of our launder that it was necessary to supply a clean water jet to keep a channel open for the mill discharge. This procedure is somewhat costly and it is only a question of a short time when we will have to elevate our tailings in order to carry them out a sufficient distance from the mill to secure the necessary flowage grade. The question of pumping the tailings has been taken up and negotiations are underway to effect this installation prior to the opening of the 1924 season.

Following is the tonnage and analysis of the crude ore treated and the concentrates produced during the seasons of 1922 and 1923; also the ratio of tonnage recovery and recovery of iron units for these years:

	<u>TONS.</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>
Crude Ore Treated During 1922-----	529,858	45.77	.048	27.42
Crude Ore Treated During 1923-----	406,915	42.28	.046	34.72
Concentrates Produced During 1922---	346,931	60.48	.061	5.53
Concentrates Produced During 1923---	255,636	59.28	.058	7.92
Ratio of Recovery for 1922 -----			65.48%	
Ratio of Recovery for 1923 -----			62.82%	
Recovery of Iron Units for 1922 -----			86.68%	
Recovery of Iron Units for 1923 -----			87.90%	

The analysis of the crude ore was over three points lower in 1923 than in 1922 and while the gross recovery was almost three points lower, the iron unit recovery was higher, and this speaks well for the mill practice of this season. We anticipate handling a somewhat higher grade of crude ore during next year and our recoveries should be higher than in 1923.

The composite samples of the 1923 shipments follow:

	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>MN.</u>	<u>SIL.</u>	<u>ALU.</u>	<u>LIME</u>	<u>MAG.</u>	<u>SUL.</u>	<u>LOSS</u>
Hill Concentrates-----	184,234	59.05	.055	.19	8.42	.83	.13	.14	.016	5.40
Trumbull Concentrates-	71,402	58.95	.062	.20	6.79	.81	.12	.14	.017	7.10
Hill Direct Ore-----	<u>44,723</u>	<u>58.03</u>	<u>.060</u>	<u>.19</u>	<u>10.50</u>	<u>1.54</u>	<u>.14</u>	<u>.15</u>	<u>.016</u>	<u>4.01</u>
TOTAL & AVERAGES-----	300,359	58.87	.057	.19	8.34	.93	.13	.14	.016	5.59

The average analysis of the product from the several machines during 1922 and 1923 follows:

<u>-----1-9-2-2-----</u>				<u>-----1-9-2-3-----</u>			
	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>		<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>
Screen-----	61.20	.065	4.30	Screen-----	60.87	.061	5.82
Log-----	61.07	.064	4.93	Log-----	58.79	.059	8.89
Turbo-----	54.75	.054	15.83	Turbos-----	54.69	.053	16.63
Tables-----	47.07	.045	27.33	Tables-----	45.49	.039	29.82
Tailings-----	15.75	---	---	Tailings-----	15.38	---	---

The iron content of the turbo, table and tailings product was about the same both years, the screen was slightly lower in 1923 and the logs were over two points in iron lower. As over 70% of our total product comes from the logs, the effect on the analysis of our concentrates was quite appreciable. Less than 5% of our product for 1923 was secured from the turbos and tables and under 25% from the screen.

The tonnage of rock rejected from the mill and the analysis of same follows:

	<u>TONS.</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>
Plant Rejects-----	7,050	22.77	.036	62.79

ACCIDENTS

Following is a list of the accidents which occurred at the Hill-Trumbull Mine during the past season and were of a nature serious enough to be reported:

CHAS. JOBIN

Injured-----January 4th, 1923.
Occupation-----S. Shovel Night Watchman.
Nationality-----American.
Time Lost-----Continued to work until
job closed down 1/8/23.
Compensation Paid-----Settled for \$72.00.

Remarks: A small steam shovel was being used in throwing up a dike on the washing plant tailing sands. Jobin was employed watching this shovel nights. He was walking on top of dike near the shovel when he slipped and fell, straining chest. The doctor's report shows, "No external evidence of an injury, but some tenderness over left costo-chondral articulation".

ALEX EDNER

Injured-----April 5th, 1923.
Occupation-----Trackman.
Nationality-----American.
Time Lost-----4½ Days.
Compensation Paid-----None.

Remarks: Track gang was laying track in pit. They had just carried a rail (85#) to place, and laid it on the ground, when it rolled over on Edner's foot, resulting in contusion of dorsum, right foot.

EARL NELSON

Injured-----May 9th, 1923.
Occupation-----Washing Plant Laborer.
Nationality-----American.
Time Lost-----14½ Days.
Compensation Paid-----\$21.00.

Remarks: Nelson slipped while climbing a car and fell to the ground. He struck his left shoulder, causing a dislocation.

ALBERT NIEMELA

Injured-----May 11th, 1923.
Occupation-----Washing Plant Laborer.
Nationality-----Finnish.
Time Lost-----13 Days.
Compensation Paid-----\$15.00.

Remarks: Niemela was picking rock off 5' conveyor when a chunk rolled down from the grizzly and struck him on right foot, bruising same.

A 3 0 W 30AM

DENNIS MALONEY

Injured-----September 24th, 1923.
Occupation-----Shop Foreman.
Nationality-----Irish.
Time Lost-----12 Days.
Compensation Paid-----\$12.00.

Remarks: Maloney was in the act of drilling a piece of steel for the washing plant, when a chip of steel entered the second finger of his right hand. Doctor's report shows, "Infected wound to dorsum second finger right hand over first phalanx".

TONY MARICH

Injured-----December 6th, 1923.
Occupation-----Track Boss.
Nationality-----Austrian.
Time Lost-----Has not yet reported for work.

Remarks: Marich was moving a rail and it turned over, tripping him. He stumbled and struck his left foot against a frozen chunk of dirt and fell a distance of six feet over edge of dump. Doctor's report shows, "Contusion to dorsum left foot. Abrasion to right thumb. Possible strain to muscles of right shoulder".

