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17. **MINE LOCATION:**

The cost for repairs on the houses in the mine location were not as heavy in 1928 as for the previous two years.

Some of the sheds on the East side of the Main Street were repaired and also some work done on the porches.

We also extended First Street South to the corner of the location and then started to make a connecting road with the main county highway, until the weather interferred.

In 1929, we should paint all the houses and provide a sewerage system adequate for handling kitchen wastes.

18. **NATIONALITY REPORT:**

Following is the nationality report for the Morris-Lloyd Mine for the quarter ending December 31st, 1928:

Finnish	84
French	53
English	29
Italian	26
Swedish	21
Norwegian	3
Austrian	1
Irish	1
Greek	1
Hollander	1
Total	220

19. **GENERAL UNDERGROUND OPERATIONS:**

The following is a description in a general way of the mining operations carried on in the various portions of the mine during the year.

Lloyd Mine East:

Twelve or thirteen contracts are regularily employed in this end of the mine as follows: Nos. 1, 2, 3, 8, 9, 10, 17, 19, 20, 40, 46, 100 and 102.

Main Deposit:

Contracts Nos. 9, 10 and 19 mined out the extreme East end of the main deposit from the 1300 foot sub-level, down to the 1270 foot elevation. This territory is usually very wet and these contracts are handicapped in getting production on a par with the dry places.

Contract #8 mined along the main dike in the South-west corner of the main deposit between the 2nd and 3rd main subs. The ore was broken in a shrinkage stope, because it was so narrow it could not be top sliced at a profit.

The North-west limb of the same deposit, above the 3rd main sub on both sides of #41 raise, was taken out by #20 by sub-stoping. We established a limit 25 feet West of #51 raise in order not to under-cut Nos. 9 and 10 mining 120 feet above.

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19. GENERAL UNDERGROUND OPERATIONS: (Continued)

Lloyd Mine East:

No. 8 Deposit:

Near the close of the year, contract #40 was moved from No. 10 deposit to No. 8 deposit and mining started on the sill floor of the 3rd main sub, directly North of #10 raise.

No. 10 Deposit:

This deposit is being mined in two places along the hanging, contract #40 mining above the 3rd main sub and Nos. 2, 46 and 100 above the 5th sub or 3rd main level.

Contract #40 mined out the top of #10 deposit from the 1210 foot sub to the 1165 foot or 3rd main sub.

The other contracts mentioned above, worked out the 1005', the 990' and part of the 980 foot sub level.

The ore area on the 990 foot sub extended 260 feet East and West, the hanging on the West end dropping back over 100 feet.

No. 12 Deposit:

Contracts Nos. 1 and 17 worked out the 1260' and 1245 foot sub-levels between the 3200' and 3400' coordinate lines. Contract #1 then moved West on the 1245 foot sub-level and took out the pillars left East of #12 raise.

Third Level:

Contract #3 finished mining out the ore pillar left between the limit of mining near the 3600' coordinate line and the old stope to the West. They mined out three subs and took what ore was left on the sill floor.

Fourth Level:

Contract #100 drove a new main level drift 230 feet long from the first cross to the crotch between the foot and the main dike.

After the drift was finished, two raises were started angling to the South, one by #9 and one by #100. By the close of the year, the raises were up half-way to the 3rd level.

In the South-west corner of the deposit, contract #46 tried to find the ore shown up in Diamond Drill Hole No. 60. They drifted South on the 795 foot sub, 65 feet to the main dike cross-cutting mixed ore all the way. They came back a few feet and put up an exploring raise to the 890 foot sub. At that elevation, they cross-cutted East and West and North and South, finding nothing of value. They dropped back down to the 795 foot sub and drove cross-cuts East and West and discovered an ore lens only a drift wide. This development work was very disappointing because the drill hole showed 140 feet of high grade ore close to the main dike.

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19. GENERAL UNDERGROUND OPERATIONS: (Continued)

Lloyd Mine:

Five contracts are employed in the Lloyd Mine area South of the Lloyd shaft Nos. 5, 7, 11, 15 and 16.

These contracts mined ore on the 995', 985', 975' and 965 foot subs.

Contract #15 scrapes into their raise in the North-west side of the deposit. No. 5 gang mined the pillars along the foot in the North central portion of the main ore lens. No. 11 took out the ore between the two dikes in the South central part of the deposit, while #7 worked East of them along the main dike and #16 subbed in the North-east corner in the crotch between the foot and dike.

Morris Mine:

Sixth Level:

At the beginning of the year, there were seven contracts mining above the 6th level, Nos. 32, 33, 35, 36, 37, 38 and 63. By the close of the year, this was reduced to one, #35 being the only one left. All of the others had been transferred below the 6th level.

East Deposit:

Contract #32 sliced out the ore from the 390 foot sub to and below the 6th level.

No. 21 Deposit:

Contract #33 located on the 410 foot sub, mined out the 390 foot sub, 380 foot sub, 370 foot sub and started the 360 foot sub, but the ore area was so lean that it did not pay us to continue mining in this deposit.

Contract #35, taking out the East side of this deposit, worked out four subs which brought them down to the back of the 6th level.

No. 61 Deposit:

Contract #36 mined out one more sub above the 6th level and then dropped down to the 250 foot sub, 70 feet below the 6th level.

West Deposit:

The pillars left on the 360' and 350 foot subs were taken out by gang #37.

Second Outlet:

The second outlet raise from the 6th to the 4th level was finished by #38. This raise, located in the the rock 600 feet South of the Morris shaft, is permanent and was made necessary by the dams built on the old 4th level.

Main Deposit:

Contract #63 sliced out one sub above the 6th level and then continued on mining down below the main level.

MORRIS-LLOYD MINE
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19. GENERAL UNDERGROUND OPERATIONS:

Morris Mine:
(Continued)
Seventh Level:
C. C. I. Co.'s Lands:
Main Deposit:

Contract #63 sliced out the 320' and 310 foot subs, finding the ore body so narrow at the latter elevation, that we thought it advisable to go down 33 feet in the raise before cutting out for a new sub. At the 280 foot elevation, they drifted East at least 50 feet beyond the old workings above. By the close of the year, the ore above this sub was pretty well mined out.

No. 21 Deposit:

Contract #64 put up a new raise from the 7th to the 6th level in No. 21 deposit. When they reached the 130 foot elevation, they drove an exploring drift North and found the bottom of No. 21 deposit to be about ten feet wide, 50 feet above the 7th level. They continued up with the raise to the 210 foot sub, about half-way between the 6th and 7th levels. At this point, the deposit was found to be 120 feet wide. The raise was then continued on through to the 6th level.

Chase Lease No. 9:
East Deposit:

Contracts Nos. 32 and 39 drove East and West from their raise from the 1400' to the 1600' coordinate lines. Small raises were then put up and the deposit sub-stoped from the 6th level down to the 290 foot sub. At the latter elevation, the ore lens seems to pinch out, because we have been unable to raise up from the 180 foot sub below and find any ore above.

No. 21 Deposit:

At the 180 foot elevation, contract #39 found the connection between the #21 deposit and the main deposit. At this elevation, #21 deposit strikes South-west from #64 raise and gradually thins out to a width of only 40 feet. Just West of the 1400 foot coordinate line, the main deposit, striking East and West, joins #21 deposit about 60 feet West of the 1400 foot coordinate line.

Main Deposit:

In the North-west corner at the 180 foot elevation, #32 took out a triangular shaped piece of ore North and West of their raise.

In the South-east corner, Nos. 71, 90, 91 and 92 mined from the 170 foot sub down to the 130 foot elevation.

In the South-west side of the main deposit, the main level drift was extended 500 feet West on the C.C.I.Co.'s lands, parallel to and about 40 feet South of the South line of Chase Lease No. 9. The material drifted through was mixed ore and Jasper.

19. GENERAL UNDERGROUND OPERATIONS: (Continued)

Morris Mine: (Continued)

No. 61 Deposit:

250' Sub-Level:

All of the ore between the 1800' coordinate line and the limit, 100 feet farther West, was mined above the 250 foot sub. No where, did we find it extending higher than 40 feet above the floor of the sub.

Between the 1800' coordinate line and the main raise, a horse of Jasper came in and cut off the ore. Right opposite the branch raise, however, there was a good breast of ore and drifting was started East to find out the extent of the ore. We followed the ore for 300 feet and found it extending up to and 50 feet above the sixth level. The average width of the ore was 50 feet.

We have developed in this portion of the mine, a new ore lens 300 feet long, 50 feet average width with an average height of about 120 feet.

West Deposit:

Contract #75 mined out five subs from the 190' to the 150 foot elevation East of old #77 sub-stope. A new raise was also put up from the main level to avoid cutting out sub-levels in rock, the old raises being located in the foot-wall of the deposit between the 160 foot sub and the 7th level.

Chase Lease No. 24:

Trench Stope Deposit:

The Trench Stope proper was mined down to the sill floor of the 7th level during 1928.

South of the trench, #92 took out all the ore from the 190 foot to the 120 foot sub-levels, mining out eight subs during the year.

North of the trench, #62 and #76 sliced what was left above the 7th level from the 250' to the 140 foot sub-levels.

Eighth Level:

The shaft was sunk 80 feet below the 8th level and a drift cut around the skip compartment side of the shaft at the bottom, to make room for cleaning out the skip pit pockets. At the skip pit elevation, a drift was also driven South from the cage compartment, being breasted opposite the proposed location for the clean-out raise.

A concrete storage pocket was built opposite the skip compartments. This pocket is lined with 3" hardwood plank and steel lining plates.

The tail drift was driven North of the shaft and the entire plat cut South of the shaft.

Excavation of the pump-house started before the end of the year.

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ANALYSIS OF COST SHEETS, EXPLAINING INCREASE OR DECREASE IN VARIOUS ACCOUNTS BETWEEN THE YEARS 1927 AND 1928

UNDERGROUND COSTS

ACCOUNT
SINKING IN SHAFT

Year 1928	$20,258.35
" 1927	27,776.73
Decrease	$ 7,518.38

The cost for 1928 shows a decrease because most of the new lift was sunk in 1927. In 1928, the shaft sinking crew worked day shift only part of the time. When the storage pocket was constructed, only one crew was employed. During the latter part of 1928, part of the old shaft sinking crew also cut the new pump-house for the 8th level.

ACCOUNT
DEVELOPMENT IN ROCK

Year 1928	$3,932.65
" 1927	3,855.59
Increase	$ 77.06

Rock Development for 1928 -	307 Ft.
" " " 1927 -	401 "

Unit cost increased from 9.61 in 1927 to 12.81 in 1928, due to the fact that the bulk of the rock development work in 1927 consisted of rock raising, whereas, in 1928, most of the work was done in driving main level drifts. The unit cost for a drift is always higher than for a raise.

ACCOUNT
DEVELOPMENT IN ORE

Year 1928	$21,275.65
" 1927	18,672.85
Increase	$ 2,602.80

We broke more tonnage doing ore development work in 1928 than in 1927, because there was a larger footage driven looking for ore in 1928 as shown by the following table.

	Ore Drifting	Ore Raising	Total
Year 1928	3,211 Ft.	2,778 Ft.	5,989 Ft.
" 1927	2,210 "	2,232 "	4,442 "
Increase	1,001 Ft.	546 Ft.	1,547 Ft.

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UNDERGROUND COSTS

ACCOUNT STOPING

Year 1928	$148,458.24	Cost Per Ton	.417
" 1927	150,188.52	" " "	.460
Decrease	$ 1,630.28	" " "	.043

Labor for 1928	$103,933.13	Cost Per Ton	.292
" " 1927	106,547.26	" " "	.326
Decrease	$ 2,614.13	" " "	.034

	Year 1928	Cost Per Ton	Year 1927	Cost Per Ton
General Supplies	$ 4,238.22	.0190	$ 3,199.98	.0098
Iron and Steel	$ 1,542.93	.0043	1,876.30	.0057
Machinery Supplies	11,813.41	.0332	11,594.65	.0355
Explosives	23,700.70	.0665	24,589.05	.0752
Miscellaneous		.0020		.0078
Total		.1250		.1340
Labor Cost		.292		.326
Grand Total		.417		.460

The unit cost for stoping shows a decrease for 1928 of .043 per ton, most of which was saved in labor charges. The supply account also shows a small reduction. In 1927, we charged off eight complete scraper units. In 1928, seven complete outfits were placed in commission.

Conditions were more favorable in 1928 for better stoping costs, because we were able to get out a portion of our product by sub stoping the ore instead of using the caving system. Where the ore lenses are from 30 to 40 feet wide, and the hanging and foot-walls are vertical and firm, it is possible to mine the ore cheaper by the stoping system.

ACCOUNT TIMBERING

Year 1928	$79,651.94	Cost Per Ton	.224
" 1927	82,821.02	" " "	.253
Decrease	$ 3,169.08	" " "	.029

Cost for timbering for 1928, shows a decrease for the same reason that the stoping account decreased. Some of our product, probably 10% to 12%, came from sub-stopes that required but little timber.

We also spent less money repairing the Section Six raises, because we discontinued using some of them.

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UNDERGROUND COSTS

ACCOUNT
TRAMMING

Year 1928	$53,447.36	Cost Per Ton	.150
" 1927	51,844.96	" " "	.158
Increase	$ 1,602.40	Decrease	.008

Although the total shows an increase, the unit cost is less. Our motor crews were increased by one in 1928 by the addition of men employed on the 4th level Lloyd shaft. We also employed a skip tender part of the year on the new 8th level Morris shaft.

ACCOUNT
VENTILATION

Year 1928	$170.94
" 1927	369.41
Decrease	$198.47

The ventilating fan was run only part of the year while the second outlet raise was being put up from the 6th to the 4th levels.

ACCOUNT
PUMPING

Year 1928	$14,967.28
" 1927	16,890.15
Decrease	$ 1,922.87

The pumps handled 227,752,993 gallons of water in 1928. Following is the water pumped for three years past.

Year 1928	227,752,993 Gallons
" 1927	223,631,596 "
" 1926	205,247,760 "

The electric power consumption for three years past was as follows:

Electric Power for 1928	$ 9,618.18
" " " 1927	11,194.17
" " " 1926	9,793.29

The amount of electric power used in 1927 was above the normal, because the flow of water into the mine increased 10%. Although there was again an increase in the amount of water pumped for 1928, the cost for power actually decreased decreased, possibly due to changing the type of valves used.

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UNDERGROUND COSTS

ACCOUNT
COMPRESSORS
AND AIR PIPES

Year 1928	$30,702.65	Cost Per Ton	.086
" 1927	30,983.84	" " "	.095
Decrease	$ 281.19	" " "	.009

The cost sheets show very little change in the expenditures for operating the compressed air plant during the past two years. The air consumption for 1928 was 693,296,200 cu. ft. compared with 688,635,000 for 1927.

ACCOUNT
UNDERGROUND
SUPERINTENDENCE

Year 1928	$13,839.50
" 1927	14,254.92
Decrease	$ 415.42

Decreased for 1928 because of less overtime put in by the shift bosses.

MAINTENANCE COSTS

ACCOUNT
COMPRESSORS
AND POWER DRILLS

Year 1928	$1,385.73
" 1927	917.45
Increase	$ 468.28

In 1927, we purchased two R.B. 12 Auger Drills and two D.C.R. 23 shaft sinking Jack Hammers. In 1928, three B.B.R. 20 Auger Drills, one R.B. 12 and two N75 Drifting Machines were charged to the above account.

ACCOUNT
HAND TRAM EQUIPMENT

Year 1928	$ 80.34
" 1927	136.51
Decrease	$ 56.17

This account is practically nil because of the substitution of scrapers for hand tramming equipment.

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MAINTENANCE COSTS

ACCOUNT
ELECTRIC TRAM EQUIPMENT

Year 1928	$19,089.73	
" 1927	20,552.29	
Decrease	$ 1,462.56	

The above cost was sub-divided as follows:

	1928	1927
Generator & Dynamo	$ 205.03	$ 2,582.25
Locomotives	5,428.36	6,865.71
Wiring	2,422.78	1,192.01
Main Line Tracks	3,662.70	3,121.43
Main Line Cars	7,370.86	6,790.89
	$19,089.73	$20,552.29

In the past year, the largest items to be charged off were $1,000.00 for second hand locomotive from the Gwinn District; 1105 feet of two conductor 4/0 concentric cable for haulage system and a carload of 40 Lb. rails for the 8th level.

We also made extensive repairs to the main line two ton and four ton cars.

ACCOUNT
PUMPING MACHINERY

Year 1928	$3,682.01
" 1927	1,635.85
Increase	$2,046.16

Cost for 1928 shows an increase due to purchase of extra heavy pipe and other material for the new 8th level pump-house. There is also an item of $1,563.28 for cutting new pump-house and sump.

SURFACE COSTS

ACCOUNT
HOISTING

Year 1928	$21,949.23	Cost Per Ton	.062
" 1927	20,787.77	" " "	.064
Increase	$ 1,161.46	Decrease	.002

Total cost shows an increase due to hoisting 10% more ore in 1928. The amount of rock handled during the two years was about the same.

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SURFACE COSTS

ACCOUNT
STOCKING ORE

Year 1928	$ 9,800.45
" 1927	11,112.75
Decrease	$ 1,312.30

The cost for 1928 is below normal. One reason for that is because during the years 1925, 1926 and 1927, we bought new stringers and trestles legs for the portable trestles and also repaired the permanent trestles.