MIKE SKORICH

Injured-----December 7th, 1923.
Occupation-----Trackman.
Nationality-----Austrian.
Time Lost-----None.

Remarks: The air mechanism for dumping car was not in working order, so he used a tie to raise one side in order to dump. In doing this, his finger was crushed between the tie and the car, resulting in laceration to medial surface index finger left hand.

SHIPMENTS

Following are the cargoes of Hill-Trumbull ore shipped during the past season and the analysis of same as obtained at the Mine and by the Lower Lake Chemists:

<u>PONTIAC</u>	----- 5/19/23 -----					7,851 Tons.
	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>MOIS.</u>	<u>FE.NAT.</u>	
Mine	60.25	.084	9.52	8.58	-----	
Crowell & Murray	58.60	---	---	7.49	54.21	
<u>A.E.R.SCHNEIDER</u>	----- 5/23/23 -----					4,827 Tons.
Mine	61.53	.069	8.45	8.23	-----	
Oscar Textor	59.30	---	---	7.74	54.71	
<u>ISHPEMING</u>	----- 5/27/23 -----					4,490 Tons.
Mine	61.60	.052	8.64	8.14	-----	
Crowell & Murray	60.10	---	---	6.61	56.13	
Cremer & Case	61.90	---	8.68	6.77	57.71	
<u>PONTIAC</u>	----- 5/30/23 -----					10,998 Tons.
Mine	60.44	.060	9.62	8.12	-----	
Hughes & Guentzler	60.07	---	---	7.18	55.76	
<u>PONTIAC</u>	----- 6/7/23 -----					5,402 Tons.
Mine	59.66	.060	8.86	10.32	-----	
Oscar Textor	59.20	---	---	8.11	54.40	
<u>ISHPEMING</u>	----- 6/11/23 -----					9,948 Tons.
Mine	59.26	.062	8.97	8.33	-----	
Crowell & Murray	59.43	---	---	9.89	53.55	
<u>NEGAUNEE</u>	----- 6/11/23 -----					2,687 Tons.
Mine	58.67	.060	9.69	8.82	-----	
Hughes & Guentzler	58.28	---	---	7.49	53.89	
<u>A.E.R.SCHNEIDER</u>	----- 6/20/23 -----					3,579 Tons.
Mine	59.82	.059	6.93	9.10	-----	
Oscar Textor	58.60	---	---	7.85	54.00	
<u>MICHIGAN</u>	----- 6/22/23 -----					10,230 Tons.
Mine	58.92	.058	9.29	10.21	-----	
Cremer & Case	58.30	---	---	9.02	53.04	
<u>PONTIAC</u>	----- 6/23/23 -----					5,909 Tons.
Mine	58.82	.050	9.34	8.89	-----	
Cremer & Case	58.20	---	---	7.67	53.74	
<u>A.E.R.SCHNEIDER</u>	----- 6/30/23 -----					3,818 Tons.
Mine	59.25	.055	7.07	11.59	-----	
Crowell & Murray	58.65	---	---	7.75	54.10	

SQUIRE - - - - - 6/30/23 - - - - - 8,638 Tons.
 Mine----- Fe. Phos Sil. Mois. FE.NAT.
 58.49 .058 8.16 10.83 -----
 Oscar Textor----- 58.90 --- --- 11.59 52.07

CHRISTOPHER - - - - - 7/2/23 - - - - - 6,241 Tons.
 Mine----- 58.45 .061 8.20 9.62 -----
 Oscar Textor----- 57.45 --- --- 9.65 51.91

J. H. SHEADLE - - - - - 7/3/23 - - - - - 6,103 Tons.
 Mine----- 58.29 .058 9.37 12.17 -----
 Hughes & Guentzler----- 58.20 --- --- 9.96 52.40

PRESQUE ISLE - - - - - 7/5/23 - - - - - 6,413 Tons.
 Mine----- 58.48 .050 10.25 14.94 -----
 Crowell & Murray----- 58.45 --- --- 9.85 52.72

PIONEER - - - - - 7/11/23 - - - - - 5,923 Tons.
 Mine----- 57.55 .058 11.13 15.38 -----
 Cremer & Case----- 58.60 --- --- 9.32 53.14

PONTIAC - - - - - 7/15/23 - - - - - 2,674 Tons.
 Mine----- 58.65 .059 8.46 14.50 -----
 Oscar Textor----- 58.60 --- --- 7.40 54.26
 Hughes & Guentzler----- 59.12 --- --- 7.38 54.76

MUNISING - - - - - 7/15/23 - - - - - 1,526 Tons.
 Mine----- 59.02 .063 8.54 12.00 -----
 Hughes & Guentzler----- 59.60 --- --- 5.09 56.57

J. H. SHEADLE - - - - - 7/17/23 - - - - - 6,318 Tons.
 Mine----- 58.22 .059 9.21 14.90 -----
 Cremer & Case----- 58.30 --- --- 9.14 52.97

PENOBSCOT - - - - - 7/21/23 - - - - - 3,673 Tons.
 Mine----- 58.71 .053 8.47 14.22 -----
 Oscar Textor----- 58.93 --- --- 8.61 53.85

PONTIAC - - - - - 7/23/23 - - - - - 11,792 Tons.
 Mine----- 58.41 .050 9.52 12.47 -----
 Cremer & Case----- 58.70 --- --- 10.17 52.73
 Crowell & Murray----- 58.70 --- --- 10.15 52.74

GRAND ISLAND - - - - - 7/27/23 - - - - - 3,890 Tons.
 Mine----- 58.30 .050 8.33 8.32 -----
 Cremer & Case----- 58.80 --- --- 11.74 51.90

PONTIAC - - - - - 7/31/23 - - - - - 11,656 Tons.
 Mine----- 58.42 .062 8.97 9.23 -----
 Hughes & Guentzler----- 58.15 --- --- 8.00 53.50

HILL-TRUMBULL MINE.