Another reason is that during 1928, we were able to get most of the portable trestles up before the weather got bad. Most of the stocking trestles were put up in October.

ACCOUNT
SCREENING AND
CRUSHING AT MINE

Year 1928	$3,274.95
" 1927	3,290.58
Decrease	$ 15.63

The cost for the past two years shows but little change. We put 90,316 tons through the crushers at the mine, compared with 85,017 tons in 1927 and 58,976 tons in 1926. The unit cost per ton crushed was .036 for 1928 and .039 for 1927.

ACCOUNT
DRY HOUSE

Year 1928	$10,831.25
" 1927	9,829.61
Increase	$ 1,001.64

Cost for 1928 increased due to repairs on roof, but most of the increase was due to heating expense. In 1927, cost for coal and labor amounted to $5,976.75 which increased to $6,863.42 in 1928.

ACCOUNT
GENERAL SURFACE EXPENSE

Year 1928	$4,809.07
" 1927	5,683.93
Decrease	$ 874.86

General surface expense decreased because of less teaming and labor required in 1928 to clean up the mine premises. In 1927, we conducted a very extensive cleaning up campaign and also built several new fences around the caves as well as building new snow fences.

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SURFACE
MAINTENANCE COSTS

ACCOUNT
HOISTING EQUIPMENT

Year 1928	$ 5,790.06
" 1927	10,985.07
Decrease	$ 5,195.01

The cost in 1927 was extraordinary because of repairs to the Morris shaft cage hoist and because we put two new skips and a new cage into commission.

ACCOUNT
SHAFT REPAIRS

Year 1928	$2,410.62
" 1927	3,901.85
Decrease	$1,491.23

The cost for 1927 was above normal. In that year, the Lloyd shaft was retimbered from the 3rd level down at a cost of $1,569.04, which is approximately the amount of the decrease for 1928.

ACCOUNT
TOP TRAM EQUIPMENT

Year 1928	$2,014.53
" 1927	2,494.03
Decrease	$ 479.50

The expense for 1928 shows a decrease as did the year 1927 compared with 1926. There were no unusual expenditures in 1928, the bulk of the expense being for wire rope, spools, idlers, etc.

ACCOUNT
DOCKS, TRESTLES
AND POCKETS

Year 1928	$1,516.39
" 1927	2,372.88
Decrease	$ 856.49

In 1927, the cost for trestles was above normal due to extensive repairs to the permanent trestles and also because a new rock trestle was built for the Morris shaft.

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SURFACE
MAINTENANCE COSTS

ACCOUNT
MINE BUILDINGS

Year 1928	$2,109.80
" 1927	2,068.54
Increase	$ 41.26

Although the increased cost for 1928 is small, still the expense for maintaining the mine buildings is above the normal due to repairs on office, dry, shops and engine house. A new roof was put on the office building. The other buildings were painted. A new sewer was laid to take care of the run-off around the dry.

GENERAL MINE ACCOUNTS

ACCOUNT
INSURANCE

Year 1928	$ 117.68
" 1927	2,233.63
Decrease	$2,115.95

Large decrease due to adjusting premiums in 1927.

ACCOUNT
ENGINEERING

Year 1928	$3,558.01
" 1927	3,262.95
Increase	$ 295.06

Increase due to more engineering supervision required because of concreting the 8th level storage pocket.

ACCOUNT
ANALYSIS

Year 1928	$11,552.63
" 1927	9,486.87
Increase	$ 2,065.76

Cost increased because of the shifting of the laboratory personnel and the difference in wages paid the new crew. Also cost increased because of the additional determinations made. The total for 1928 reached a peak of 38,479.

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GENERAL MINE ACCOUNTS

ACCOUNT
PERSONAL INJURY EXPENSE

Year 1928	$6,548.67
" 1927	7,046.65
Decrease	$ 497.98

The only reason that this account does not show a still greater decrease is because we charge 2% of the payroll against this account each month to take care of compensation costs. The total charged for the year was $4,843.67 and as we had no accidents since that charge was made, our personal injury expense is actually only 1/3 of the total for the year 1927.

ACCOUNT
SAFETY DEPARTMENT EXPENSE

Year 1928	$220.43
" 1927	236.27
Decrease	$ 15.84

The expense incurred under this heading was light for the past two years.

ACCOUNT
TELEPHONES AND
SAFETY DEVICES

Year 1928	$2,624.23
" 1927	1,700.06
Increase	$ 924.17

The cost for 1928 increased due to installation of a large footage of flexible cable and lights in the sub-levels. Nearly all the mining contracts have two or more electric lights in their working places.

ACCOUNT
LOCAL GENERAL WELFARE

Year 1928	$4,975.97
" 1927	3,575.27
Increase	$1,400.70

Increase due to old accounts charged to Club House Expense in 1928.

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GENERAL MINE ACCOUNTS

1. GENERAL:

ACCOUNT
MINE OFFICE

Year 1928	$16,847.15
" 1927	15,076.80
Increase	$ 1,770.35

Most of the increase is due to charging off general-storehouse overhead expense against the operating mines the latter part of the year.

2. PRODUCTION, SHIPMENTS & INVENTORIES:

a. Production by Grades:

Tilden Silica	116,415 Tons
Rock	4,500 "

The mine started production April 26th on single shift, and continued on single shift until August 20th. From Aug. 20th to Sept. 1st, 12 days, the mine worked on double shift, but lost five full shifts during this period casting rock. From Sept. 2nd to Oct. 5th the mine worked on single shift again, but was idle the first three days in October, waiting for orders. There were 129 work-days, and production averaged 902 tons per day and 686 tons per shift. Gross production was 57,691 tons less than in 1927. All ore was crushed at the Mass Crusher.

b. Shipments:

Grade of Ore:

Tilden Silica	116,415 Tons

c. Stockpile Inventories:

None.

There is about 15,000 tons of broken ore in the pit, but it is badly mixed with rock, and will require secondary blasting.

OGDEN MINE

ANNUAL REPORT

YEAR 1928.

1. GENERAL:

The Ogden Mine was opened on April 24th, and production started on April 26th. Work was continued until October 5th, working single shift up to August 20th, and after September 1st.

Production was delayed frequently by rock in the ore, which had to be cast back separately. Approximately 10% of the loading time was taken up in this way, and there were other delays waiting for cars and for shipping instructions.

In September, after the final blast of the season, a sale of 15,000 tons was cancelled, and there remains about this amount of ore broken in the pit. There is a good deal of rock in it, however.

A small amount of ore remains in place above the floor of the pit, approximately 50,000 tons, and the floor of the pit is all ore, but it will be cheaper to mine the ore needed in future at the Tilden Mine.

After the shipping season was over all the equipment was moved to the Tilden Mine, except the pump used for stripping. This was sent to the General Storehouse. The buildings were torn down, and nothing now remains at the mine except a few tons of rails and a powder magazine.

The large shovel was moved to the Tilden Mine on its own power, using a temporary transmission line, built through the woods.

The mine operated throughout the season without an accident.

2. PRODUCTION, SHIPMENTS & INVENTORIES:

a. Production by Grades:

Tilden Silica	116,415 Tons
Rock	4,500 "

The mine started production April 26th on single shift, and continued on single shift until August 20th. From Aug. 20th to Sept. 1st, 12 days, the mine worked on double shift, but lost five full shifts during this period casting rock. From Sept. 2nd to Oct. 5th the mine worked on single shift again, but was idle the first three days in October, waiting for orders. There were 129 work-days, and production averaged 902 tons per day and 856 tons per shift. Gross production was 57,691 tons less than in 1927. All ore was crushed at the Maas Crusher.

b. Shipments:

Grade of Ore:

Tilden Silica	116,415 Tons

c. Stockpile Inventories:

None.

There is about 15,000 tons of broken ore in the pit, but it is badly mixed with rock, and will require secondary blasting.

OGDEN MINE
ANNUAL REPORT
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2. PRODUCTION, SHIPMENTS & INVENTORIES: (Continued)

e. Production by Months:

Month	Days	Tons per Day	Total Tons
April	4	630	2,520
May	26	867	22,557
June	25	1012	25,312
July	24	835	20,032
August	25	916	22,918
September	23	901	20,734
October	2	1171	2,342
Total	129	902	116,415
Rock			4,500

f. Ore Statement:

	Year Tons	Last Year Tons
On Hand Jan. 1st, 1928.	None	1,394
Output for Year	116,415	174,106
Shipments	116,415	175,500
Decrease in Output	57,691	
Decrease in Shipments	59,085	

1928 - 1 - 9 Hour Shift, 6 Days per Week, Apr. 26 - Aug. 20.
2 - 9 Hour Shifts, 6 Days per Week, Aug. 20 - Sept. 2.
1 - 9 Hour Shift, 6 Days per Week, Sept. 2 - Oct. 5.
Mine Closed October 5th.

g. Delays:

Except in the month of June there was frequent delay from casting rock out of the ore, and approximately 10% of the loading time was taken up in this way. In addition to holidays there were other delays as follows:

On July 10th and Aug. 31st the mine was idle all day, because there were no railroad cars and on the first three days in October it was idle again waiting for shipping orders. On July 24th the lightning struck the power-line, and burned out three transformers and a switch. The mine was idle half a day.

3. ANALYSIS:

a. Average Mine Analysis on Output:

Grade	Iron	Phos.	Silica
Tilden Silica	39.46	.049	38.40

b. Average Analysis on Straight Cargoes:

Grade	Mine			Lake Erie	
	Iron	Phos.	Silica	Iron	Moisture
Tilden Silica	39.55	.049	38.41	38.41	2.88

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4. **ESTIMATE OF ORE RESERVES:**

a. **Developed Ore:**

Assumption - 15 cu. ft. equals one ton.
10% deduction for rock.

All ore is Tilden Silica grade.

	Ore Tons	Less 10% Rock Tons	Net Ore Tons
Above Floor of Pit	72,000	7,000	65,000
15 Ft. Below Pit Floor	200,000	20,000	180,000
Total	272,000	27,000	245,000

b. **Prospective Ore:**

By going 15 feet deeper another 180,000 tons can be obtained, but this cannot be mined with present haulage equipment.

c. **Estimated Analysis:**

	Iron	Phos.	Silica	Alum.	Mang.	Lime	Mag.	Sul.	Igni.	Moist.
Dried 212°	40.50	.055	38.87	.64	.160	.620	.260	.008	1.43	
Natural	39.00	.053	37.43	.62	.154	.597	.250	.008	1.38	3.70

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5. LABOR AND WAGES:

a. Comments:

1. Labor:

There was no shortage of labor in 1928.

b. Comparative Statement of Wages and Product:

	1928	1927	Increase	Decrease
PRODUCT	116,415	174,106		57,691
No. of Shifts and Hours	1 - 9 Hr.	1 - 9 Hr.		
AVG. NO. MEN WORKING:				
Surface	10	7	3	
Underground	2	4		2
Total	12	11	1	
AVG. WAGES PER DAY:				
Surface	4.65	4.72		.07
Underground	6.37	5.68	.69	
Total	5.00	4.97	.03	
WAGES PER MO. OF 25 DAYS:				
Surface	116.25	118.50		2.50
Underground	159.25	142.00	17.25	
Total	125.00	124.75	.25	
PRODUCT PER MAN PER DAY:				
Surface	86.00	118.52		32.52
Underground	334.04	322.42	11.62	
Total	68.39	86.66		18.27
LABOR COST PER TON:				
Surface	.054	.039	.015	
Underground	.019	.019	.000	
Total	.073	.058	.015	
TOTAL NO. OF DAYS:				
Surface	1353½	1469		115½
Underground	348½	539¾		191¼
Total	1702	2008¾		306¾
AMOUNT FOR LABOR:				
Surface	6296.02	6933.44		637.42
Underground	2221.00	3067.55		846.55
Total	8517.02	10000.99		1483.97

Mine Produced from June 4th to Nov. 15th, 1925.
" " " June 1st to Oct. 27th, 1926.
" " " April 18th to Oct. 21st, 1927.
" " " April 24th to Oct. 5th, 1928.

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6. SURFACE:

a. Buildings:

All the buildings, except the powder-houses have been torn down, and all the pipes, machinery and equipment have been removed.

7. OPEN PIT OPERATIONS:

a. Stripping:

The scraper finished a small area at the northwest end of the pit, and was moved to the Tilden Mine in June.

The hose was used to clean the ledge after the scraper had finished, and also to wash off the northeast corner near the boundary. A total of 1565 cu. yds. was moved.

Stripping Statement:

	1928	1927	Total
Cubic Yards Stripped	1,565	9,645	34,071
Captain		$ 49.70	$ 918.33
Labor At Mine	$ 594.29	3,990.80	18,817.69
Supplies At Mine	77.99	1,383.21	6,753.37
Personal Injury Expense			21.40
Local General Welfare, Labor		.92	30.85
" " " Supplies		1.33	25.13
Contingent Expense		36.94	404.18
Central Office, Labor		156.82	1,067.44
" " Supplies		96.61	609.88
Engineering		16.85	390.10
Clerk		38.62	475.74
Superintendent		6.24	207.25
Total	$ 672.28	$ 5,778.04	$ 29,721.36
Charged To Production	12,589.03	8,705.30	29,721.36
Balance	$ 11,916.75	$ 2,927.26	$ 0
Tons of Ore Stripped	30,000	130,000	567,000
Cost Per Cubic Yard	$ .430	$ .599	$ .872
Cost Per Ton of Ore Stripped	.022	.044	.052
Cost Per Ton of Ore Mined			.059

f. Drilling, Blasting and Explosives:

For primary blasting the same three Cyclone drills were used as last year, using 5-7/8 inch bits. The holes were all loaded with 60% or 80% gelatine in the bottom and bulk powder (Special #1) higher up. Approximately 105,000 tons of ore was blasted during the season, and about 15,000 tons of broken ore remains in the pit. After the final blast was made, there was a cancellation of 15,000 tons in sales made, so that the over-break was unavoidable. Approximately 10,000 tons of rock was broken with the ore.

Two drills were moved to the Tilden Mine on July 25th and one on August 25th.

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7. OPEN PIT OPERATIONS: (Continued)

f. Drilling, Blasting and Explosives: (Continued)

Blast Hole Drilling:

Month	Holes Drilled	Holes Lost	Holes Net	Feet Drilled	Feet Lost	Feet Net
April	1	0	1	69	0	69
May	14	0	14	911	0	911
June	15	0	15	1086	0	1086
July	13	2	11	946	29	917
August	4	0	4	267	0	267
Total	47	2	45	3279	29	3250

Cost of Drilling:

3250 Ft. of Holes Drilled: (Not Including Lost Holes)

Operating	Labor	Supplies	Total	Cost Per Foot
Drilling at Mine	$ 2164.01	$ 319.77	$ 2483.78	$ .764
Building Roads	195.00	6.42	201.42	.062
Sharpening Bits	669.01	406.13	1075.14	.331
Pipe & Fittings		38.40	38.40	.012
New Drill Bits		372.52	372.52	.114
Rope		103.65	103.65	.032
Drilling Tools		15.59	15.59	.005
Electric Power		106.50	106.50	.033
Teaming	435.35	182.89	618.24	.190
Total	$ 3463.37	$ 1551.87	$ 5015.24	$ 1.543
Maintenance				
Drills	$ 45.29	$ 562.87	$ 608.16	$ .187
Sharpener	34.00	74.18	108.18	.033
Total	$ 79.29	$ 637.05	$ 716.34	$ .220
Grand Total	$ 3542.66	$ 2188.92	$ 5731.58	$ 1.763
Cost per Ton				$ .071

At 25 tons per foot the cost for drilling was $ .071.

Drilling was started on April 28th and was finished on August 23rd. At the beginning of the season there were 21 holes drilled with a total of 1467 feet of hole. The average tons broken per foot of hole was 25, 8 less than last year. The decrease is due to tighter ground and to rock, which was broken, but was not included in the estimated tonnage. There were three large blasts made during the year as follows:-

1.	May 3rd	-	6	Holes Broke	-	15,000 Tons
2.	June 7th	-	33	" "	-	60,000 "
3.	Aug. 27th	-	27	" "	-	30,000 "
	Total	-	66	" "	-	105,000 "

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7. OPEN PIT OPERATIONS: (Continued)

f. Drilling, Blasting and Explosives: (Continued)

Cost per Ton for Drilling and Blasting:

116,415 Tons	Drilling	Per Ton	Explosives	Per Ton	Total	Per Ton
Primary Blasting & Drilling	10145.55	.087	5795.68	.050	15941.23	.137
Secondary Blasting	2324.09	.020	1430.33	.012	3754.42	.032
Total as per Cost Sheet	12469.64	.107	7226.01	.062	19695.65	.169

Statement of Explosives Used:

Kind	Quantity	Average Price	Amount
Hercomite No. 2 1½ x 8	1,000	13.50	135.00
Hercomite No. 3 1½ x 8	4,300	13.50	571.50
Hercomite No. 4 5 x 16	6,100	13.50	823.50
Hercomite 40% Gel. 5 x 16	2,700	12.75	344.25
Hercomite 60% Gel. 5 x 16	9,300	15.00	1395.00
Hercomite 60% Gel. 1½ x 8	2,750	15.00	412.50
Hercomite 80% Gel. 5 x 16	15,050	19.00	2859.50
Total Powder	41,200	15.87	6541.25
No. 6 Caps Per M.	6,500	11.34	73.74
Crescent Fuse " M.	37,800	6.26	236.84
Dbl. Count. Cord. Bickford Fuse C.	5,860	4.89	285.56
Plain " " " "	2,011	4.25	85.47
Cordeau Couplings	100		.90
Cap Crimpers	4	.56	2.25
Total Fuse, Caps, Etc.			684.76
TOTAL EXPLOSIVES AS PER COST SHEET			7226.01

Distribution:

Primary Blasting:

Hercomite No. 4 5 x 16	6,100	13.50	823.50
40% Gelatin 5 x 16	2,700	12.75	344.25
60% " 5 x 16	9,300	15.00	1395.00
80% " 5 x 16	15,050	19.00	2859.50
Total Powder	33,150	16.34	5422.25
Dbl. Count. Cord. Bickford Fuse	5,860	4.89	285.56
Plain " " " "	2,011	4.25	85.47
Cordeau Couplings	100		.90
Cap Crimpers	3	.50	1.50
Total Fuse, Etc.			373.43
TOTAL EXPLOSIVES - PRIMARY BLASTING			5795.68

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7. OPEN PIT OPERATIONS: (Continued)

f. Drilling, Blasting and Explosives: (Continued)
Statement of Explosives Used: (Continued)
Distribution:
Secondary Blasting:

	Quantity	Average Price	Amount
Hercomite No. 2 1½ x 8	1,000	13.50	135.00
Hercomite No. 3 1½ x 8	4,300	13.50	571.50
Hercomite 60% Gel. 1½ x 8	2,750	15.00	412.50
Total Powder	8,050	13.90	1119.00
No. 6 Caps	6,500	11.34	73.74
Crescent Fuse	37,800	6.26	236.84
Crimpers	1		.75
Total Fuse, Caps, Etc.			311.33
TOTAL EXPLOSIVES - SECONDARY BLASTING			1430.33

b. Detailed Cost Comparison:
1. Days and Shifts:
The mine worked six days a week one nine-hour shift per day from April 26th to August 20th, 93 days, and two nine-hour shifts per day from August 21st to September 1st, 12 days, and then one nine-hour shift per day from September 2nd to October 5th, 24 days, 129 days in all. In 1927 the mine worked 108 days on single shift and 43 days double shift, 151 days in all.

PIT OPERATING ACCOUNTS:

Drilling and Blasting:

1927	$ 25184.93	$ .145
1928	19695.65	.169
Decrease	$ 5489.28	
Increase		$ .024

The decrease in total cost is due to smaller production. The increase in cost per ton is due to blasting more ore than was loaded and to harder ground.

Steam-Shovels, Operating:

1927	$ 3450.18	$ .020
1928	2692.15	.023
Decrease	$ 758.02	
Increase		$ .003

The decrease is due to smaller production. Cost per ton increased on account of handling rock.

Steam-Shovels, Reprs. & Maintenance:

1927	$ 2973.18	$ .018
1928	2406.65	.021
Decrease	$ 566.53	
Increase		$ .003

A new dipper front was put on in each year, and teeth and points were about the same. In 1927 a new pinion cost $ 300 and repairs to generator cost $ 216.

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8. COST OF OPERATING:

a. Comparative Mining Costs:

	1928	1927	Increase	Decrease
PRODUCT	116,415	174,106		57,691
Pit Operating Cost	.462	.459	.003	
Pit General Cost	.026	.043		.017
Total Producing Cost	.488	.502		.014
Original Cost	.097		.097	
Plant & Equipment	.060	.067		.007
Movable Equipment	.006		.006	
Taxes	.037	.022	.015	
Central Office	.016	.003	.013	
Welfare, Hospital, Etc.	.011		.011	
Contingent Expense		.003		.003
Cost Adjustment		.014		.014
Stripping	.108	.050	.058	
Total Cost on Cars	.823	.661	.162	
COST OF PRODUCTION				
Labor	.138	.119	.019	
Supplies	.350	.383		.033
Total	.488	.502		.014

b. Detailed Cost Comparison:

1. Days and Shifts:

The mine worked six days a week one nine-hour shift per day from April 26th to August 20th, 93 days, and two nine-hour shifts per day from August 21st to September 1st, 12 days, and then one nine-hour shift per day from September 2nd to October 5th, 24 days, 129 days in all. In 1927 the mine worked 108 days on single shift and 43 days double shift, 151 days in all.

PIT OPERATING ACCOUNTS:

Drilling and Blasting:

1927	$ 25184.93	$ .145
1928	19695.65	.169
Decrease	$ 5489.28	
Increase		$ .024

The decrease in total cost is due to smaller production. The increase in cost per ton is due to blasting more ore than was loaded and to harder ground.

Steam-Shovels, Operating:

1927	$ 3480.15	$ .020
1928	2692.13	.023
Decrease	$ 788.02	
Increase		$ .003

The decrease is due to smaller production. Cost per ton increased on account of handling rock.

Steam-Shovels, Reprs. & Maintenance:

1927	$ 2973.18	$ .018
1928	2406.65	.021
Decrease	$ 566.53	
Increase		$ .003

A new dipper front was put on in each year, and teeth and points were about the same. In 1927 a new pinion cost $ 300 and repairs to generator cost $ 216.

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8. COST OF OPERATING: (Continued)

PIT OPERATING ACCOUNTS: (Continued)

Locomotives & Cars, Operating:			
1927	$	1825.51	$ .013
1928		1896.75	.016
Increase	$	71.24	$ .003
Locomotives & Cars, Reprs. & Maint:			
1927	$	39.71	$ .000
1928		130.66	.001
Increase	$	90.95	$ .001
Track Expense:			
1927	$	197.85	$ .001
1928		324.53	.003
Increase	$	126.68	$ .002
Screening and Crushing:			
1927	$	42769.45	$ .246
1928		23556.97	.202
Decrease	$	19212.48	$ .044
General Open Pit Expense:			
1927	$	2129.43	$ .012
1928		1674.01	.014
Decrease	$	455.42	
Increase			$ .002
Open Pit Superintendence:			
1927	$	1327.81	$ .007
1928		1312.50	.012
Decrease	$	15.31	
Increase			$ .005

Pipes for wetting the track and a pair of new leaf springs were put on the locomotive in 1928.

In 1928 the face was shorter and for this reason and because of overcasting rock the track had to be relaid several times.

This work is done at the Maas Crusher, and is not under the mine supervision.

The decrease is due to the smaller number of days worked.

The increase in cost per ton is due to larger shipments in 1927.

PIT GENERAL ACCOUNTS:

Insurance:			
1927	$	91.34	$ .001
1928		57.06	.000
Decrease	$	34.28	$ .001
Engineering:			
1927	$	563.63	$ .004
1928		452.97	.004
Decrease	$	110.66	$ .000
Analysis:			
1927	$	935.56	$ .005
1928		682.55	.006
Decrease	$	253.01	
Increase			$ .001

Central Office charge. Less surveying in 1928.

The decrease in 1928 is due to the shorter season and smaller shipment.

9. EXPLORATIONS AND FUTURE EXPLORATIONS:

Ogden Mine is closed and no exploration work is planned at present. There is a good chance to find high-

10. TAXES:

11. PERSONAL INJURIES:

There were no personal injuries in 1928.

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8. COST OF OPERATING: (Continued)

PIT GENERAL ACCOUNTS: (Continued)

Personal Injury Expense:		
1927	$ 4398.15	$ .025
1928	409.72	.003
Decrease	$ 3988.43	$ .022

In 1927 there was a fatal accident. There were no accidents in 1928. Charges are 2% of pay-roll in 1928.

Telephones and Safety Devices:		
1927	$	$
1928	3.12	.000
Increase	$ 3.12	$ .000

Local General Welfare:		
1927	$ 34.99	$ .000
1928	60.21	.001
Increase	$ 25.22	$ .001

Mine Office:		
1927	$ 1452.47	$ .009
1928	1406.16	.012
Decrease	$ 46.31	
Increase		$ .003

9. EXPLORATIONS AND FUTURE EXPLORATIONS:

The Ogden Mine is closed, and no exploration work is planned at present. There is a good chance to find high-grade ore under the pit, as the geological structure is very favorable, and drilling should be tried here, when it is desired to find high-grade Bessemer ore to meet market requirements.

The explorations mentioned last year under this heading will be covered by the Tilden Mine report.

10. TAXES:

Statement of Taxes:

	1928		1927	
	Valuation	Taxes	Valuation	Taxes
Supplies & Equipment	$ 36,000	$ 1428.69	$ 58,000	$ 2351.11
Lot 3, Sec. 13, 47 - 27	150	5.95	150	6.08
Part of Lot 4, Sec. 13, 47 - 27	100	3.97	100	4.05
Lot 5, Sec. 13, 47 - 27	44,000	1746.18	35,000	1418.77
SE¼ of SW¼, Sec. 13, 47 - 27	200	7.94	200	8.11
Total	$ 80,450	$ 3192.73	$ 93,450	$ 3788.12
Collection Fees		31.93		37.88
Total		$ 3224.66		$ 3826.00

11. PERSONAL INJURIES:

There were no personal injuries in 1928.

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18. NATIONALITY OF EMPLOYEES:

Nationality Statement:

American	12
English	4
Finnish	2
French Canadian	1
Total	19

This statement is based on the month of July.

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1. GENERAL:

Work was started in the fall of 1927, as reported under paragraph 9 of the Ogden Mine report for that year. Exploration by diamond drilling was done in that year, a dam and pipe-line for hydraulicking stripping were built, and clearing of the site was started.

In 1928 the area of the pit was cleared, more than half the stripping of the upper bench, where operations will start, was completed, the equipment from the Ogden Mine was brought to the mine, the railroad grade was built, and the track laid but not ballasted, and the main building and crushing-plant partly built. Construction work on the crusher will be continued during the winter till it is completed, and the building will be finished in the spring.

Drilling was carried on for three months with churn drills, and there are now eighty-five large holes ready to blast, sufficient to break over 80,000 tons of ore.

The Lake Superior & Ishpeming Ry. completed their connecting line to the plant in September.

Part of the crushing plant is to consist of machinery used at the Maas Crusher, and this has all been received at the Tilden Mine.

4. ESTIMATE OF ORE RESERVES:

a. Developed Ore:

Assumption - 14 cu. ft. equals one ton.

All ore is Tilden Silica.

Upper Bench	1,560,000	Tons
Lower Bench	1,870,000	"
Total	3,430,000	"

b. Prospective Ore:

In addition to this ore there is an indeterminate but probably very large tonnage of ore adjoining the pit on the northwest. This ore has not been proven by drilling, but is indicated by outcrops and old test-pits.

c. Estimated Analysis:

	Iron	Phos.	Silica	Alum.	Mang.	Lime	Mag.	Sul.	Igni.	Moist.
Dried 212°	42.50	.046	35.10	.67	.120	.48	.31	.014	.90	
Natural	40.93	.044	33.80	.65	.116	.46	.30	.013	.87	3.70

7. OPEN PIT OPERATIONS:

a. Stripping:

The area of the pit was cleared on contract, the contractor removing all timber and brush, except oak trees six inches in diameter and larger. The timber removed was accepted in payment for the labor performed.

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7. OPEN PIT OPERATIONS: (Continued)

a. Stripping: (Continued)

The 6" pipe-line from the dam in the valley, built in 1927, was completed, and two hydraulic monitors, with swivel-heads and 1¼ inch nozzles, were built and connected to branches of the pipe-line by 2½ inch fire-hose. With these nozzles over half of the area of the pit was stripped clean, and some of the rest was roughed over. The clay and loam was carried by the water down into the swamp, and the heavier material was washed to the lower part of the slope, where much of it was loaded by the Erie shovel, and was used for building railroad embankments. The haulage equipment used with the Erie shovel consisted of four 1¼ cu. yd. gravel cars and a 1½-ton gasolene locomotive.

The big pump, used for supplying water for hydraulicking, was bought from the Stephenson Mine, and has a capacity of 1500 gals. per minute against 500 feet head. The pressure at the nozzles is about 160 lbs. per square inch.

Early in the summer a storage dam was built above the dam by the pump, to impound more water. Both dams were washed out by a heavy rain, before the upper one was completed, and had to be partly rebuilt.

The scraper was used for stripping for a short time, but was not as effective as the hydraulicking, except in coarse material.

Stripping Statement:

	1928	1927	Total
Cubic Yards Stripped	23,000		23,000
Holmes Mine		$ 53.53	$ 53.53
General Storehouse		68.60	68.60
Cliffs Shaft Mine		510.85	510.85
Ogden Mine		1,197.40	1,197.40
Labor At Mine	$ 7,455.47		7,455.47
Supplies At Mine	6,535.24		6,535.24
Total	$ 13,990.71	$ 1,830.38	$ 15,821.09
Cost Per Cubic Yard			$ .688

f. Drilling, Blasting and Explosives:

The three Cyclone drills were moved to the Tilden Mine from the Ogden Mine, two in July and one in August, and 85 holes were drilled at the east end of the pit. These holes were not blasted, but will be shot early in the spring of 1929 so that the mine can start at full production as soon as navigation opens. 5-7/8 inch bits were used, the same as at the Ogden Mine, but the speed of drilling was greater.

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7. OPEN PIT OPERATIONS: (Continued)

f. Drilling, Blasting and Explosives: (Continued)

Blast Hole Drilling:

Month	Holes Drilled	Holes Lost	Holes Total	Feet Drilled	Feet Lost	Feet Total
July	2	1	1	65	31	34
August	28	0	28	1195	0	1195
September	28	2	26	1255	60	1195
October	30	0	30	1267	0	1267
Total	88	3	85	3782	91	3691

It is estimated that these holes will break 80,000 tons of ore.

10.

Cost of Drilling:
3691 Ft. of Holes Drilled (Not Including Lost Holes)

Operating	Labor	Supplies	Total	Cost Per Foot
Drilling At Mine	2012.87	368.14	2381.01	.645
Building Roads	612.34	10.85	623.19	.169
Sharpening Bits	475.69	103.32	579.01	.157
Pipe and Fittings	52.08	335.89	387.97	.105
Rope		213.39	213.39	.058
Drilling Tools		.44	.44	.000
Electric Power		183.34	183.34	.050
Teaming	244.17	108.21	352.38	.095
Total	3397.15	1323.58	4720.73	1.279
Maintenance				
Drills	125.54	662.12	787.66	.213
Sharpener	8.40	13.25	21.65	.006
Total	133.94	675.37	809.31	.219
Grand Total	3531.09	1998.95	5530.04	1.498
Cost per Ton				.071

11.

12.

Statement of Explosives Used:

Kind	Quantity	Average Price	Amount
Hercomite No. 2	500	13.50	67.50
Hercomite No. 5	3,275	13.53	443.13
Hercomite 60% Gelatin	1,500	15.00	225.00
Total Powder	5,275	13.94	735.63
No. 6 Caps	3,300	11.65	38.46
No. 6, 8 Ft. Inst. Caps	100	6.71	6.71
Crescent Fuse	16,600	5.94M	98.66
Connecting Wire	2		1.60
Cap Crimpers	1		.75
TOTAL EXPLOSIVES			881.81

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9. EXPLORATION & FUTURE EXPLORATIONS:

Northwest of the new pit there is a large area of silicious ore indicated by old test-pits and outcrops extending as far as the old Foster Mine, but between this area and the pit there is a small swamp in which no exploration has been done. This swamp should be tested by churn-drilling, to see if the ore continues under it.

South of the pit there is another area of low ground. Geologically this is on the Palmer Fault, the south limit of the iron-range, and the chances of discovering good ore at this point by diamond-drilling are good.

10. TAXES:

		1928		1927	
N½ of NW¼ Sec. 26 - 47-27	$ 25,000	$ 992.15			
SW¼ of SE¼ Sec. 23 - 47-27	4,000	158.74	$ 4,000	$ 162.15	
Total	$ 29,000	$ 1150.89	$ 4,000	$ 162.15	
Collection Fee		11.51		1.62	
Total		$ 1162.40		$ 163.77	

11. PERSONAL INJURIES:

One man was slightly injured during the season. Charges at the rate of 2% of the pay-roll were made against all operations to provide for employer's liability payments.

12. NEW CONSTRUCTION AND PROPOSED NEW CONSTRUCTION:

E & A. No. 514. Opening and Equipping the Tilden Mine.

The new construction necessary to place the Tilden Mine on a production basis at the beginning of the shipping season in 1929 is well along, and will be completed on time.

The Lake Superior & Ishpeming Ry. built a connecting line to the property, and the mining department graded and laid track from the crusher site to the pit. This track was not ballasted, because the ground was frozen, when it was laid.

Enough of the pit has been stripped and enough drilling has been done to start operations at full capacity in the spring. Completion of the stripping will not interfere with operations in the pit.

A combination office, warehouse, engine-house, shop and dry has been built close to the crushing-plant, using the framework of the old shops at the Angeline Mine. The building is 32 feet wide and 101 feet long. The outside is to be "gunited" in the spring, when weather permits. The interior has not been finished, but the compressor is running and the shop, dry, office and warehouse are in use.

A garage for the tractor was also built, and a small storehouse, which was used temporarily as an office.