<u>WM. G. MATHER</u> -----9/21/23----- 3,159 Tons.					
	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>MOIS.</u>	<u>FE.NAT.</u>
Mine-----	59.45	.049	8.17	9.20	-----
Hughes & Guentzler-----	59.30	---	---	12.98	51.60
<u>FRONTENAC</u> -----9/23/23----- 1,425 Tons.					
Mine-----	59.85	.049	7.33	9.12	-----
Oscar Textor-----	60.13	---	---	11.13	53.44
<u>PONTIAC</u> -----9/25/23----- 5,533 Tons.					
Mine-----	58.79	.055	8.31	8.30	-----
Oscar Textor-----	58.30	---	---	7.76	53.78
<u>E.N.SAUNDERS</u> -----10/7/23----- 2,312 Tons.					
Mine-----	59.25	.060	6.94	7.77	-----
Crowell & Murray-----	58.70	---	---	7.28	54.43
<u>PIONEER</u> -----10/7/23----- 8,579 Tons.					
Mine-----	59.02	.057	7.67	7.79	-----
Oscar Textor-----	58.50	---	---	6.85	54.49
<u>WM. G. MATHER</u> -----10/19/23----- 1,513 Tons.					
Mine-----	58.60	.049	9.46	7.51	-----
Crowell & Murray-----	58.10	---	---	8.15	53.36
<u>MARQUETTE</u> -----10/22/23----- 2,397 Tons.					
Mine-----	59.79	.049	8.15	7.46	-----
Oscar Textor-----	58.80	---	---	7.47	54.41

Following are the cargoes of Upson Grade shipped during the 1923 season. These cargoes are made up of approximately 60% Hill-Trumbull ore and 40% Boeing ore.

<u>A. S. UPSON</u> -----5/11/23----- 6,255 Tons.					
	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>MOIS.</u>	<u>FE.NAT.</u>
Mine-----	59.10	.061	9.49	9.85	-----
Cremer & Case-----	58.40	---	---	8.64	53.35
<u>A. S. UPSON</u> -----6/5/23----- 6,337 Tons.					
Mine-----	59.58	.060	9.27	9.88	-----
Oscar Textor-----	58.90	---	---	8.73	53.75
<u>A. S. UPSON</u> -----6/24/23----- 6,275 Tons.					
Mine-----	58.56	.072	8.19	11.91	-----
Hughes & Guentzler-----	58.30	---	8.85	10.33	52.28
<u>A. S. UPSON</u> -----7/15/23----- 6,402 Tons.					
Mine-----	58.20	.064	8.19	14.60	-----
Crowell & Murray-----	58.80	---	7.31	9.56	53.18
<u>A. S. UPSON</u> -----7/26/23----- 6,636 Tons.					
Mine-----	58.21	.068	9.12	10.01	-----
Cremer & Case-----	57.80	---	9.24	11.07	51.40

HILL-TRUMBULL MINE.

HILL-TRUMBULL MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1923.

GRADE	IRON	PHOS.	SILICA
Hill Bessemer Concentrates,	61.55	.039	8.09
Hill Non-Bessemer Concts.,	59.33	.057	8.40
Hill Direct,	58.28	.060	10.63
Trumbull Bessemer Concts.,	(No Production)		
Trumbull Non-Bessemer Concts.,	59.15	.063	6.78

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1923.

GRADE	Mine			Lake Erie		
	IRON	PHOS.	SILICA	IRON	PHOS.	MOIST.
Hill Bessemer Concentrates,	(All Mixed)					
Hill Non-Bessemer Concts.,	(All Mixed)					
Hill Direct,	(All Mixed)					
Trumbull Bessemer Concts.,	(No Shipments)					
Trumbull Non-Bessemer Concts.,	(All Mixed)					

HILL-TRUMBULL MINE

ORE STATEMENT - DECEMBER 31ST, 1923.

	HILL CRUDE	HILL BESS. CONCTS.	HILL NON-BESS. CONCTS.	HILL BESS. DIRECT.	HILL NON-BESS. DIRECT	TRUMBULL CRUDE	TRUMBULL BESSEMER CONCTS.	TRUMBULL NON-BESS. CONCTS.	TOTAL	TOTAL LAST YEAR
On hand Jan. 1, 1923,	-	-	-	-	-	-	-	-	-	-
Output for Year,	299,245	3,123	181,111	-	44,723	107,670	-	71,402	707,274	350,015
Transferred,	-	3,123	3,123	-	-	-	-	-	-	-
Total,	299,245	-	184,234	-	44,723	107,670	-	71,402	707,274	350,015
Shipments,	299,245	-	184,234	-	44,723	107,670	-	71,402	707,274	350,015
Balance on Hand,	-	-	-	-	-	-	-	-	-	-
Percentage of Recovery,	62 %					66 %			63 %	
Output Last Year,	270,744	4,136	175,147	-	3,084	259,114	16,828	150,820	350,015	
Increase in Output,									357,259	

1923 -- Began producing May 5th; ceased Oct. 3rd-, 1923.

1922 -- Began producing May 10th; ceased Oct. 31st, 1922.

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HILL-TRUMBULL MINE.