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13. NEW EQUIPMENT AND PROPOSED NEW EQUIPMENT:

E AND A. NO. 514.

a. Steam-Shovels:

In October the 80 B. Bucyrus Electric Shovel #4616, C.C.I. Co. No. 29, was moved from the Ogden Mine to the Tilden Mine by its own power, a distance of two miles.

A temporary transmission line was built from the Ogden Mine and from the Tilden Mine, with a gap of 1000 feet in the middle, and the shovel, by means of its 700 foot cable, tapped into this line at 1000 ft. intervals. The shovel followed the Cliffs Drive for about a mile through the woods, but left the road as soon as cleared ground was reached. In the last four tenths of a mile the shovel had to dig its way along the face of the hill through the woods. The move was accomplished without accident, except for one stripped pinion and two broken treads. Difficulties were tremendously increased by heavy rainfall.

The cost of moving was as follows:-

Cost of Moving 80 B. Electric Shovel from Ogden Mine to Tilden Mine:

	Total	Per Mile
Power Line (1½ Miles)		
Labor (81½ Days)	$ 374.86	$ 249.91
Supplies	191.63	127.75
Total	$ 566.49	$ 377.66
Widening Road		
Main Road (1 Mile) 69 Days Labor	$ 282.80	$ 282.80
Branch Road (.4 Mile) 34 Das. "	139.10	397.75
Total	$ 421.90	$ 301.35
Moving Shovel		
Main Road & Clearings (1.6 Miles)		
Labor	$ 262.17	$ 163.85
Supplies	61.41	38.37
Total	$ 323.58	$ 202.22
Branch Road (.4 Mile)		
Labor	$ 146.25	$ 365.60
Supplies	15.32	38.30
Total	$ 161.57	$ 403.90
Total Moving	$ 1473.54	$ 736.77

There was a rebate of $ 160.37 for supplies used on the transmission line and returned to the warehouse. This brought the net cost of moving down to $ 1313.17. The cost of dismantling the shovel, loading it on cars, shipping it by rail to the Tilden Mine and erecting it there would have been over $ 4000.

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13. NEW EQUIPMENT AND PROPOSED NEW EQUIPMENT: (Continued)

E AND A. NO. 514.

b. Crushing Plant:

The new crushing plant is to consist of a 42 inch Traylor gyratory crusher, into the hopper of which the cars from the pit will dump directly. The product from this crusher will pass over a rotary grizzly, and the oversize will go to two 10-inch Superior reduction crushers, set to 2 inches. The undersize from the grizzly and the product of the two crushers will join on a 36-inch belt and be elevated to the railroad pocket. The plant is planned for a maximum capacity of 300 tons per hour, although the greatest loading capacity of our present equipment will not exceed 200 tons per hour.

The large crusher has been ordered, and will be delivered in February. One of the small crushers came from the Maas Crushing Plant, and the other was bought from the Allis-Chalmers Mfg. Co. Both are on hand with their motors.

The pocket has been erected over the railroad-tracks, and the belt conveyor, received from the Maas Mine Crusher, is being erected.

The excavation for the big crusher foundation has been completed, and the foundation has been finished. Excavation for the small crusher foundations has not been finished, but will be completed in January.

The steel-work from the Maas Crushing Plant, which is to enclose the grizzly and the two small crushers is also on hand, and the steel frame-work for the crane over the big crusher has been received. This steel work will not be erected until the excavation has been completed.

A 20 K. Cleveland tractor was purchased for this mine and was used until November. It is now in use at the Cliffs Shaft Mine.

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13. NEW EQUIPMENT AND PROPOSED NEW EQUIPMENT: (Continued)

Statement Showing Expenditures to E & A. 514, Opening and Equipping Tilden Mine:

Acct. No.		Estimated	Total To Date	Unexpended Balance
1	Diamond Drilling	11,000.00	10,658.26	341.74
2	Undepreciated Value of Ogden Equipment	35,000.00		35,000.00
3	Undepreciated Value of Maas Equipment	25,000.00		25,000.00
6	Moving & Erecting Ogden Equip.			
a	Moving Drills & Equipment	100.00	102.80	2.80
b	Moving & Erecting Air Comp.			
	1. Foundation	500.00	259.24	240.76
	2. Moving & Erecting	500.00	377.12	122.88
	3. Elect. Connections	200.00	226.77	26.77
	4. Laying Pipe to Pit	300.00	391.80	91.80
	Sub-Total	1,500.00	1,254.93	245.07
c	Moving Steam-Shovel:			
	1. Power Line	1,000.00	406.12	593.88
	2. Widening Road	500.00	421.90	78.10
	3. Moving Shovel	500.00	489.95	10.05
	Sub-Total	2,000.00	1,317.97	682.03
d	Moving Pump, Pipes, Rail, Etc.	400.00	97.57	302.43
	Total	4,000.00	2,773.27	1,226.73
7	Railroad Tracks:			
a	Crusher to Pit:			
	1. Clearing & Grading, Including Trestle, Culverts, Etc.	6,000.00	4,108.41	1,891.59
	2. Track, Incl. Rail, Ties, Switches, Etc., Laying Tracks & Ballast	13,000.00	3,346.58	9,653.42
	Sub-Total	19,000.00	7,454.99	11,545.01
b	Connecting Track to Main Line:			
	1. Clearing & Grading, as above	2,000.00	4,973.50	2,973.50
	2. Track, as above	2,000.00	32.40	1,967.60
	Sub-Total	4,000.00	5,005.90	1.005.90
	Total Railroad	23,000.00	12,460.89	10,539.11
	FORWARD ----------	98,000.00	25,892.42	72,107.58

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13. NEW EQUIPMENT AND PROPOSED NEW EQUIPMENT: (Continued)

Statement Showing Expenditures to E & A. 514, Opening and Equipping Tilden Mine:

Acct. No.		Estimated	Total To Date	Unexpended Balance
	BROUGHT FORWARD ----------	98,000.00	25,892.42	72,107.58
8	Railroad Cars:			
a	620 cu. yd. Cars	19,000.00		19,000.00
b	Freight	1,000.00		1,000.00
	Total	20,000.00		20,000.00
9	Crushing Plant:			
a	Foundations:	6,500.00		
	1. Excavation		4,292.61	
	2. Forms		666.13	
	3. Concrete		955.94	
	4. Belts, Steel Work, Etc.		705.09	
	Sub-Total	6,500.00	6,619.77	119.77
b	Jaw Crusher:	3,000.00		
	1. Moving from Maas Mine			
	2. Erecting			
	3. Motor & Switchboard		28.89	
	4. Hopper & Guards			
	5. Belt			
	Sub-Total	3,000.00	28.89	2,971.11
c	Rotary Grizzly:			
	1. Grizzly	700.00		700.00
	2. Motor Switch & Wiring	200.00		200.00
	3. Belts & Erecting	150.00		150.00
	4. Chute	450.00		450.00
	Sub-Total	1,500.00		1,500.00
d	Gyratory Crushers:			
	a. 1 New Crusher	7,000.00	3,607.40	3,392.60
	b. Moving 1 Crusher from Maas Mine	500.00	917.04	417.04
	c. Freight & Erecting	500.00	54.00	446.00
	d. 1 Speed Reducer	700.00		700.00
	e. Motors & Switchboard	1,800.00	1,110.10	689.90
	Sub-Total	10,500.00	5,688.54	4,811.46
e	Belt Conveyor:			
	1. Chute & Feeder	300.00		300.00
	2. Belt - 125' @ $ 5	625.00		625.00
	3. Erection	525.00		525.00
	4. Enclosure & Trestle	1,500.00	402.28	1,097.72
	5. Motor, Speed Reducer, Wiring, Etc.	1,550.00		1,550.00
	Sub-Total	4,500.00	402.28	4,097.72
f	Railroad Pocket:			
	1. Foundations	500.00	365.51	134.49
	2. Pocket Construction	2,000.00	2,109.26	109.26
	Sub-Total	2,500.00	2,474.77	25.23
	FORWARD ----------	146,500.00	41,106.67	105,393.33

13. NEW EQUIPMENT AND PROPOSED NEW EQUIPMENT: (Continued)

Statement Showing Expenditures to E & A. 514, Opening and Equipping Tilden Mine:

Acct. No.		Estimated	Total To Date	Unexpended Balance
	BROUGHT FORWARD --------	146,500.00	41,106.67	105,393.33
9	Crushing Plant: (Continued)			
g	Pumping Machinery:			
	1. Air Cylinder	500.00		500.00
	2. Steel Work for Crane	2,000.00	101.34	1,898.66
	3. 20-Ton Crane	1,500.00		1,500.00
	4. 20-Ton Chain Block	500.00		500.00
	5. Elec. Crane, Hoist, Erect.	500.00	414.00	86.00
	6. Chutes & Platforms	300.00		300.00
	7. Housing - Corrugated Iron	1,200.00	20.31	1,179.69
	8. Lighting, Light. Arrest., Belts, Etc.	500.00		500.00
	9. Floors	500.00	43.81	456.19
	Sub-Total	7,500.00	579.46	6,920.54
	General Expense	1,000.00		1,000.00
	Total Crushing Plant	37,000.00	15,793.71	21,206.29
10 a	Main Building:			
	1. Foundations	500.00	1,161.71	661.71
	2. Building	4,000.00	4,041.13	41.13
	3. Lighting, Piping, Etc.	500.00	73.65	426.35
	Sub-Total	5,000.00	5,276.49	276.49
b	Storage Building:	3,000.00	15.10	2,984.90
	Total Buildings	8,000.00	5,291.59	2,708.41
11	Miscellaneous Items:			
e	2-Ton Motor Truck	3,000.00		3,000.00
f	2-Ton Tractor	2,700.00	2,114.80	585.20
g	50 H.P. Scraper-Hoist	1,300.00	367.78	932.22
h	Clearing, Grading & Planting	2,000.00		2,000.00
i	Road Construction	2,000.00	299.95	1,700.05
j	Water-Tank & Pump	1,000.00		1,000.00
k	Car-Hoist & Spotting Engine	2,000.00		2,000.00
	Total	14,000.00	2,782.53	11,217.47
12	Feeder:			
	1. First Cost	6,500.00		6,500.00
	2. Freight & Erecting	1,000.00		1,000.00
	3. Drive & Connections	500.00		500.00
	Total	8,000.00		8,000.00
	FORWARD ----------	185,000.00	49,760.25	135,239.75

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13. NEW EQUIPMENT AND PROPOSED NEW EQUIPMENT: (Continued)

Statement Showing Expenditures to E & A. 514, Opening and Equipping Tilden Mine:

Acct. No.		Estimated	Total To Date	Unexpended Balance
	BROUGHT FORWARD --------	185,000.00	49,760.25	135,239.75
13	General Expense:			
a	Engineering		844.13	844.13
b	Analysis		99.08	99.08
c	Mine Office		426.21	426.21
d	Personal Injury Expense		479.76	479.76
e	Superintendence		72.25	72.25
f	Captain		337.50	337.50
g	Watchman		139.00	139.00
	Total		2,397.93	2,397.93
	Grand Total	185,000.00	52,158.18	132,841.82
	Contingencies	11,000.00		11,000.00
	Grand Total	196,000.00	52,158.18	143,841.82
	Summary:			
	E & A. 514A	196,000.00	52,158.18	143,841.82
	E & A. 514B	56,000.00	15,821.09	40,178.91
	Total	252,000.00	67,979.27	184,020.73

Stripping Expenditures: E & A. 514-B:

Acct. No.		Estimate	Total To Date	Unexpended Balance
5	Stripping			
A	Upper Level			
	44,000 Yds. Hydraulicked @ 50¢	22,000.00	15,294.71	6,705.29
B	16,000 Yds. St. Shovel @ 60¢	10,000.00	526.38	9,473.62
	Sub-Total	32,000.00	15,821.09	16,178.91
C	Lower Level			
	31,500 Yds. Steam-Shovel @ 60¢	19,000.00		19,000.00
	Total Stripping	51,000.00	15,821.09	35,178.91
	Contingencies	5,000.00		5,000.00
	GRAND TOTAL	56,000.00	15,821.09	40,178.91
	Cu. Yards Stripped		23,000	
	Cost per Yard		.688	

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18. NATIONALITY REPORT:

American	5
German	1
French Canadian	9
Swede	13
Norwegian	1
Finn	14
Irish	1
English	16
Total	60

This statement is based on the month of October. The report shows parentage rather than nationality at birth.

NEGAUNEE MINE

ANNUAL REPORT

YEAR 1928.

1. GENERAL:

The mine operated from January 1st to April 9th on a six day per week schedule, from April 9th to October 1st on a five day per week schedule, and from October 1st to the end of the year on a six day basis. The operating schedule was practically six months at six days per week and six months at five days per week. This compares with nearly ten months operation in the previous year on a six day per week schedule.

Production decreased in 1928 due to the mine operating less days, and to unfavorable operating conditions on the eleventh level due to crushing. A new foot wall haulage drift was driven on the eleventh level, new raises put up from this drift, which with a number of raises from the twelfth level, enabled mining to be resumed the last of the year in this territory.

2. PRODUCTION, SHIPMENTS & INVENTORIES:

a.

Four transfer systems were installed during the year between the tenth and the twelfth levels. A transfer system consists of a transfer drift located 50' below the operating sub level, connected with one or two raises from crosscuts on the main haulage level below. From the transfer drift single compartment raises are put up at close intervals to the operating sub level. Scraper hoists are used on the sub level and the ore falls directly on the floor of the transfer drift, where it is handled by a large scraper with a 25 H.P. motor. The advantages of this system are as follows: Decreased number of crosscuts on main levels, fewer two-compartment raises and less raising in rock, and greater rapidity in mining on sub levels due to more raises, hence, more scrapers in operation. To operate successfully the ore should be dry, and the sub level and transfer drift free from water.

Stoping was continued above the tenth level in the north foot wall territory near the Maas Mine. Additional raises were put up and scrapers used by all the contracts. The speed of mining in this area materially increased.

b. Mining was also continued during the year in the south foot wall area on and above the tenth level.

Stoping was continued on several sub levels between the tenth and eleventh levels. During the latter part of 1927 and the early part of this year, the crosscuts and raises on the eleventh level crushed and finally had to be abandoned. Pending the reopening of this territory, the contracts were concentrated on the hanging side, where raises were already holed from the twelfth level. Reopening of the foot wall territory is still under way, and it has progressed far enough to permit the transfer of some of the contracts back to the foot wall territory. Due to crushing on the eleventh level, mining in the hanging wall area has progressed faster than on the foot wall side. Water is interfering with mining on the hanging side, and mining will now be concentrated on the foot wall until the water is diverted from the hanging. Successful operation of scrapers depends on freedom from water on the sub levels. Mining has to be planned so as to permit, if possible, the control of incoming water.

Development work was continued throughout the year on the twelfth level. Crosscuts have been connected and one driven to the west to the hanging, where a second outlet to the fourth level, Maas Mine, will soon be completed. One sump has been excavated and a raise from the pumphouse to the eleventh level is now nearly completed. One of the eleventh level pumps will be moved to the twelfth level next year.

NEGAUNEE MINE
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1. GENERAL: (Cont.)

The grade of ore produced in 1928 was very close to the guarantee. The output of Bessemer ore decreased as compared with the previous year, and a further decrease is expected in 1929.

Labor conditions were very satisfactory during the year. There has been an excess of labor available, and consequently, an exceedingly small labor turnover.

The mine is in better condition than it was a year ago. A heavy program of drifting and raising was necessary during 1928, due to crushing of the eleventh level. Some development work is still under way, but it is no more than normal for a large mine.

The splendid record established by the Negaunee Mine of ten years operation with no fatal accidents was broken on December 17th, when a miner was instantly killed by a fall of ground. It was classified as a trade risk, as the place was well timbered and in good condition. As a result of this accident, new standards of mining practice have been adopted, which it is expected will prevent another accident of this kind.

2. PRODUCTION, SHIPMENTS & INVENTORIES:

a. Production by Grades:

	1928	1927	Difference
Negaunee Bessemer Ore	28,329	41,013	12,684 Decr.
Negaunee Ore	426,234	446,867	20,633 "
Total Ore	454,563	487,880	33,317 "
Rock	17,944	13,804	4,140 Incr.

The total product for the year was 33,317 tons less than in 1927, due to working five days per week for a six month period, April 9th to October 1st, as compared with only 2½ months on a five day schedule in 1927. The product was also decreased due to unfavorable operating conditions underground, caused by the crushing of haulage roads on the eleventh level.

b. Shipments:

Grade of Ore	Pocket Tons	Stockpile Tons	Total Tons	Total Last Year
Negaunee Bessemer	10,402	18,548	28,950	68,635
Negaunee Ore	204,062	239,721	443,783	465,927
Total	214,464	258,269	472,733	534,562
Total Last Year	250,487	284,075	534,562	
Decrease	36,023	25,806	61,829	

The shipments for the year decreased 61,829 tons, but were 17,965 tons more than were mined.

c. Stockpile Inventories:

The ore by grades in stock December 31st, 1928, were as follows:

Grade of Ore	Dec. 31, 1928	Dec. 31, 1927	Difference
Negaunee Bessemer	5,784	6,405	621 Decr.
Negaunee Ore	41,624	45,992	4,368 "
Total	47,408	52,397	4,989 "

On December 31st, 1927, there were 6,405 tons of Bessemer in stock. Shipments decreased from 68,635 tons in 1927 to 28,950 tons in 1928, leaving a balance of 5,784 tons in stock December 31st, 1928.