HILL-TRUMBULL MINE

COMPARATIVE MINING COSTS FOR YEAR

	1923	1922	INCREASE	DECREASE
<u>PRODUCT</u>				
Direct Shipping	44,723	3,084	41,639	
Concentrates	255,636	346,931		91,295
Total Production	300,359	350,015		49,656
<u>DIRECT SHIPPING ORE</u>				
Labor	.120	.184		.064
Supplies	.086	.236		.150
Total	.206	.420		.214
<u>CRUDE ORE - CONCENTRATED BASIS</u>				
Labor	.171	.098	.073	
Supplies	.100	.074	.026	
Total	.271	.172	.099	
<u>MISCELLANEOUS GROUP</u>				
Superintendence	.007	.006	.001	
Concentrating	.171	.143	.028	
Stripping	.560	.560		
Insurance	.003	.001	.002	
District Office	.014	.012	.002	
Central Office	.045	.018	.027	
Contingent Expense	.031	0	.031	
Special Expense	.003	.002	.001	
Occupation Tax	.089	-	.089	
Taxes	.459	.337	.122	
Winter Expense	.161	.146	.015	
Cost Adjustment	.005	.003	.002	
Depreciation	.200	.200		
Total Cost on Cars	2.011	1.603	.408	
Misc. Debits & Credits	.003	.010		
Grand Total Cost	2.008	1.593	.415	
<u>DIRECT SHIPPING</u>				
No. Shifts & Hours	1-10-43	1-10-7		
Avg. Daily Product	1,040	440	600	
<u>CRUDE ORE - CONCENTRATED BASIS</u>				
No. Shifts & Hours	1-10-130	1-10-147		
Avg. Daily Product	1,967	2,360	393	

HILL-TRUMBULL MINE

COMPARATIVE WAGES AND PRODUCT

	1 9 2 3	1 9 2 2	INCREASE	DECREASE
PRODUCT	300,359	350,015		50,656
No.Shifts & Hours	1-10hr	1-10hr		
AVG.NO.MEN WORKING	91	79	12	
AVG.WAGES PER DAY	5.22	4.40	.82	
PRODUCT PER MAN PER DAY	20.42	27.40		6.98
LABOR COST PER TON	.256	.161	.095	
TOTAL NO.OF DAYS	14,703 $\frac{1}{2}$	12,778- $\frac{3}{4}$	1,924- $\frac{3}{4}$	
AMOUNT PAID FOR LABOR	76776.33	56281.01	20,495.32	

In 1921 Production from May 12th to Sept.24th.
 In 1922 " " " 10th Oct.30th.
 In 1923 " " " 5th Oct.3rd.

HILL-TRUMBULL MINE

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE

KIND	QUANTITY	AVERAGE PRICE	AMOUNT 1923	AMOUNT 1922
60% Powder	250	.1525	38.13	88.79
40% "	4,100	.1358	556.62	750.28
35% "	2,100	.1353	284.11	- -
20% "				187.50
17% "	100	.1230	12.30	356.70
Black "				1,006.50
Hercules Special #1	6,450	.1477	952.75	663.75
Du Pont Blasting Powder	500	.1075	53.75	
Trojan Special C	300	.1500	45.00	
Trojan 17%	300	.1230	36.90	
Total Powder	14,100	.1404	1,979.53	3,053.52
Cap Crimpers				1.09
Fuse				2.28
#6 Blasting Caps	200	.1460	2.92	4.38
Electric Exploders	1,800	.0720	129.69	248.40
Connecting Wire	10	.4490	4.49	5.54
Total Fuse, Etc.			137.10	261.69
Total Explosives			2,116.63	3,315.21
	1923 CRUDE & DIRECT	1923 CONCTS. & DIRECT	1922 CRUDE & DIRECT	1922 CONCTS. & DIRECT
Product	451,638	300,358	532,942	350,015
Lbs. Powder per ton of ore	.0312	.0469	.0452	.0689
Cost per ton for Powder	.0044	.0066	.0057	.0087
" " " " Fuse, Etc.	.0003	.0005	.0004	.0007
" " " " All Explosives	.0047	.0070	.0062	.0094
Average Cost per Lb. for Powder	.1404	.1404	.1265	.1265

Commenced operating May 4, 1923; suspended operations Oct. 3, 1923.

BOEING MINE
ANNUAL REPORT FOR 1923.

The Boeing Mine was operated actively throughout the past year. Underground activities were conducted steadily and stripping and open pit ore work was pushed forward as weather conditions and the situation in the pit warranted.

Shipments were made from the shaft stockpile, which had been accumulated up to April 16th, the loading from pocket went forward from April 16th until the end of the ore season, November 10th, and ore was forwarded from the open pit from June 2nd, when the 350-ton shovel was ready for operation, until November 8th, when the season's ore requirements were completed. The stockpiling of underground ore was resumed November 12th and continued throughout the balance of the year.

The following table shows the tonnage and analysis of the product shipped during 1923:

	<u>TONS.</u>	<u>FE.</u>	<u>PHOS</u>	<u>MN.</u>	<u>SIL.</u>	<u>AL.</u>	<u>MOIS.</u>
Open Pit Shipments-----	363,225	56.17	.081	.70	10.25	3.73	14.72
Shaft Pocket Shipments----	87,074	57.85	.080	.89	8.11	3.53	13.74
Shaft Stockpile Shipments--	44,471	57.07	.084	1.02	9.22	3.67	13.86
Shaft Lean Ore Stockpile--	<u>5,357</u>	<u>53.10</u>	<u>.078</u>	<u>1.39</u>	<u>13.51</u>	<u>2.76</u>	<u>14.11</u>
TOTAL SHIPMENTS - 1923----	500,127	56.51	.081	.77	9.82	3.68	14.47

The average analysis of the ore placed in stockpile from November 12th to December 31st. follows:

	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>MN.</u>	<u>SIL.</u>	<u>AL.</u>	<u>MOIS.</u>
In Stock January 1st. 1924-	17,569	57.81	.076	.90	8.43	3.15	--

Of the 500,127 tons of ore forwarded, 466,519 tons were shipped as Boeing grade and the balance, 33,608 tons, as Upson grade. The Upson grade was a new mixture the past season and was composed of 40% Boeing and 60% Hill-Trumbull Non-Bessemer.

Both the iron dried and iron natural analysis of our 1923 shipments were very close to those of 1922 and also checked very closely with the anticipated analysis for 1923. The report January 1st. 1923 showed the expected iron

natural as 48.46%, whereas we realized 48.52%. While we showed our expected iron natural as 48.46%, we were very much in hopes of shipping a better product and we would have done so, but for the fact that the material encountered in the ore bank the last two weeks of the season ran off quite decidedly. We anticipated getting some lean ore here, but not the amount that was encountered.