On December 31st, 1927, there were 45,992 tons of Negaunee ore in stock as compared with 41,624 tons at the end of the year. The reduction for the year was 4,368 tons.

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2. PRODUCTION, SHIPMENTS & INVENTORIES:

d. Division of Product by Levels:

The ore hoisted from the various levels was as follows:

	1928		1927	
Tenth Level	117,618	26.0%	187,547	38½%
Eleventh Level	166,930	36.6%	278,788	57 %
Twelfth Level	170,220	37.4%	21,545	4½%
Total	454,768	100 %	487,880	100 %

The above statement shows the changes in product by levels caused by the crushing of the eleventh level.

e. Production by Months:

The production by months is as follows:

Month	Bessemer	Negaunee	Total	Rock
January	5,080	37,349	42,429	836
February	2,676	38,219	40,895	736
March	4,940	41,744	46,684	896
April	2,192	31,905	34,097	1,936
May	1,088	33,389	34,477	2,638
June	1,502	28,565	30,067	2,576
July	2,436	31,092	33,528	1,848
August	5,354	29,757	35,111	1,988
September	4,664	31,100	35,764	1,548
October	2,495	40,149	42,644	1,112
November	3,564	36,936	40,500	724
December	3,208	35,159	38,367	1,108
Total	39,199	415,364	454,563	17,946
Transferred from	10,870 to	10,870		
Stockpile Overrun		12,976	12,976	
Total	28,329	439,210	467,539	17,946

The product was distributed as follows:

Grade	Negaunee Mine	American Mining Co.	Total
Negaunee Bessemer	28,329		28,329
Negaunee Ore	413,743	12,696	426,439
Total	442,072	12,696	454,768

f. Ore Statement:

	Negaunee Bessemer	Negaunee	Total	Total Last Year
On Hand Jan. 1, 1928	6,405	45,992	52,397	99,079
Output for Year	39,199	415,364	454,563	487,768
Overrun		12,976	12,976	112
Transferred from	10,870 to	10,870		
Total	34,734	485,202	519,936	586,959
Shipments	28,950	443,783	472,733	534,562
Balance on Hand	5,784	41,419	47,203	52,397
Decrease in Output			33,205	
Decrease in Ore on Hand			5,194	

1928 - 1-8 Hour Shift, 6 days per week, January 1st to April 9th, 1928.
1-8 Hour Shift, 5 days per week, April 9th to October 1st, 1928.
1-8 Hour Shift, 6 days per week, October 1st to December 31st, 1928.

1927 - 1-8 Hour Shift, 5 days per week, January 1st to March 12th, 1927.
1-8 Hour Shift, 6 days per week, March 12th to Dec. 31st, 1927.

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2. PRODUCTION, SHIPMENTS & INVENTORIES:

g. Delays:

There was only one serious delay during the past year, caused by the burning out of coils on the armature of the skip hoist generator set. The mine was idle two days while repairs were being made. A new motor will be purchased, as further trouble is anticipated with the present motor.

The delays during the year were as follows:

January 27th, 2 hours delay due to damaged lip of skip catching in shaft, making inspection of shaft necessary.
January 28th, 1 hour delay due to fire at 11th level ventilation door.
June 5th, 4 hours delay on transfer drift, due to wet ore breaking down chute.
August 22nd, 1½ hours delay due to burning out of fly wheel set.
October 26th, 8 hours delay.
October 27th, 8 hours delay. The generator on the skip hoist set broke down at 8 A.M. October 26th, and the mine did not hoist on the 26th or 27th. The men were sent home at noon on the 26th.
November 15th, 1 hour delay due to burned out coil on the underground haulage armature.
November 17th, 1 hour delay due to burned out coil on the underground haulage armature.

The underground haulage set was replaced by a spare set, which has been in use since November 17th. The capacity of the spare set was greater than the old set, so that it is planned to purchase it and keep the old set as a spare, for use in case of an accident to the new set. The use of more electric scraper hoists has increased the load carried by the haulage set.

h. Delays from Lack of Current:

There were no serious electrical delays during the past year.

January 24th, 4 hours delay due to no current; trouble on pipe line.
March 14th, 1½ hours delay due to no current.
June 19th, ½ hour delay due to no current.
August 8th, 2 hours delay due to poor current.
September 17th, 1½ hours delay due to no current.

3. ANALYSIS:

a. Average Mine Analysis on Output:

Grade	Iron	Phos.	Silica
Negaunee Bessemer	62.44	.050	5.72
Negaunee Ore	60.08	.094	7.02

b. Average Analysis on Straight Cargoes:

Grade	Mine			Lake Erie		
	Iron	Phos.	Moist.	Iron	Phos.	Moist.
Negaunee Bess.	62.56	.047	-		All mixed	
Negaunee	59.60	.095	-	59.20	-	11.89
Negaunee Special (Beth. Steel)	59.84	.097	-		None.	

c. High Sulphur Ore:

There was no high sulphur ore encountered during the year.

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4. ESTIMATE OF ORE RESERVES:

a. Developed Ore:

Assumption: 12 cubic feet equals one ton.
10% deducted for rock.
10% deducted for loss in mining.
Percentage of Bessemer equals 11.

Above 9th Level:

No. 1 Shaft Pillar	1,148,681 tons
No. 2 Shaft Pillar	113,906 "
Total above 9th Level	1,262,587 "
Between 9th and 10th Levels	298,012 tons
Between 10th and 11th Levels	1,546,762 "
Between 11th and 12th Levels	1,938,836 "
Total above 12th Level	5,046,197 "

This estimate and the analysis under Section "C" will be presented to the Tax Commission. The estimate this year is 243,845 tons less than the estimate of a year ago. The decrease due to mining was 454,778 tons, while 161,156 tons were developed between the eleventh and twelfth levels and 49,867 tons above the eleventh, giving the net decrease of 243,845 tons. The area between the eleventh and twelfth levels is now considered as fully developed.

b. Prospective Ore:

No prospective ore is shown in this report. All ore below the twelfth level is prospective ore. The total estimated tonnage in the mine on December 31st, 1928 is 6,880,510 tons, of which 1,834,313 tons is prospective ore. The Tax Commission figures, based on Findlay's estimate, is 6,577,630 tons, or only 302,880 tons less.

c. Estimated Analysis:

Ore Reserves: Approximate Expected Natural Analysis.

	Iron	Phos.	Silica	Mang.	Alum.	Lime	Mag.	Sul.	Igni.	Moist.
Bessemer	52.80	.042	6.20	.220	2.30	.640	.290	.008	1.50	12.00
Negaunee	52.00	.088	6.78	.232	2.75	.910	.360	.009	2.10	12.00

Ore in Stock: Average Natural Analysis.

	Iron	Phos.	Silica	Mang.	Alum.	Lime	Mag.	Sul.	Igni.	Moist.
Bessemer	55.45	.042	5.15	.221	2.55	.882	.288	.008	1.41	11.75
Negaunee	52.06	.088	6.12	.232	2.75	1.14	.414	.010	2.14	11.75

A few minor changes have been made in the analysis, as compared with last years' report, to bring them more in line with the actual analysis of ore produced.

5. LABOR AND WAGES:

a. Comments:

(1) Labor:

There was no shortage of men at any time during the past year. The use of more mechanical equipment in the mines is reducing the number of men required underground. This, coupled with the extra men in Ishpeming, Negaunee, and Republic, has resulted in a large over-supply of men for all positions. This situation caused some hardships last winter and promises to be more serious this winter.

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5. LABOR AND WAGES:

a. Comments: (Cont.)

(2) New Construction:

E. & A. #531 - Moving 21 Negaunee Mine Houses and Sheds.

On account of mining operations at the Negaunee and Maas Mines, it became necessary to vacate the Maas, Lonstorf, and Mitchell Addition, on which there were 21 dwelling houses. Provision had been made in the new location for these houses, and moving started in September and was completed in October. The sheds and garages were then moved. Repairs on these houses were not completed at the end of the year. All the houses are in better condition than before, due to a full concrete basement for each house. This E. & A. will be completed in 1929.

Statement Showing Expenditures to E. & A. #531 to December 31, 1928.

	Estimate	Total Expenditures to Dec. 31st	Unexpended Balance Dec. 31st.
Purchase price of 5 houses on 7 lots,	49,500.00	49,500.00	0
Moving 21 houses, foundations, etc.	42,300.00	44,732.48	2,432.48(red)
22 lots in C.C.I.Co. First Addition to City of Negaunee,	22,000.00	0	22,000.00
General Expense,	-	20.00	20.00(red)
Contingencies, 10% on cost of moving 21 houses,	4,230.00	0	4,230.00
Total,	118,030.00	94,252.48	23,777.52

Exclusive of the full amount still due for the 22 lots, there is an unexpended balance of only $1,777.52. This must provide for fencing, sidewalks to houses, grading and seeding lots, planting of shrubbery, and the balance of repairs on houses and sheds.

E. & A. #534 - Painting Houses and Sheds.

The condition of the exterior of several of the houses that were moved rendered it necessary to paint them, and E. & A. #534 covers this work. Several houses were painted this fall, but it was not possible to complete the work on account of cold weather.

Statement Showing Expenditures to E. & A. #534 to December 31st, 1928.

	Estimate	Total Expenditures to Dec. 31st	Unexpended Balance Dec. 31st
Painting five houses and sheds,	715.00	288.54	426.46
Contingencies, 10%,	72.00	-	72.00
Total,	787.00	288.54	498.46

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5. LABOR AND WAGES:

b. Comparative Statement of Wages and Product:

	1928	1927	INCREASE	DECREASE
PRODUCT	454,563	487,880		33,317
No. Shifts and Hours	1-8	1-8		
AVERAGE NO. MEN WORKING:				
Surface	42	43		1
Underground	201	207		6
Total	243	250		7
AVERAGE WAGES PER DAY:				
Surface	4.37	4.31	.06	
Underground	5.13	5.18		.05
Total	4.99	5.02		.03
WAGES PER MONTH OF 25 DAYS:				
Surface	109.25	107.75	1.50	
Underground	128.25	129.50		1.25
Total	124.75	125.50		.75
PRODUCT PER MAN PER DAY:				
Surface	35.34	35.71		.37
Underground	7.90	7.87	.03	
Total	6.46	6.45	.01	
LABOR COST PER TON:				
Surface	.124	.121	.003	
Underground	.648	.658		.010
Total	.772	.779		.007
AVERAGE PRODUCT MINING:				
Stoping	18.67	16.90	1.77	
Ore Development	9.71	11.92		2.21
Total	17.81	16.71	1.10	
AVERAGE WAGES CONT. LABOR	5.47	5.60		.13
TOTAL NUMBER OF DAYS:				
Surface	12,867	13,663 1/2		796 1/2
Underground	57,541 3/4	61,983 1/2		4,441 3/4
Total	70,408 3/4	75,647		5,238 1/4
AMOUNT FOR LABOR:				
Surface	56,196.85	58,887.65		2,690.80
Underground	294,928.95	320,995.39		26,066.44
Total	351,125.80	379,883.04		28,757.24

Proportion of Surface to Underground Men:

1928 - 1 to 4.79	1-8 hr. shift 6 days per week, Jan. 1st to May 30.
	1-8 hr. shift 5 days per week April 1st to Sept. 15.
	1-8 hr. shift 6 days per week Sept. 16 to Dec. 31.
1927 - 1 to 4.81	1-8 hr. shift 5 days per week Jan. 1st to March 12.
	1-8 hr. shift 6 days per week March 12 to Dec. 31.
1926 - 1 to 4.89	1-8 hr. shift 5 days per week.
1925 - 1 to 5.18	1-8 hr. shift 5 days per week.
1924 - 1 to 4.33	1-8 hr. shift 6 days per week, Jan. 1 to Aug. 1.
	1-8 hr. shift 4 days per week, Aug. 1 to Dec. 1.
	1-8 hr. shift 5 days per week, Dec. 1 to Dec. 31.

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6. SURFACE:

a. Buildings, Repairs:

A 9' addition to the carbide room was built on the side of the tunnel near the dry building for a fuse cutting and capping room. The new standards covering handling of explosives made it necessary to provide this room.

Only a few minor repairs to mine buildings were required during the year.

Twenty-one houses and sheds in the location adjacent to the mine were moved to the new Cleveland-Cliffs Iron Company location in September and October.

b. Stockpiles:

During the year, 13 new bents were added to the rock trestle extending west from the north track of the west steel trestle. Four were erected in February, five in May, and four in October. The trestle has been curved to the north, away from the old rock pile, to provide greater capacity.

In November, the wooden stocking trestle at the east end of the east steel trestle was repaired and put in condition for stocking Bessemer ore.

c. Roads:

In October the road from Main Street to the location and the mine office was closed, after the houses and sheds had been moved. A new private road was graded and surfaced with ashes, from the east end of Lincoln Street to Maas Street, to provide an entrance to the mine. About 2500' of snow fence has been erected to protect the new private road and the mine timber yard.

7. UNDERGROUND:

a. Shaft Sinking:

There was no shaft sinking at the mine in 1928.

b. Development:

Development work increased in 1928 as compared with the previous year. Work was continued on the twelfth level, and in addition, considerable work was necessary on the eleventh level, due to crushing. There was some development work on the tenth and considerable work on the transfer sub levels. There was an average of two contracts worked the entire year developing the main levels. In addition, one contract worked all the year cutting the sump on the twelfth level and raising from the twelfth level pumphouse to the eleventh. There was an average of three contracts raising throughout the year. The average number of gangs on development work during 1928 was six.

Twelfth Level:

#8 crosscut advanced to the west 240' in ore and 25' in jasper, a total of 265'. A branch from this crosscut advanced 70' to the north, 40' in ore and 30' in jasper.

#5 crosscut advanced 280' during the year, 200' in ore and 80' in jasper. It is now being extended parallel with the Maas boundary and has 90' to advance in the jasper to hole to #8 crosscut.

#6 crosscut advanced 50' in ore and holed to #5 crosscut.

There was a total of 300' of rock drifting in connection with excavating the sump and motor barn, and 75' of rock raising in the pumphouse. These figures do not appear on the cost sheet under "Ore or Rock Development", as the expense of this work is charged directly to "Pumping Machinery."

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7. UNDERGROUND:

b. Development:(Cont.)

Twelfth Level: (Cont.)

During the year, twelve raises were completed from the twelfth to the eleventh level, some of which were extended to the subs above the eleventh level. There was a total of 1,199' of raising on the twelfth level, including the 75' of raising in the sump.

Summary of development work on the twelfth level, including pumphouse and sump, was as follows: Rock drifting, 435'; ore drifting, 530'; rock raising, 155'; ore raising 1,044'.

Eleventh Level:

A new foot wall haulage drift was driven on the eleventh level to replace the old foot wall drift that was driven many years ago in ore. The weight on the old drift was such that it finally became impossible to keep it open for haulage, even with five repair gangs working night shift. A total of six raises were put up from the new foot wall drift and two in other parts of the eleventh level. The latter part of the year a drift was started and advanced 20' in the foot wall near the Maas boundary, from which a number of raises will be put up later on to mine the foot wall pillar left in this part of the ore body.

A summary of development work on the eleventh level is as follows: Rock drifting, 577'; ore drifting, 114'; rock raising, 160'; ore raising, 510'; total, 1361'.

Tenth Level:

During the year two raises were put up from the tenth level to the 555' sub level. Total raising on this level was 90' in ore.

Transfer Sub Levels:

In addition to the above work on the main levels, there was a total of 1,418' of single compartment raises put up from the transfer sub levels, namely, the 450' and the 370'.

The grand summary of development work for the year is as follows:

	Drifting	Raising	
Level	Ore and Rock	Ore and Rock	Total
Twelfth Level	965'	1,199'	2,164'
Eleventh Level	691'	670'	1,361'
Tenth Level	0	90'	90'
Transfer Subs	0	1,418'	1,418'
Total Ore and Rock Work	1,656'	3,377'	5,033'
Sump and Pumphouse	300'	75'	375'
Grand Total	1,956'	3,452'	5,408'

c. Stoping:

(1) General Remarks:

Mining during 1928 was confined to the area between the ninth and eleventh levels, and to practically the same territories as in 1927. Mining was continued in two areas between the ninth and tenth levels, one on the north foot wall near the Maas boundary on the 555' and 545' sub levels, the other on the south foot wall, south on #2 dike on the 530' and 520' sub levels. Mining of this latter area on the sill floor of the tenth level was started the last of the year. Between the tenth and eleventh levels mining has been continued on the 460', 450', and 440' sub levels, and in addition, the 425' sub was opened and a small area mined near the hanging. The latter part of the year mining of this small area under the hanging was started on the sill floor of the eleventh level.

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7. UNDERGROUND:

c. Stoping: (Cont.)

(2) Detail of Stoping:

Subs between ninth and tenth levels:

555' Sub Level, North Foot:

This sub level was opened in August, 1927, and mining was completed in December, 1928. The time required to mine this sub level was five months less than the time required to mine the same area on the sub level above. This increased speed of mining was due to the use of scraper hoists in practically all contracts, after several additional raises were put up from the tenth level.