We have put down a number of test-pits to the south of the past season's ore cuts and we have shown that the ore here is about the same average grade as that mined from the pit to-date. We have endeavored to put down a number of test-pits at the east end of the pit, but due to water conditions, these explorations have not gone to the desired depth. From such information as we have, we are quite apprehensive that the east end of the open pit ore body is lower grade than was indicated by the drilling and we feel that it will be necessary to do some casting and sorting when taking our ore cuts in this vicinity during the coming season. We are to put up at least two raises from the main underground level crosscuts in order to properly drain the ore area, as well as to show the grade of the material. We are very much in hopes of putting down some additional test-pits in the east pit area next spring.

The anticipated tonnage and analysis of our shipments for 1924 are as follows:

	<u>TONS.</u>	<u>FE.</u>	<u>MOIS.</u>	<u>FE.NAT.</u>
First Class Open Pit Ore-----	200,000	56.60	14.50	48.39
Second Class Open Pit Ore-----	160,000	55.00	16.00	46.20
Underground Ore-----	<u>140,000</u>	<u>57.50</u>	<u>14.00</u>	<u>49.45</u>
TOTAL AND AVERAGES-----	500,000	56.34	14.84	47.99

While a larger shipment could be made from the open pit, we feel that the production above estimated is the maximum which we could forward and keep the grade up to that shown.

Every endeavor will be made to secure a better grade material, but from information at hand, a higher estimate would not be justified. In laying out our operating plans for 1924, the question of casting and sorting at the east end of the pit, as well as manoeuvring the 350-ton shovel, so as to secure an average grade, has been considered and plans made to this end. The raises from the main level at the east end of the pit may drain this open pit deposit sufficiently, so that the moisture is reduced from that shown in the table.

In case we are to ship an Upson grade next season, it would be possible to absorb some low grade Boeing in this mixture, as the Hill-Trumbull output for at least the forepart of the season should be high grade. The absorption of the low grade Boeing ore in the Upson mixture would necessarily raise the analysis of the straight Boeing shipments by a corresponding amount.

It will not be possible to work off any of the 33,417 tons of open pit cretaceous ore stocked on the Boeing property during 1922 operations. We had hoped to move some of this ore during 1924, but we now see that it will be out of the question to do so until 1925.

One point in favor as to grade in our open pit operations in 1924 is the fact that the stripping has all been completed and we would be able to shift equipment about without interfering with any other work. Heretofore, we have always had to consider the Contractor's stripping and it has obliged us to operate along certain rather restricted lines. During 1924 we will have seven months in which to get out our open pit tonnage and as our capacity for loading is such that we could handle the 360,000 tons of pit ore in a considerably shorter period, we will have certain leeway in conducting our operations so as to do some grading in the pit.

Last season we loaded some stockpile ore prior to May 1st., so as to avoid the heavy taxes thereon. It will not be advisable this year to move any stockpile ore until our pit operations begin, as we will need all of the stockpile material for sweetening the pit ore, especially will this be true during the early part of the season.

The Great Northern car service during 1924³ was not what we had expected. This Company put 1,500 new 75-ton cars into service and had rebuilt their No. 2 dock at Allouez and the operating companies expected a decided improvement in the service, as compared with previous years. The fact that the railway was called upon to handle the largest tonnage in its history and the number of grades was increased materially, due largely to the taking over of the Mahoning property by the Pickands, Mather Company, resulted in an acute car shortage at times. We suffered a delay of 241 $\frac{1}{2}$ hours at the Boeing Mine, due to inadequate car service. We would have been able to have forwarded our
BOEING MINE.

season's output by operating one shift without working any overtime, had the car service been satisfactory. The Railway Company is putting extensive repairs onto their hauling equipment and figure on extensive enlargements to their classification yards at Superior before the opening of the next shipping season. Further than this, the Company is making much needed repairs to their No. 1 dock.

We feel that the Great Northern Railway Company will be able to handle a tonnage as large as that of 1923, to better advantage in 1924.

BOEING MINE ORE ESTIMATE OF JANUARY 1ST. 1924

Following is an estimate of the ore in sight at the Boeing Mine on January 1st., 1923, the tonnage mined during the past year and the estimate of January 1st., 1924.

A factor of 14 cubic feet per ton was used in these estimates, and a 10% deduction for rock was made in the entire deposit and an additional deduction of 10% for mining loss was made in the case of underground ore.

ESTIMATE OF JANUARY 1ST. 1923

<u>OPEN PIT MERCHANTABLE</u>	<u>OPEN PIT LEAN SANDY</u>	<u>MILLING</u>	<u>UNDERGROUND</u>	<u>TOTAL</u>
1,338,000	225,500	521,500	628,500	2,713,500

MINED DURING 1923

302,725	60,500	---	137,500	500,725
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ESTIMATE OF JANUARY 1ST. 1924

1,035,000	165,000	521,500	491,000	2,212,500
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While the rock conditions encountered both underground and in the pit have been somewhat different than anticipated from drilling and previous exploratory records, about as much additional ore has been disclosed as we have been obliged to deduct. In other words, our mining during the year shows conditions to be such that a change in our ore estimates is not warranted at this time.

The Boeing Mine ore body has now been well established and we do not anticipate showing up an additional tonnage by future exploratory work or mining.

The following table shows the analysis of the January 1st., 1924, ore estimate:

	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>MN.</u>	<u>MOIS.</u>	<u>FE.NAT.</u>
Open Pit Merchantable-	1,035,000	56.50	.085	8.80	.98	15.00	48.02
Open Pit Sandy-----	165,000	49.40	.119	19.24	.17	9.50	44.71
Milling Ore-----	521,500	58.85	.080	7.24	1.24	15.00	50.02
Underground Ore-----	<u>491,000</u>	<u>57.50</u>	<u>.093</u>	<u>8.50</u>	<u>.90</u>	<u>14.00</u>	<u>49.45</u>
TOTAL & AVERAGES-----	2,212,500	56.74	.088	9.14	.96	14.36	48.59

Mining operations underground and in the pit have led us to make a reduction in the estimated analysis of the ore in these deposits, as compared with our figures in the Annual Report for 1922. The open pit merchantable ore has been reduced .69% and the underground ore .96% in iron units. During next summer we will be able to determine more definitely the grade of material in the pit and the figures in our next Annual Report should be quite accurate. The draining of the east end of the pit and mining operations to be conducted here will show us definitely the grade of this ore and we contemplate doing some test-pitting along the deep ore channel to determine the character and analysis of the merchantable ore.

GENERAL SURFACE

Due to the settlement of the ground from underground caving operations, a crack extended under Captain Prudom's house and it was necessary to move this structure. In deciding on the limits of the area that would be affected by caving, we all felt that as the ore body was so shallow, the settlement would extend in a somewhat vertical line and that there would not be any appreciable pull to the outlying ground. The pull in this case extended over 50' beyond the line of cave. Captain Prudom's house was moved to the west of the boarding houses and now stands at the corner of Fifth and Washington Street. This structure was moved during September.

The crack caused by caving ground extended northward to the east boarding house and it was deemed advisable to move this building a short distance west and also change the water and sewer lines. We feel that the further settlement of ground should not extend the cracks and that the houses as they now stand should not be affected.

All of the location houses were painted during the months of September and October. The Company purchased the material and a contract was let covering labor.

The usual amount of cleaning was done around the mine premises and some planting of shrubs and trees was undertaken.

When pocket shipments were begun in April, it was found that the railway track was too great a distance from the shaft pocket to permit of satisfactory loading, especially in the case of the 75-ton cars. An auxiliary lip was put on the pocket chute and the Great Northern section crew lined over the track better than one foot.

The Great Northern Railway Company laid an additional track in the Boeing Mine yards and did the necessary ballasting during the spring of 1923. Two tracks had been placed here in 1922 and the third was added this year. Our original plans called for a 4-track yard, and we are desirous of having this put in. It was very difficult last year to get the Great Northern Railway to do any work that they felt was not absolutely required.

The surface along the Susquehanna line settled very appreciably during the spring of 1923. A large quantity of surface material slid along our pit face in March and the ground settled and cracked under the Susquehanna coal dock track, necessitating a removal of the approach to the coal dock. The Susquehanna Company laid a new track to the north and we paid for a proportion of the cost thereof. The Susquehanna Company bore part of the expenses due to the fact that they anticipated caving some ground later that would have endangered the old arrangement.

The Crosby Mine timber, ties and lagging were sold and moved to the Boeing Mine during the winter and stored in the yards east of the coal dock.

On account of excessive weight developing underground and a lack of large strong timber, it was necessary to secure several cars during the summer. It is extremely difficult to secure good timber in the summer and in covering our requirements for 1924, we have specified a sufficient proportion of large size timber to carry us through.

During June, the 1370' Sub-Level workings were connected with the open pit and our work in the pit was so conducted that an adequate timber yard was provided. Since June, we have taken our timber into the pit and handled it through the 1370' Sub-Level opening, rather than taking it down the shaft. By handling the timber in this manner, we are able to do all our hoisting of ore on day shifts and we have cut down the cost of handling the timber to our underground working places quite appreciably.

Work on the new stockpile trestle was started the latter part of September and completed November 12th. In order to handle our daily output on single shift, a double trestle was erected and two stocking cars were put in service. We have found it very advantageous to do our stocking on days shifts at this property, due to the very severe weather and the difficulties in handling material at night.

The necessary changes were made in the shaft house so that the skips in separate cars. The old top tram engine handles the two cars and endless rope arrangement to good advantage. One car is under the dump, while the second is out on the trestle.

The labor situation has been quite satisfactory on the whole as regards the open pit work and since early in the summer, we have been able to maintain a full crew at all times underground. We had some difficulty during the winter in picking up a crew and our turn over during the spring months was quite large, due to the fact that the men shifted about considerably and the starting of open pit operations.

STOCKPILES

Orders were received to forward 20,000 tons of Boeing stockpile ore prior to May 1st. A crew prepared the shovel for operation and loading started on the 18th of April. There was considerably frost in the pile and progress was somewhat slower than anticipated. We had forwarded 21,554 tons, or approximately one-half of the stockpile by the 5th of May, 774 tons of this ore coming from the lean pile. The balance of the high grade ore was forwarded little by little, as it was necessary to sweeten pit shipments.

While the ore operations in the pit were suspended on account of the stripping work cutting out the approach tracks, both the high grade and lean ore stockpiles were cleaned up.

The high grade stockpile showed an overrun of 2,983 tons, as compared with the skip tally, and the lean ore pile showed an overrun of 213 tons.

Following is the tonnage and analysis of the ore shipped from stockpile during 1923:

	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>MN.</u>	<u>AL.</u>	<u>MOIS.</u>
No. 1 Stockpile Ore-----	44,471	57.07	.084	9.22	1.02	3.67	13.86
Lean Ore Stockpile-----	5,375	53.10	.078	13.51	1.39	2.76	14.11

The analysis of the No. 1 stockpile as loaded out was about one-half point lower in iron than that secured when the pile was being accumulated. During the winter months of 1922-1923, mining operations on the top sub were carried up to the cretaceous ore in a number of instances. This material is of very fine structure and in loading the railway cars, we feel that the tendency was to place too much of this ore on the top of the cars. The sampler was cautioned about this matter and endeavored to secure a representative sample.

We were unable to forward any open pit lean ore, which was stockpiled

during 1922, as our grade was not sufficiently high to work in this material. We now feel that we will not be able to load out any of this ore until 1925.

Prior to resuming stocking operations on November 12th, 1923, a new double stocking trestle was erected and the necessary changes made to utilize two stocking cars. As explained under "General Surface", this new arrangement allows for the handling of the output on day shifts and will give us capacity for practically one year's underground output.