545' Sub Level, North Foot:

Mining was started on this sub level in May, 1928, and at the end of the year there were nine contracts mining here. The area in the center of this sub level is too low grade to mine. On the north side of the main dike, the ore extends down to the tenth level. On the hanging side of the sub level the ore continues to the eleventh level. A new foot wall drift has just been started on the eleventh level, from which raises will be put up to mine the downward extension of the ore on the hanging wall side of this sub level.

530' Sub Level, South Foot:

This sub level was opened in November, 1926, and mining was completed in November of this year.

520' Sub Level, South Foot:

This sub level was opened in December, 1927, and at the end of the year eight contracts were working here. The ore in the area between #1 and #2 dikes has practically all been handled through one of the transfer systems on the 450' sub level. The ore being mined in the area south of #1 dike is handled direct to the eleventh level.

Tenth Level:

During the year two raises were put up from the drift that parallels the Maas boundary to the elevation of the 555' sub level. In July, mining of the area controlled by the transfer raises from the 450' transfer sub was started, and the area above the south transfer drift is about one-half mined at present. The area above the north transfer drift had not been mined as rapidly, due to crushing of part of the transfer drift on the 450' sublevel, as also the transfer raise from the eleventh level. A raise was put up from the new eleventh level foot wall drift to the transfer sub, through which the ore is now handled to the eleventh level. Late in the year another raise was put up from the new eleventh level foot wall drift from which a contract is now driving to the foot wall to cut off the water and keep it out of the area being mined by a transfer system.

Subs between tenth and eleventh levels:

460' Sub Level:

This sub level was opened in 1924 and mining was completed in April, 1928.

450' Sub Level:

Early in the year two transfer drifts were driven to the foot wall in the ore south of #2 dike and transfer raises put up to the 520' sub level. The crushing of the eleventh level foot wall haulage drift practically stopped all mining on this sub level, until the new rock foot wall drift was completed in September. Contracts have been moved back into the foot wall territory on this sub level and at the end of the year there were ten contracts working here.

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7. UNDERGROUND:

c. Stoping: (Cont.)

Subs between tenth and eleventh levels: (Cont.)

440' Sub Level:

This sub level was opened in 1925 and mining has been in progress since. In December, 1928, there were four contracts mining on this sub level, three of which were using the transfer raises from the 370' transfer systems. Mining was nearly completed on this sub level at the end of the year.

425' Sub Level:

Mining on this sub level was started in January of this year from twelfth level raises near the hanging side of this area. At the end of the year there were three contracts working on this sub level.

Eleventh Level:

A new foot wall drift that was started near the Winze was driven during the year, holing into an old stub drift north of #2 dike. From this new drift six raises have been put up, two on the foot wall side to the tenth level and four on the hanging side to the 450' sub level. Two other raises were also put up on the eleventh level, one located just south of the Winze that was extended to the 520' sub level, and one near #9 crosscut to the 450' sub level. The raises to the 450' sub replace raises that were lost when the eleventh level foot wall drift crushed. There was also a drift driven on the eleventh level to connect #1260 system of raises from the twelfth level. In December a new foot wall drift was started in rock near the Maas boundary, from which raises will be put up to the north foot wall territory above the tenth level.

Mining in the southwest part of the main eleventh level was started about the middle of the year and the area controlled by this system of twelfth level raises had been nearly mined out at the end of the year, at which time there were four contracts still working here. The contracts working in this territory are transferred, after mining is finished, to the foot wall side of the deposit, which has been mined to a point about 50' above the level. The hanging wall side, being mined out 50' lower, is now getting the water that normally came in on the foot wall side. The passing of this foot wall water through the mat from the foot wall to the hanging wall has caused the whole level to be wet. It is now planned to push mining on the foot wall side until the water has again been concentrated in this area.

370' Sub Level:

In January of this year it was decided to open two transfer systems in the territory above the area between #6 and #8 crosscuts, twelfth level. #7 crosscut on the twelfth level would have been entirely in jasper and the raises from this crosscut to the eleventh level would have been in jasper half way from the twelfth level to the eleventh level. Two drifts were driven on the 370' sub level to connect with raises from #6 and #8 crosscuts, and four transfer raises were put up from each of these drifts to the 440' sub level above the eleventh level. These raises started in the foot wall, but soon passed out of the foot into ore. The latter part of the year mining was started on the 450' sub, from the transfer raises put up from the two transfer drifts on the 370' sub level.

Twelfth Level:

During the year, #5 and #6 crosscuts were connected on the side near the Maas boundary. The latter part of the year a contract started continuing this drift parallel to the Maas boundary to hole to #8 crosscut. This will complete the connection of all the crosscuts on the Maas Mine boundary side. This drift is now in foot wall material.

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7. UNDERGROUND:

c. Stoping: (Cont.)

Twelfth Level: (Cont.)

#3 crosscut was extended to the west 240' to the hanging and a curve started to the right, which soon encountered the jasper hanging. The curved drift was continued 20' in the jasper, as a raise will later hole here. This raise is being put up from the 215' sub level, Maas Mine, to provide another second outlet for both properties and for ventilation.

During the year, raises have been completed from the twelfth to the eleventh level, and four others that were started in 1927 were also completed.

One contract has worked the entire year on the sump and pumphouse development. A drift was turned off about 240' north of the shaft and the entrance to the two sump drifts and a motor barn was excavated. A sump drift 200' long was driven 10' below the twelfth level, and holed to the northeast corner of the pumphouse. In the latter part of the year a raise was started from the twelfth level pumphouse to the eleventh level pumphouse. This will provide a second outlet for the pumpman independent of the shaft, and will also be used to carry the discharge line.

At the end of the year there were three contracts working on the twelfth level, one putting up a raise in ore, one raising in rock to connect the pumphouse, and one drifting in rock on the main level.

d. Timbering:

In the timber statement that follows, the main increase occurs in 6" to 8" cribbing timber, due to 1,950' more raising in 1928. The increase in the use of 8" to 10" timber is due directly to mining with scrapers, which permits the use of smaller timber on the sub levels, owing to mining more rapidly. More treated timber was used in 1928 on account of more main level drifting in ore. The number of poles used increased due to the use of more scraper hoists, as poles were used in many contracts as floor covering to keep the scraper from digging in the floor of the drifts.

The increase in the cost per ton for timber, and the feet of timber used per ton of ore, was due to more raising in 1928. The total cost per ton for timber, lagging, poles, etc., was due to 1,950' more raising and more poles used in mining.

Statement of Timber Used:

	LINEAR FEET	AVG. PRICE PER FOOT	AMOUNT 1928	AMOUNT 1927
6" to 8" Crib. Timber	186,200	.0424	7,898.42	4,474.25
8" to 10" Stull Timber	83,800	.0644	5,394.94	4,436.69
10" to 12" " "	55,300	.0794	4,393.22	5,168.34
12" to 14" " "	18,950	.1280	2,425.40	3,187.13
Athens Treated Timber	6,951	.2840	1,975.02	1,314.52
Total Timber - 1928	351,201	.0629	22,087.00	
Total Timber - 1927	275,044	.0675		18,580.93
		per 100'		
7' Lagging	1,344,800	.697	9,378.39	10,566.82
Poles, 9½'	592,200	1.532	9,075.27	6,161.57
Cover Boards, 1"	19,100	17.87 M	341.40	694.12
Total - 1928			18,795.06	
Total - 1927				17,422.51
Grand Total - 1928			40,882.06	
Grand Total - 1927				36,003.44

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7. UNDERGROUND:

d. Timbering: (Cont.)
Statement of Timber Used: (Cont.)

	AMOUNT 1928	AMOUNT 1927
Product	454,563	487,880
Feet of timber per ton of ore	.7726	.5638
Feet of lagging per ton of ore	2.9584	3.1241
Feet of lagging per foot of timber	3.8291	5.5416
Cost per ton for Timber	.0485	.0381
" " Lagging	.0206	.0217
" " Poles	.0200	.0126
" " Covering Boards	.0008	.0014
" " All timber	.0899	.0738
Equivalent of stull timber to board measure	597,944	514,545
Feet of board measure per ton of ore	1.315	1.055

Total cost for timber, lagging, poles, and cover boards, and cost per ton:

1928	$40,882.06	$.0899
1927	36,003.44	.0738
1926	31,579.36	.0868
1925	29,572.15	.0844
1924	25,226.86	.0781
1923	32,507.41	.0851
1922	24,766.16	.0828

e. Drifting and Raising:

A detailed statement of this work is given under "c-Development." In 1927, practically all drifting and raising was confined to the twelfth level, while in 1928 all the active levels participated in this work. The raising program increased 130% as compared with 1927, due, primarily, to the crushing of drifts and crosscuts on the eleventh level, and partly, to development of the transfer systems on the 450' and the 370' sub levels.

The following is a statement of drifting and raising for the years 1928 and 1927:

YEAR	ORE DRIFTING	ORE RAISING	ROCK DRIFTING	ROCK RAISING	TOTAL
1928	644'	2,882'	1,012'	495'	5,033'
1927	588'	1,021'	896'	445'	2,950'
Increase	56'	1,861'	116'	50'	2,083'

The above figures do not include 300' of sump drift and 75' of rock raise in the twelfth level pumphouse that was charged to "Pumping Machinery."

f. Explosives, Drilling and Blasting:

The cost for powder in 1928 and 1927 was almost equal. The product was lower in 1928, so that the cost per ton increased. There was more ore drifting and ore raising in 1928, which increased the amount of powder, fuse, and caps used per ton of ore. The slight decrease in cost per pound for powder partially offset the increased consumption per ton of ore. In 1928, there was 107,150 pounds of 1¼" powder used in the mine, and 102,850 pounds of 1½" powder, while in 1927 practically all the powder was 1¼" in size. The 1½" powder was used exclusively in tight ground, where it proved to be cheaper than the 1¼" size.

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7. UNDERGROUND:

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

Statement of Explosives Used: (Ore Development and Stoping.)

	Quantity	Average Price	1928 Amount	1927 Amount
40% Am. Gel.				32.50
50% " "	127,850	.1396	17,851.11	20,361.35
60% " "	59,350	.1510	8,962.35	6,440.80
Total Powder - 1928	187,200	.1432	26,813.46	
Total Powder - 1927	183,300	.1464		26,834.65
Fuse	509,100	.5886 C	2,985.00	2,882.75
Caps	78,300	1.1008 C	861.96	893.72
Cap Crimpers	52	.667	34.70	26.04
Tamping Bags	22,430	2.15 M	48.22	65.60
Total Fuse, etc. 1928			3,929.88	
Total Fuse, etc. 1927				3,868.11
Total All Explosives - 1928			30,743.34	
Total All Explosives - 1927				30,702.76
Product			454,563	487,880
Pounds of powder per ton of ore			.4118	.3757
Cost per ton for powder			.0590	.0550
" " fuse, caps, etc.			.0086	.0079
" " all explosives			.0676	.0629

Sinking, Rock Development, etc.

	Quantity	Average Price	1928 Amount	1927 Amount
50% Am. Gel.	4,300	.1396	601.09	567.98
60% " "	18,500	.1510	2,793.50	2,188.48
Total Powder - 1928	22,800	.1489	3,394.59	
Total Powder - 1927	18,250	.1510		2,756.46
Fuse	50,200	.5863 C	294.32	231.30
Caps	11,400	1.1010 C	125.54	97.01
Connecting Wire	12#	.40	4.74	.82
Electric Exploders				.81
Cap Crimpers	7	.667 ea.	4.67	2.67
Tamping Bags	2,770	2.15 M	5.96	6.45
Total Fuse, etc. 1928			435.23	
Total Fuse, etc. 1927				339.06
Total - 1928			3,829.82	
Total - 1927				3,095.52
Total explosives used in mine			34,573.16	33,798.28
Average price per pound for powder			.1438	.1468

34% of the powder used in 1928 was 60% strength.
22% of the powder used in 1927 was 60% strength.

g. Mining and Loading:

There was no change in mining methods during the past year. The transfer systems changed the method of handling ore in certain territories. A much larger percentage of ore was handled by mechanical loaders in 1928. The percentage in 1928 was 83%, in 1927, 72%, and in 1926, 66%. After several

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7. UNDERGROUND:

g. Mining and Loading: (Cont.)

years successful use, as compared with hand shoveling, the Mayne Loaders gave way to scraper hoists. The number of scrapers in use increased from 35 at the end of the previous year to 44 at the end of 1928. Since 1926 the number of scrapers in use in the mine has more than doubled, until at present they are used in every contract where conditions will permit. Considerable study has been given to this comparatively new method of handling ore, as a result of which larger horsepower units will be purchased in the future. Changes in methods of covering down sub levels have been made from the use of scrapers, which in time will give cleaner ore and increase safety. The following statements give interesting information:

	1928 Tons	1927 Tons	1928 % of Product	1927 % of Product	Incr. tons per man over hand shoveling
Hand Shoveling	73,309	139,128	16%	28%	
Mayne Loaders	3,967	72,258	1%	15%	
Scrapers	377,287	276,494	83%	57%	78%
Total	454,563	487,880	100%	100%	

No Mayne Loaders were used after March, 1928.
Hand shoveling used only where the ore is too wet for scrapers.

A comparison of the number of contracts at the end of the year mining ore with mechanical loaders, and by hand, is shown below:

	Dec. 1, 1928	Dec. 1, 1927
Hand shoveling	4	16
Mayne Loaders	0	5
Scrapers	46	32
Total	50	53

i. Ventilation:

The jointly owned ventilating plant located at the collar of #2 Shaft has worked satisfactorily during the year. The rock drift on the third level, Maas Mine, had not holed to the twelfth level, Negaunee Mine, at the end of the year. It will be completed within 60 days. When finished, it will provide a solid rock drift from the Negaunee to the Maas Mine, a permanent opening for ventilation, and a second outlet. #3 crosscut was extended to the west on the twelfth level, Negaunee Mine, and drifting and raising is now under way from a sub level between the third and fourth levels, Maas Mine, to hole to this crosscut, Negaunee Mine. This will provide another ventilation course between the mines directly to the fourth level, Maas, and also gives another second outlet for both properties.

j. Pumping:

The number of gallons pumped per minute during 1928, 1927, and 1926, are shown below:

Month	1928	1927	1926
January	1,120	962	708
February	1,076	999	683
March	1,023	1,034	786
April	1,038	1,034	806
May	1,107	1,073	816
June	1,156	1,179	821
July	1,223	1,222	784
August	1,280	1,273	843

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7. UNDERGROUND:

j. Pumping: (Cont.)

Month	1928	1927	1926
September	1,319	1,294	870
October	1,354	1,282	886
November	1,342	1,233	911
December	1,333	1,147	921
Total Average	1,198	1,144	819

The above table shows the average gallons pumped per minute for each month of the past three years. A large increase occurred in 1927, and a further increase in 1928. This increase was particularly noticeable during the last four months of the year, when the average rose to over 1,300 gallons per minute. Rainfall in three of these months was above normal, and in December the weather was unusually mild. This may account for the increase; it is hoped that a decrease will occur during the balance of the winter months. The caves are growing larger and deeper each year, which is increasing the drainage area. After ten years of sub-normal rainfall we have passed into a period of normal and abnormal rainfall, so that it is probable that further increases will occur.

The average number of gallons pumped per minute over the last six years is as follows:

Year	Gals. per minute
1923	927
1924	796
1925	705
1926	819
1927	1,144
1928	1,198

The increase in 1928 was 4.7% above 1927, and 46% above 1926.

k. Underground in General:

The past year has been one of progress in regard to mechanization of this property. Further improvements will occur as better equipment becomes available and minor difficulties in operation are overcome. Slightly different layouts of levels are indicated for future development.

Standardization of "Underground haulage operations" and "Handling of explosives" have been adopted by the Company, and are now in effect; other standardizations will be adopted during the coming year which will increase efficiency and safety.

It was decided the last of the year to make the interval between sub levels 11' or 11½', and to use 9½' poles and 7' cross lagging on all sub levels for covering down. After two of these new sub levels are mined, no back lagging will be needed on the succeeding sub levels. This will give cleaner ore, less loss in mining and greater safety for employees.

The difficulty of operation on the eleventh level due to crushing of haulage drifts has been overcome by driving a new drift in the foot wall on the eleventh level and putting up a number of raises on the eleventh and twelfth levels. The sub levels being mined in the area under weight are causing some trouble, but with rapid mining with scrapers, comparatively little retimbering is required.

Development work on the eleventh and twelfth levels is not yet completed, but progress has been made and much less work will be necessary in 1929.

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8. COST OF OPERATING:

a. Comparative Mining Costs:

	1928	1927	INCREASE	DECREASE
PRODUCT	454,563	487,880		33,317
Underground Costs	1.139	1.053	.086	
Surface Costs	.131	.126	.005	
General Mine Accounts	.094	.074	.020	
Cost of Production	1.364	1.253	.111	
Loading and Shipping	.025	.025		
Total Cost on Cars	1.389	1.278	.111	
Depreciation - Original Cost	.090	.090		
Plant and Equipment	.031	.032		.001
Movable Equipment	.004	.000	.004	
Taxes	.424	.414	.010	
Depletion of Appreciated Value	.308	.310		.002
Central Office	.089	.069	.020	
Welfare, Safety, Hosp.	.035	.019	.016	
Cost Adjustment	.000	.006		.006
Misc. Debits & Credits	.006(Red)	.003(Red)		.003
Administrative Expense	.011	.010	.001	
Total Cost at Mine	2.375	2.225	.150	
No. of Days Operated	280½	294		13½
No. Shifts & Hours	1-8 hr.	1-8 hr.		
Average Daily Product	1,621	1,659		38
COST OF PRODUCTION:				
Labor	.785	.786		.001
Supplies	.578	.467	.111	
Total	1.363	1.253	.110	

b. Detailed Cost Comparison:

(1) Days and Shifts:

During 1928, the mine worked one eight hour shift for 280½ days, and the average number of men employed during the year was 243, for a total of 70,409 days. During 1927 the mine worked one eight hour shifr for 294 days, and the average number of men employed during the year was 250, for a total of 75,647 days.