The following table shows the ore placed in stock during November and December and the analysis of same:

	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>MN.</u>	<u>ALU.</u>
Ore in Stock Jan. 1st. 1924-----	17,569	57.81	.076	8.43	.90	3.15

The tonnage and analysis of the lean ore stockpiled from pit operations during 1922 follows:

	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>MN.</u>	<u>ALU.</u>
Lean Ore Stocked in 1922-----	33,417	50.84	.101	17.74	--	5.91

While the iron content of the ore in stock is below our expectations, based on previous estimates, we feel that it is close to the average of the underground deposit and that we will not be able to maintain it much above 57.50 in iron during the balance of our operations. We will always have a number of contracts working in the proximity of the rock walls and the grade of this ore runs off considerably at times. We will do our best to show an average iron content of 58% in our stockpile when navigation opens next spring. We will have some lean ore to sweeten in our pit operations during the forepart of the season and it is desirable to maintain a high grade output from the shaft.

UNDERGROUND OPERATIONS

Underground operations were carried forward steadily during 1923 and the output secured was in excess of our estimates.

We did not work up to a maximum production until the middle of June. While we kept the contracts pretty well filled during the months of January, February and March, the working places were not favorable for a large output. During April and May it was difficult to maintain a full crew, due to the fact that the men kept changing to other underground properties and the open pit mines started to open up.

The following table shows the underground output by months, the tons per miner and the tons per man (total payroll) secured during 1923:

<u>MONTH</u>	<u>TONS PRODUCED.</u>	<u>TONS PER MINER IN ORE</u>	<u>TOTAL TONS PER MAN</u>
January-----	9,747	7.44	3.15
February-----	9,597	7.04	3.52
March-----	9,193	7.32	3.57
April-----	8,702	7.18	3.46
May-----	9,343	7.56	3.57
June-----	12,094	9.16	4.54
July-----	11,271	10.35	4.60
August-----	13,909	9.96	4.80
September----	14,586	10.78	5.48
October-----	16,199	10.94	5.49
November-----	12,708	9.19	4.62
December-----	<u>10,118</u>	<u>8.28</u>	<u>3.73</u>
TOTAL-----	137,467	8.80	4.22

It was necessary to clean our pump sump of silt washed down by the open pit water four times during the months of January and February. In March, a Prescott sinker pump was installed in the pit and pumped the water directly into the drainage ditches. The amount of silt carried in the water was so great that we could not allow it to go underground. This Prescott pump was operated with air until erection work was started on our 350-ton shovel. We did not have sufficient air for both jobs, in excess of our underground requirements, and we were obliged to use a locomotive for furnishing steam to the Prescott pump during the latter part of the spring.

During the spring break-up, it was necessary to clean our sump from

two to three times per week. The material from the sump was very soupy and it was found advisable to discharge it on surface through our loading pocket, rather than to tram and dump it from the rock trestle. The silt was drawn off through the cleanout drift and run into the skips. The water drained into the mine launder and there was comparatively little silt to clean up by hand.

Hoisting was done on two 8-hour shifts until shipments were started from pocket April 16th. Due to the fact that we had considerable trouble in operating the butterfly device on our rotary dump, account of wet sticky ore, we were forced to use one skip. We increased the size of the air cylinders operating the butterfly and since then have experienced no difficulty with this mechanism. By remedying this defect and putting two skips in operation, we were able to handle our underground output by hoisting day shifts.

While the Boeing Mine was closed down, from April, 1921, until November, 1922, our main level timbers decayed to an appreciable extent on account of poor air circulation. The timber was not high class material, but it was the best we could secure at the time and compared favorably with the general run on the Mesaba Range. It was necessary to repair a large part of the main level workings during the past year and there remains some work to be done before the job is completed.

An average underground force of 15 gangs was employed on double shift throughout the year. While we had some difficulty in maintaining full crews up to June, since then we have been able to work full handed.

"MAIN LEVEL"

Contract No. 2 pushed crosscut No. 7 out under the open pit for 95' during January and put up a number of milling chutes to handle the west channel open pit ore. No. 2, with a force of Company Account men worked here until the month of March, when the north stripping bank slid into the pit. The ore in the west channel had been mined down to the back of the main level when the work had to be discontinued here.

Contract No. 8 cut out from No. 7 crosscut at a point near the main tramway and drove to the south and west for 190'. The first 90' of this drift was in ore, the balance being in broken taconite. Contract No. 8 completed work

here the forepart of December and was transferred to the east main level heading. Contract No. 3 put up three raises from No. 8's crosscut and mining operations have been started on the 1370' Sub above.

Since being transferred from No. 9 crosscut, No. 8 has been engaged in cleaning up the silt that has been washed into the east heading and has now started drifting ahead for the purpose of opening up our east underground deposit. It is the intention to complete development operations at the east end of the property prior to next winter, so that mining and caving may be completed during the winter months and the necessary fills made to bring our shaft track up to grade before the opening of navigation in 1925. We have done no work in the east deposit and our estimated outline of the ore body was based entirely on drill records. We know that the ore body is comparatively thin and unless we show up considerably more tonnage than anticipated, we should be able to mine out and cave back the deposit during one winter's operations, at least that part of it which underlies the shaft track.

"1380 FOOT SUB-LEVEL"

At the beginning of the year, 15 contracts were employed in caving and slicing operations at this elevation. As the pillars at this level were exhausted, the gangs dropped down in their raises to the 1370' Sub and at the end of the year but two contracts are left here.

Contracts Nos. 1 and 2 mined and caved the pillars to the south and west of No. 139 raise. No. 1 was transferred to the No. 135 raise workings the forepart of October and No. 2 dropped down in their raise to the 1370' Sub the same month.