(2) Wages:

Both years the mine operated on the same wage schedule.

(3) Comparison of Production:

Production, 1928 -	454,563 tons
Production, 1927 -	487,880 "
Decrease -	33,317 "

(4) Comparison of Number of Men and Wages:

	No. Men	No. Days	Amount	Rate per day
1928	243	70,409	$351,125.80	$ 4.99
1927	250	75,647	379,883.04	5.02
Decrease	7	5,238	28,757.24	.03

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8. COST OF OPERATING:

b. Detailed Cost Comparison: (Cont.)

(5) Tons per man per day:

The tons of ore mined per man per day were as follows:

	1928	1927	INCREASE	DECREASE
Surface	35.34	35.71		.37
Underground	7.90	7.87	.03	
Total	6.46	6.45	.01	

(6) Cost of Production:

1928 -	$619,937.94	Cost per ton,	$1.363
1927 -	611,493.67	" " "	1.253
Incr.-	8,444.27	" " "	.110

	Total Cost				Cost per ton		
	Labor	%	Supplies	%	Labor	Supplies	Total
1928 -	$357,189.46	57.6%	$262,748.48	42.4%	$.785	$.578	$1.363
1927 -	383,641.19	62.7%	227,852.48	37.3%	.786	.467	1.253
	26,451.73	5.1%	34,796.00	5.1%	.001	.111	.110
	Decrease	Decr.	Increase	Incr.	Decr.	Incr.	Incr.

The above statement shows the change in the ratio of labor and supplies due mainly to further mechanization of the mine. Supplies increased 5.1% over the previous year.

The main reason for the increase in cost per ton was the curtailment of the operating schedule from six to five days per week for six months in 1928, while in 1927 the mine operated 9½ months on a six day schedule. The other main factor influencing the cost was the crushing of the eleventh level haulage drifts, which materially increased the amount of development work in ore and rock.

(7) Detail of Accounts:

UNDERGROUND COSTS:

Development in Rock

1928 Amount	$9,256.35	Cost per ton,	$.020
1927 Amount	8,517.51	" " "	.017
Increase	738.84		.003

Sub Division.

	Drifting	Raising	Total Ft.	Cost per ft.
1928 -	1,012'	495'	1,507'	$ 6.14
1927 -	896'	445'	1,341'	6.35
Decrease				.21
Increase	116'	50'	166'	
		50'		

The increase in cost per ton is due to a decrease in production and more rock drifting and raising in 1928.

Development in Ore

1928 Amount	$16,894.31	Cost per ton,	$.037
1927 Amount	8,629.64	" " "	.018
Increase	8,264.67		.019

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8. COST OF OPERATING:

Development in Ore (cont.)

	Drifting	Raising	Total Ft.	Cost per Ft.
1928 -	644'	2,882'	3,526'	$ 4.79
1927 -	588'	1,021'	1,609'	5.37
Increase	56'	1,861'	1,917'	
Decrease				.68

The increase in cost per ton is due to a decrease in production, and to more ore drifting and raising in 1928.

Stoping

1928 Amount	$197,943.05	Cost per ton,	$.435
1927 Amount	212,240.35	" " "	.435
Decrease	14,297.30		.000

Detail.

	Labor		Supplies	
1928 -	$ 137,962.68	69.7%	$59,980.37	30.3%
1927 -	165,385.65	77.9%	46,854.70	22.1%

Cost per ton.

	Labor	Supplies	Total
1928 -	$.304	$.131	$.435
1927 -	.339	.096	.435
Increase		.035	
Decrease	.035		

The labor cost decreased due to the use of more scraper hoists. Supply cost increased due to larger expenditures for scraper hoists and equipment, and to a slight increase in the cost per ton for powder.

Explosives.

	1928	1927
Total pounds of powder	187,200	183,300
Average price per pound	.1432	.1464
Cost of powder	$26,813.46	$26,834.65
Cost of fuse, caps, etc.	3,929.88	3,868.11
Cost of all explosives	30,743.34	30,702.76
Lbs. of powder per ton of ore	.4118	.3757
Cost per ton for powder	.0590	.0550
Cost per ton for fuse, caps, etc.	.0086	.0079
Cost per ton for all explosives	.0676	.0629

There was more pounds of powder used in 1928, with less product, and more feet of fuse used in 1928 with less product, due to more raising in ore and more ore mined in areas where the ore was tight and hard to break. On account of the tight ground, more 60% powder was used in 1928.

Timbering

1928 Amount	$119,492.53	Cost per ton,	$.263
1927 Amount	116,831.26	" " "	.240
Increase	2,661.27		.023

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8. COST OF OPERATING:

Timbering, (Cont.)

	1928	1927
Timber cost	$22,087.00	$18,580.93
Lagging, Poles, and Cover Boards,	18,795.00	17,422.51
Total	40,882.06	36,003.44

Detailed Cost of Timber.

	1928	1927
Feet of timber per ton of ore,	.7726	.5638
Feet of lagging " " " "	2.9584	3.1241
Cost per foot for timber	3.8291	.0675
Cost per ton for timber	.0485	.0381
" " " " lagging	.0206	.0217
" " " " poles	.0200	.0126
" " " " cover boards	.0008	.0014
" " " " timber, lagging, poles, and cover boards	.0899	.0738
Equivalent of stull timber to board measure	597,944	514,545
Feet of board measure per ton of ore	1,315	1,050

The increased cost per ton is due to a greater amount of cribbing timber used in 1928. There was 3,416' of raising done in 1928 as compared with 1,466' in 1927. There was also a large increase in the number of poles used, due to the increase in the number of scrapers in the mine. Considerable unusual expense for timbering was incurred in the early part of the year, due to crushing of drifts and crosscuts on the eleventh level. Repairs crews worked at night in this area for several months.

Tramming

1928 Amount	$44,659.37	Cost per ton,	$.098
1927 Amount	46,811.86	" " "	.096
Decrease	2,152.49	Increase	.002

The increased cost per ton is due to charging out three rocker dump cars in 1928. These tight body cars are used in cleaning tracks and ditches.

Ventilation

1928 Amount	$4,548.91	Cost per ton,	$.010
1927 Amount	3,567.07	" " "	.007
Increase	981.84		.003

The increased cost is due to charging out one Siroco Fan used as a booster to force air into a sublevel, and more hours operation of the main fan on surface at #2 Shaft.

Pumping

1928 Amount	$41,792.77	Cost per ton,	$.092
1927 Amount	40,184.91	" " "	.080
Increase	1,607.86		.012

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Pumping (Cont.)

	1928	1927
Total gallons of water pumped	629,675,383	602,747,376
Gallons pumped per minute	1,198	1,147

There was an increase of 26,928,007 gallons of water pumped, or 51 gallons per minute, which, with the decreased product, accounts for the increase in the cost per ton.

Compressors & Air Pipes

1928 Amount	$43,036.85	Cost per ton, $.095
1927 Amount	38,293.42	" " " .079
Increase	4,743.43	.016

	Compressors	Air Pipes
1928 -	$37,401.94	$5,634.91
1927 -	32,771.21	5,522.21
Increase	4,630.73	112.70

Total cu. ft. of air used in 1928 - 1,048,240,000 cu. ft.
" " " " " " 1927 - 895,680,000 " "
Cubic feet per ton of ore - 1928 - 2,306 " "
" " " " " " 1927 - 1,836 " "

The increase in compressor cost is due to one compressor operating night shift for a twelve month period in 1928, as compared with a nine month period in 1927. Development work was pushed on double shift during the greater part of 1928.
The small increase in Air Pipes is due to more pipe fittings used in 1928, due to more extensions of air lines.

Back Filling

1928 Amount	$3,673.95	Cost per ton, $.008
1927 Amount	2,966.69	" " " .006
Increase	707.26	.002

The increase is due to more filling broken in 1928.

Underground Superintendence

1928 Amount	$14,245.10	Cost per ton, $.032
1927 Amount	15,032.05	" " " .031
Decrease,	786.95	Increase .001

The increase in cost per ton is due to less product in 1928. The decreased amount is due to one less shift boss since July, when the bosses' territory was rearranged.

Cave-In

1928 Amount	$ 14.52	Cost per ton, $.000
1927 Amount	4.22	" " " " .000
Increase	10.30	

More repairs to fences around caves in 1928.

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MAINTENANCE ACCOUNTS:

Compressors & Power Drills

1928 Amount	$1,083.55	Cost per ton,	$.002
1927 Amount	915.71	" " "	.002
Increase	167.84		

	Compressors		Power Drills
1928 -	$396.86		$686.69
1927 -	415.61		499.10
	Decr. 18.75	Incr.	187.59

The decrease in compressors is due to less repairs. In 1928, two N-72 Ingersoll Rand drifter machines, costing $686.69, were purchased, while in 1927, seven second-hand BBR #230 Ingersoll Rand jackhammers were purchased from the Gwinn District.

Hand Tramming Equipment

1928 Amount	$ 69.62	Cost per ton,	$.000
1927 Amount	1,036.46	" " "	.002
Decrease	966.84		.002

The decrease in the cost per ton is due to replacing the hand tramming equipment with scraper outfits.

Electric Tram Equipment

1928 Amount	$15,760.73	Cost per ton,	$.035
1927 Amount	15,497.46	" " "	.032
Increase	263.27		.003

Sub Division.

	Gen. & Motor	Locomotives	Wiring
1928 -	316.23	4,164.69	1,672.26
1927 -	174.76	4,088.11	1,468.62
Increase	141.47	76.58	203.64

	M. L. Tracks	M. L. Cars
1928 -	5,837.48	3,725.07
1927 -	6,410.50	3,355.49
Decrease	573.02	Incr. 369.58

Generator and Motor: Increase due to more repairs.
Locomotives: Increase due to general repairs to locomotives.
Wiring: Increase due to more trolley wiring and rail bonding in 1928 in twelfth level drifts.
M. L. Tracks: Decrease due to opening the twelfth level in 1927, new rail being installed.
M. L. Cars: More motor cars rebuilt and repaired in 1928.

Pumping Machinery

1928 Amount	$5,048.48	Cost per ton,	$.011
1927 Amount	3,016.62	" " "	.006
Increase	2,031.86		.005

On September 16th, 1927, the cutting out of a new pumphouse on the twelfth level was begun. This work was continued throughout 1928. The cost of 300' of sump drift and 75' of rock raise in the pumphouse was charged to this account in 1928.

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Total Underground Costs

1928 Amount	$517,520.09	Cost per ton,	$1.138
1927 Amount	513,545.25	" " "	1.053
Increase	3,974.		.085

An analysis of the labor and supply charges in all of the above accounts show that the labor cost decreased $25,320.52 and the supply charge increased $30,052.51 in 1928.

Supplies under account "Stoping" increased $13,005.67 over 1927, and amount to 43% of the total increase in Supplies. 22.8% of the increase occurs in "Pumping" supplies, and 15.7% in "Compressor" supplies. The balance of 19.1% is distributed over the other nine accounts while one account, "Hand Tramming", shows a decrease in supplies. The supply charge for stoping is higher, due to purchase of scraper hoists, $10,306.85 being expended for this purpose in 1928. The maintenance of these hoists, and the wire rope, sheaves, scrapers, etc., used in scraping, account for the balance of increase in this account.

Six accounts show increases in labor cost and seven show decreases. "Stoping, Timbering, and Tramming" accounts show the greater part of the decrease, while the largest increase is in "Development in Ore."

SURFACE COSTS:

Hoisting

1928 Amount	$26,727.98	Cost per ton,	$.059
1927 Amount	27,054.17	" " "	.056
Decrease	326.19	Increase	.003

Electric Power 1928 -	$19,258.50	Cost per ton,	$.0425
Electric Power 1927 -	19,429.60	Cost per ton,	.04

The increased cost per ton is due to less tonnage in 1928, and a large increase in the amount of ore hoisted from a greater depth, the twelfth level.

Stocking Ore

1928 Amount	$5,984.90	Cost per ton,	$.013
1927 Amount	5,951.89	" " "	.012
Increase	33.01		.001

The increase in cost per ton in 1928 is due to more ore stocked and a lower product. There was 240,304 tons stocked in 1928, as compared with 237,201 tons in 1927.

Dry House

1928 Amount	$7,680.76	Cost per ton,	$.017
1927 Amount	7,795.93	" " "	.016
Decrease	115.17	Increase	.001

Coal to Boiler House:	Tons	Cost
1928 -	1,278	$6,985.01
1927 -	1,149	6,534.77

Increase in cost per ton due to less product in 1928, and more coal used at heating plant.

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General Surface Expense

1928 Amount	$5,457.62	Cost per ton,	$.012
1927 Amount	5,586.92	" " "	.012
Decrease	129.30		.000

The cost per ton is the same in both years. The decreased expenditure is due to less general surface work.

MAINTENANCE ACCOUNTS:

Hoisting Equipment

1928 Amount	$7,607.97	Cost per ton,	$.017
1927 Amount	6,091.65	" " "	.013
Increase	1,516.32		.004

	Sub Division.			
	Sheaves	Wire Rope	Mach. Parts	Skips & Skip Roads
1928 -	$230.28	$1,483.63	$2,516.29	$3,377.77
1927 -	604.74	986.16	1,625.05	2,875.70
	374.46	497.47	891.24	502.07
	Decr.	Incr.	Incr.	Incr.

Sheaves: There was one steel lined sheave put on in 1927, costing $605.00, and one cast iron sheave put on cage road in 1928, costing $230.00.
Wire Rope: Increase due to three new ropes installed in 1928, one on the south skip, one on the north skip, and one on the cage. In 1927 there were two new ropes installed, one on the north skip and one on the south skip.
Machinery Parts: The increase in cost is due to a breakdown of the armature of the motor on the hoist set.
Skips & Skip Roads: There was 153 new skip and cage runners installed in 1928, as compared with 102 runners in 1927, also more general repairs.

Shaft

1928 Amount	$1,778.21	Cost per ton,	$.004
1927 Amount	3,515.91	" " "	.007
Decrease	1,737.70		.003

The decrease in cost per ton is due to the concreting of the tenth and eleventh level pockets during 1927, as compared with the ordinary work of shaft repairs in 1928.

Top Tram Equipment

1928 Amount	$2,880.53	Cost per ton,	$.006
1927 Amount	2,915.56	" " "	.006
Decrease	35.03		.000

	Sub Division.		
	General Repairs		Wire Rope
1928 -	$2,312.16		$568.37
1927 -	2,194.47		721.09
Increase	117.69	Decr.	152.72

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Top Tram Equipment (Cont.)

General Repairs: There were more repairs to machinery and more sheaves and rollers installed in 1928, but less repairs to tracks and cars.
Wire Rope: There was 5,120' of 5/8" wire rope installed on the south tram in 1928, as compared with 4,100' of 5/8" wire rope installed on the north tram in 1927.

Docks, Trestles & Pockets

1928 Amount	$1,168.65	Cost per ton,	$.002
1927 Amount	1,194.16	" " "	.002
Decrease	25.51		

The cost in 1928 is due to building new rock trestles, while in 1927 there was some expense for painting the steel trestle, and also some repairs and renewals to the rock trestles.

Mine Buildings

1928 Amount	$ 473.02	Cost per ton,	$.001
1927 Amount	1,176.49	" " "	.002
Decrease	703.47		.001

During 1928 there were some extra repairs to shaft house building and timber tunnel, and various minor repairs to other buildings, as compared with the charge in 1927, when the outside woodwork on all buildings was painted and there were more minor repairs to the various buildings.

Total Surface Costs

1928 Amount	$59,759.46	Cost per ton,	$.131
1927 Amount	61,282.68	" " "	.126
Decrease	1,523.04	Increase	.005

GENERAL MINE ACCOUNTS:

Insurance

1928 Amount	$ 93.60	Cost per ton,	$.000
1927 Amount	206.54	" " "	.000
Decrease	112.94		

Engineering

1928 Amount	$2,238.56	Cost per ton,	$.005
1927 Amount	2,229.98	" " "	.005
Increase	8.58		

The engineering cost was about the same in both years.

Analysis

1928 Amount	$13,165.18	Cost per ton,	$.029
1927 Amount	13,854.02	" " "	.028
Decrease	688.84	Increase	.001

Cost per determination in 1928 - $.1485
Cost per determination in 1927 - .1430

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Analysis (Cont.)