Nos. 7, 11 and 16 were engaged in slicing and caving operations in their old crosscuts to the west of Nos. 136, 137 and 138 raises. The pillars being worked by these gangs were exhausted, Nos. 11 and 16 moving down to the 1370' Sub in November and No. 7 being transferred to old No. 5 workings.

Contracts Nos. 1 and 7 have been engaged the last few months of the year in slicing and caving back along the 30' pillar between Nos. 135 and 136 raise crosscuts. These are the only gangs remaining at this elevation at the end of the year. At least one contract will be employed here for several

additional months.

Contract No. 5, besides driving their crosscut northward for 60', where the ore pinched down to a 5' thickness, have sliced back the pillar between their workings and No. 9 to 131 raise. This pillar was 130' long and had an average width of 50'. No. 5 scrambled and caved to the east and north of 131 raise until practically the end of the year, when they were transferred to 151 raise, which was put up in November from No. 9 crosscut.

Contracts Nos. 3, 4, 8 and 12 spent about half of the year in slicing and caving back from the Susquehanna boundary to the north and west of Nos. 130 and 131 raises at this elevation. The gangs were transferred to the 1370' Sub below during the summer.

Contracts Nos. 6, 10, 14 and 17 were engaged the first few months of the year in slicing out the remaining pillars and caving back toward their raises from the Susquehanna boundary. The slide of the north stripping bank in March crushed Nos. 122, 123 and 124 raises and the movement of the ground was sufficient to make operations to the south of the raises at this elevation hazardous. After the slide, operations at this elevation were conducted by two gangs, No. 17 working to the east of the raises affected and No. 10 to the west. The deposit was exhausted at this elevation and the gangs moved down to the 1370' Sub during the summer.

"1370 FOOT SUB-LEVEL"

At the beginning of the year no mining activities were being conducted at this elevation. As the force on the 1380' Sub mined out the pillars, the gangs dropped in their raises and by November, 13 contracts were employed. No. 8 moved down to the 1370' Sub in February, No. 14 in March, 6 and 10 in April, 3 and 17 in June, 4 and 11 in August, 15 in September, 2 and 12 in October and 9 and 16 in November. With the exception of Nos. 6 and 8, all of these contracts are working on the 1370' Sub at the end of the year.

Contracts Nos. 2, 11, 15 and 16 developed the 1370' Sub to the south and westerly limits of Nos. 137, 138 and 139 raises. Rock was encountered in the bottom of the drifts a short distance in from the raises and it has been

necessary to either climb the rock on rather steep grades, or climb the rock and make a transfer. Contracts Nos. 2, 15 and 16 have started slicing back from the shore line and No. 11 has been temporarily transferred to other workings until No. 16 draws back their room.

Contracts Nos. 3, 4, 8, 12 and 14 dropped down in their raises, developed this Sub between the raises to the Susquehanna line and by the end of the year had caved and drawn back in the proximity of the raises. No. 8 was transferred to the main level in October and No. 14 completed their work and were moved to the area just west of the open pit and drove several hundred feet of a timber drift. No. 3 completed their pillars during the fall and were engaged in raising from No. 9 main level crosscut.

At the end of the year, Nos. 4 and 12 remain in their old workings, No. 12 outlining the pillars in the vicinity of 131 raise and No. 4 mining over the Susquehanna line to the north of 126 raise.

Contracts Nos. 6 and 10 dropped down in their raise in April and No. 17 in June. These gangs outlined the deposit between their raises and the Susquehanna boundary and had practically exhausted the deposit at this elevation by the end of the year. No. 6 has dropped down to the sub below and started development work there.

Contract No. 9 was moved to this elevation in November and spent the balance of the year slicing and gouging out the ore over the Susquehanna line to the north of 123 raise.

Since No. 3 put up the raises from No. 9 main level crosscut to this elevation, Nos. 5 and 11 have been engaged in outlining pillars between **these** raises and the open pit.

"1358 FOOT SUB-LEVEL"

Contract No. 6 was moved to this elevation the latter part of the year. The gang cut out from 124 raise and has drifted to the east for 110'. It is the intention to push this drift out to 119 raise, making connections with all the intermediate raises. This drift passes through the ground affected by the slide of last March and it is necessary to forepole and exercise considerable care in conducting the work. The bottom of the drift is in rock and for a considerable

distance the drift itself has been through surface material. The rock rises quite abruptly to the north and we will not be able to push in any crosscuts to the Susquehanna boundary from any of these raises. The deep ore channel swings to the northwest and we expect to go to the Susquehanna workings at this elevation from Nos. 126, 127 and 128 raises at least.

OPEN PIT ORE OPERATIONS

Our work in connection with open pit ore operations was started March third and consisted in grading for tracks to be used in unloading our new Model 350 shovel. The track work was completed on the 17th of March and we received our first cars of shovel parts on this date. We rented a locomotive crane from the Winston-Dear Company for unloading and erecting the shovel parts. The balance of the shovel machinery was received in two or three car loads, the last consignment reaching the property April 20th. The last two cars carried the boom and as our tracks into the pit were in rather bad shape, due to rains and washes, it was necessary to unload the boom in the mine yards and reload and take it into the pit when the construction work on the shovel had reached a point where the boom could be installed.

We had been promised delivery on the shovel March 1st., but in spite of all the pressure that was brought to bear on the Marion Company, they were over a month late in their delivery and as a result we were delayed in starting our open pit ore operations. The track, which we had constructed into the pit for unloading the shovel, had to be shifted on account of bank washes and we were put to considerable expense on this job. If all of the shovel parts had been delivered prior to April 1st., the additional track work would not have been necessary.

The shovel erector, who was sent from the Marion factory, reached Hibbing on April third and the work of assembling the shovel was started on the 4th. To assist the erector, we secured the services of our regular shovel runner and picked up a good crew for the erection work. The crew was made up of locomotive engineers and firemen largely. The shovel crew from the Wade Mine spent some time on this erection work. Exceptionally good progress was made on the erection of the machine, in spite of the fact that operations were slowed up