This account includes our proportion of the district laboratory and sampling expense. The total cost for the laboratory in 1928 was $17,172.95, and the total determinations were 115,609. In 1927 the cost was $16,280.36 and the total determinations were 113,870. There was an increase of $892.59 in cost and an increase of 1,739 determinations in 1928. The increase in operating cost is due to an increase in labor and assistant chemists, and an increase in the cost of repairs and renewals of apparatus. All analyses of Gwinn District ores were made at the Negaunee laboratory in 1928, as compared with a few months in 1927.

Personal Injury Expense

1928 Amount	$7,212.16	Cost per ton,	$.016
1927 Amount	5,274.34	" " "	.011
Increase	1,937.82		.005

9. EXPLORATIONS AND FUTURE EXPLORATIONS:

On the 17th of December occurred the first fatal accident since January 23rd, 1919, a period of about ten years.

The increased cost is due to establishing a personal injury reserve, 2% of the cost sheet labor being added each month.

10. TAXES:

Safety Department Expense

1928 Amount	$283.34	Cost per ton,	$.001
1927 Amount	122.80	" " "	.000
Increase	160.54		.001

The increase in cost is due to salaries of committees, and donations on account of safety records.

Telephones & Safety Devices

1928 Amount	$3,118.42	Cost per ton,	$.007
1927 Amount	1,678.71	" " "	.003
Increase	1,439.71		.004

The increase is due to installing more lights for levels and more wiring, more telephone expense, more underground safety improvements, and more sign-boards, signals, etc.

11. ACCIDENTS AND PERSONAL INJURY:

Local General Welfare

1928 Amount	$1,479.47	Cost per ton,	$.003
1927 Amount	1,442.52	" " "	.003
Increase	36.95		.000

The amount of welfare expense was about the same in both years.

Special Expense

1928 Amount	$328.99	Cost per ton,	$.001
1927 Amount	97.97	" " "	.000
Increase	231.02		.001

Increase due to Lake Superior Iron Ore Association assessment.

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Mine Office

1928 Amount	$14,738.49	Cost per ton,	$.032
1927 Amount	11,758.86	" " "	.024
Increase	2,979.63		.008

	Direct Charges		Mine Office
1928 -	$6,891.36		$7,847.13
1927 -	3,583.91		8,174.95
Increase	3,307.45	Decr.	327.82

The increase in direct charge is due to the addition of an assistant superintendent in January, 1928, and our proportion of General Storehouse overhead being charged to this account since September, 1928.

The decrease in mine office is due to less office expense, less superintendent's mileage, and less traveling expense of various persons.

9. EXPLORATIONS AND FUTURE EXPLORATIONS:

There were no explorations at the mine during the year.

10. TAXES:

The comparison of the total taxes for the Negaunee Mine Company for the years of 1928 and 1927 are as follows:

DESCRIPTION	1928		1927	
CITY OF NEGAUNEE	VALUATION	TAXES	VALUATION	TAXES
Negaunee Mine Total by Tax Commission,	5,644,000	190,727.50	6,103,000	199,677.94
Maas, Lonstorf, and Mitchell Addition Lots,	6,200	209.52	6,200	202.88
Collection Fees		1,909.37		1,998.81
TOTAL OPERATING NEGAUNEE MINE	5,650,200	192,846.39	6,109,200	201,879.63
Total Rented Buildings	20,500	699.63	15,900	525.39
TOTAL NEGAUNEE MINE CO.	5,670,700	193,546.02	6,125,100	202,405.02
Tax Rate		3.379		3.272
Total City of Negaunee Tax		571,121.55		589,686.71
Negaunee Mine % of City Tax		34%		34%

11. ACCIDENTS AND PERSONAL INJURY:

It is to be regretted that a fatal accident occurred in December, 1928, the first one in ten years. It occurred at 9:40 A. M., December 17th, 1928, on the tenth level, in a sub level opened at the same elevation as the tenth level. It was due to a fall of ground that knocked the caps off two timbered sets. A large chunk of ore weighing six tons came off to a slip. Gust Koski, miner, was instantly killed, his partner escaped with a few bruises. The place was well timbered and in good condition. The accident was classified as a trade risk.

It is a well established practice to open sub levels from 10' to 16' below the sub above. In order to bring this sub level to the elevation of the tenth level, it was opened approximately 13½' below the sub above. This left

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11. ACCIDENTS AND PERSONAL INJURY: (Cont.)

from 3½' to 4' of ground in the back of the sub. As a result of this accident, it has been decided to standardize the sub level interval to about 11', so that all the ore in the back will be mined as the drifts advance. More attention will be given to covering down, so that there will be less opportunity for material to run from the mat, and the ore will be cleaner. After two sub levels are mined under this system, the covering on the sub above should act as back lagging on the succeeding sub level.

There was a total of 17 accidents in 1928, one fatal and 16 minor accidents.

The 16 accidents are classified as follows:

Twelve were slight injuries, the men returning to work in less than a month.

Three were more serious, and kept the men home from one to two months.

One was quite serious, a fractured arm and five fractured ribs. This man was home for eight months, but expects to resume work on January 2nd, 1929.

During 1928 two men were paid compensation for injuries received prior to 1926. Two men are receiving the difference in wages, one being injured in 1926, and the other prior to 1926.

12. NEW CONSTRUCTION AND PROPOSED NEW CONSTRUCTION:

E. & A. #531, Moving 21 Houses, and E. & A. #534, Painting Five Houses and Sheds, were authorized in 1928. Both were uncompleted at the end of the year. Through an error, the detail of both is reported under #5, "Labor and Wages - (2) New Construction."

13. EQUIPMENT AND PROPOSED EQUIPMENT:

a. Steam Shovels:

The overhauling of four steam shovels was done in the Negaunee Mine shops last winter, three Negaunee District shovel and one Gwinn District shovel. This winter three Negaunee District shovels are being overhauled.

b. Stockpile Trestles:

(2) Wooden Trestle:

Nine additional bents were erected on the end of the rock trestle, which was swung to the north away from the old rock pile to provide additional capacity.

d. Scraper Hoists:

The mine is now supplied with the following scraper equipment:

Company	On Hand 1/1/1928	Purchased 1928	On Hand 1/1/1929
Ingersoll Rand Co., air,	9	1	10
Denver, air,	7	-	7
Denver, 7½ H.P. Electric,	8	1	9
Denver, 10 H.P. Electric,	0	2	2
Sullivan, 6½ H.P. Electric,	10	-	10
Sullivan, 7½ H.P. "	0	2	2
Sullivan, 25 H.P. "	1	2	3
Total,	35	8	43

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13. EQUIPMENT AND PROPOSED EQUIPMENT:

d. Scraper Hoists: (Cont.)

Five new scraper hoists were purchased and charged out in 1928. Twelve second-hand hoists were charged out during the year, as follows: Three from the Boeing Mine, and nine from Gwinn. There are two scraper hoists in the mine on trial.

e. Mayne Loaders:

There were no Mayne Loaders in use at the end of the year. Four were used in January, two in February, one in March, and none in April or since.

14. MAINTENANCE AND REPAIRS:

There were no extraordinary repairs made during the year. All ordinary maintenance and repairs were made as occasion required.

15. POWER:

Electric power was supplied during the year by the Cliffs Power and Light Company, a subsidiary of the Cleveland-Cliffs Iron Company. There were no serious delays due to lack of power during the year. The delays from this cause are listed under 2 - h.
The rate charged for current was 1 1/2¢ per k.w. hour, the same as has been in effect for a number of years.

17. CONDITION OF PREMISES:

The lawn and planted borders were kept in good condition throughout the year. The removal of all the houses from the location near the mine will make it necessary to do landscaping next year to improve the appearance of the entrance to the mine.

18. NATIONALITY OF EMPLOYEES:

This report has been prepared under two statements. The first gives the report as submitted quarterly. It shows the nationality of the employees as to parentage; for instance, a man has been classified as a Finn when born in this country of Finnish parentage. This naturally shows the number of Americans employed to be very small. The second statement separates the nationalities into "Foreign born" and "American born", the latter being shown as Americans.

As to parentage	1928	%		1927	%	
English	54	23		66	25	
Finnish	100	42		102	38	
Italian	29	12		34	13	
Swedish	22	9		26	10	
French, Canadian	15	6		16	6	
Americans(Mixed)	10	4		10	4	
Germans	5	2		5	2	
Austrians	2			2		
Argentines	1		(All	2		(All
Norwegians	1	1	others)	2	2	others)
Total	239	100%		265	100%	

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18. NATIONALITY OF EMPLOYEES: (Cont.)

As to birth	Total	American born	Foreign born
English	54	24	30
Finnish	100	26	74
Italian	29	4	25
Swedish	22	8	14
French, Canadian	15	11	4
American	10	10	
German	5	2	3
Austrians	2		2
Argentines	1		1
Norwegians	1	1	
Total	239	86	153
Percentage	100%	36%	64%

MAAS MINE

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1. GENERAL:

The most important event of the past year affecting this property was the abandonment by the City of Negaunee of the streets and alleys in the Race Course Tract. This only came after a prolonged struggle with the City Council, where there is a majority opposed to the Company. In order to impress the Council and the people of Negaunee with the necessity for abandoning this area, work on and adjacent to the fourth level was temporarily stopped in September, and resumed in October. All employees in this area adjacent to the Race Course were laid off, and not hired again until this matter was settled. The reduction in output during this period amounted to 33 1/3%.

The opening of the Race Course ore body, and the abandonment of work in other areas, with a gradual concentration of mining in two general areas instead of half a dozen as formerly, will eventually result in improving operating conditions. The mine is now in a period of adjustment to these new conditions, and it will require several months to obtain the estimated monthly production.

Most of the ore produced in 1928 came from the same areas.as in 1927. In the fall development of the Race Course property was undertaken and the last of the year mining started on the 170' sub level just east of the Race Course. Mining on the 200' sub level under the hanging was practically completed at the end of the year, and preparations are under way to open the 185' sub level in this same area.

Mining operations in 1928 were confined to the foot wall pillar above the second level, to the foot wall pillar between the third and fourth levels, and to several areas under the hanging above the fourth level. The two foot wall areas were very wet and it was not possible to use scrapers in a number of the contracts. It is hoped to overcome these conditions in 1929.

The cost of production increased in 1928, due to curtailment of output in the month of September, and to the heavy development program which was in effect during the last four months of the year.

Bessemer product increased in 1928, due to more ore mined from hanging wall areas. A further increase is expected in 1929, due to starting mining operations under the hanging over the Race Course ore body.

The mine operated five days per week during the past year. Production can be increased by working six days per week instead of five, and by breaking more ore on the day shift ahd hoisting on double shift. There is, unfortunately, still a stockpile reserve of 250,000 tons that is only slowly being reduced. This mine should increase production to at least 300,000 tons within another year, so as to give an opportunity for lowering the cost of production.

2. PRODUCTION, SHIPMENTS & INVENTORIES:

a. Production by Grades:

	1928	1927	Increase	Decrease
Maas Bessemer	36,778	7,885	28,893	
Race Course Bessemer	161		161	
Maas	224,121	262,121		38,000
Race Course	394	19,600	394	
Total	261,454	270,006		8,552
Rock	12,408	4,580	7,828	
Total hoist	273,862	274,586		

Product decreased 8,552 tons in 1928.

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2. PRODUCTION, SHIPMENTS & INVENTORIES:

b. Shipments:

Grade of Ore	Pocket Tons	Stockpile Tons	Total Tons	Total Last Year
Maas Bessemer	18,792	13,762	32,554	12,370
Maas	106,881	188,107	294,988	308,083
Race Course Bess.	161	-	161	-
Race Course	322	-	322	-
Total	126,156	201,869	328,025	320,453
Total Last Year	130,086	190,367	320,453	
Increase		11,502	7,572	
Decrease	3,930			

The ore shipped in 1928 came from the Maas pile west of the shaft, where all the Maas ore hoisted in the winter of 1927 - 1928 was removed, and in addition a cut made on the south side of the old pile. The Bessemer ore was stocked east of the shaft and was all shipped to make room for the new steel trestle.

c. Stockpile Inventories:

The ore by grades in stock December 31st, 1928, was as follows:

	1928	1927	Increase	Decrease
Maas Bessemer	6,252	2,028	4,224	
Maas Ore	244,510	315,377		70,867
Race Course Bess.	0	0		
Race Course	72	0	72	
Total	250,834	317,405		66,571

Ample stocking capacity has been provided by the erection of a steel stocking trestle east of the shaft, approximately 1000' in length. Maas Bessemer and the two grades from the Race Course are being stocked in this area. Maas ore is being stocked west of the shaft from a portable wooden trestle, the same as in the previous years.

d. Division of Product by Levels:

The ore hoisted from the various levels was as follows:

Second Level	72,812 tons	27.8%
Third Level	5,908 "	2.3%
Fourth Level	182,734 "	69.9%
Total	261,454 "	100%

The product from the second level increased in 1928, while the product from the third and fourth levels decreased.

e. Production by Months:

The production by months by grades was as follows:

Month	Bessemer	Maas	Race Course	R.C. Bess.	Total	Rock
January	316	21,520			21,836	600
February	816	21,168			21,984	1,048
March	1,180	21,008			22,188	1,372
April	2,696	18,552			21,248	1,260
May	4,856	17,076			21,932	1,632
June	3,435	19,530			22,965	1,188
July	4,627	18,522			23,149	628
August	4,274	20,135			24,409	1,116
September	1,731	15,142		92	16,965	1,148

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2. PRODUCTION, SHIPMENTS & INVENTORIES:

e. Production by Months: (Cont.)

Month	Bessemer	Maas	Race Course	R.C. Bess.	Total	Rock
October	4,813	18,293	209		23,315	1,552
November	4,759	16,628	118	64	21,659	296
December	4,212	14,488	72		18,772	568
Total	37,715	222,062	491	64	260,332	12,408
Transferred from Bess. stock-pile overrun	2,059 to 1,122	2,059	from 97 to	97	1,122	
Total	36,778	224,121	394	161	261,454	12,408
Last Year	7,885	262,121			270,006	4,580
Increase	28,893		394	161		7,828
Decrease		38,000			8,552	

Production from the various leases was as follows:

	1928	1927
George Maas Lease	203,901	216,670
Catholic Cemetery	38,355	38,232
C. C. I. Co. (Right-of-way)	10,031	10,240
American Mining Company (Right-of-way)	4,208	4,864
Race Course	555	0
City of Negaunee (B.K. Road)	4,404	0
Total	261,454	270,006

f. Ore Statement:

	Maas Bessemer	Maas	R. C. Bess.	Race Course	Total	Total Last Year
On Hand Jan. 1st, 1928	2,028	315,377	0	0	317,405	367,852
Output for Year	37,715	222,062	64	491	260,332	270,006
Transferred	2,059	to 2,059	97	to 97		
Overrun	1,122				1,122	
Total	38,806	539,498	161	394	578,859	637,858
Shipments	32,554	294,988	161	322	328,025	320,453
Balance on Hand	6,252	244,510	0	72	250,834	317,405
Decrease in Output					9,674	
Decrease in ore on hand					66,571	

1928 - 1-8 hour shift, 5 days per week, January 1st to December 31st, 1928.
1927 - 1-8 hour shift, 5 days per week, January 1st to December 31st, 1928.

g. Delays:

There were no non-electrical delays affecting production during the past year.

h. Delays from Lack of Current:

The delays from lack of current were as follows:
March 15th, ½ hour delay due to no power.
June 19th, ½ hour delay due to no power.
September 19th, 2½ hours delay due to burn-out of haulage cable in the shaft.

3. ANALYSIS:

a. Average Mine Analysis on Output:

Grade	Iron	Phos.	Silica
Maas Bessemer	61.14	.044	8.38
Maas	59.32	.099	9.15
Race Course Bessemer	56.00	.075	14.50
Race Course	62.30	.119	4.88

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3. ANALYSIS:

a. Average Mine Analysis on Output: (Cont.)

The grade of ore produced in 1928 was not as good as in the previous year. This was due to more gangs mining under the hanging above the fourth level, where the ore in large areas is mixed with jasper. It is advisable to mine a sub level clean when possible, in order to cover down the entire area. With a more thorough covering down program adopted for all the Company mines, an improvement in grade is certain to follow when mining starts on lower sub levels.

b. Average Analysis on Straight Cargoes:

	Mine			Lake Erie	
Grade	Iron	Phos.	Silica	Iron	Phos.
Maas Bessemer		(All mixed)		-	-
Maas ore		(All mixed)		-	-

4. ESTIMATE OF ORE RESERVES:

a. Developed Ore:

Assumption: 12 cubic feet equals one ton.
10% deducted for rock.
10% deducted for loss in mining.
Percentage of Bessemer equals 10.

Between first and second levels,	95,296	tons	
Between second and third levels,	1,237,398	"	(1)
Between third and fourth levels (excl. R. Course)	3,454,730	"	(2)
Total developed ore, all available,	4,787,424	"	
Total developed ore available previous year,	3,077,910	"	
Increase, 1928 un-	1,708,514	"	
Increase over 1927 (inc. available ore)	284,964	"	

(1) Larger than in 1927, although no mining has been done, due to the foot on third level being found further north than was assumed heretofore.
(2) Increase of 333,517 tons over the 1927 estimate, in spite of large amount of mining in the area, is due (1st) to increased area assumed south of Race Course to Negaunee boundary, lying west of main fourth level north-south drift, with an assumed thickness of about 100'. (2nd) Including pillars below 270' sub that had been previously considered unavailable on account of supporting Race Course surface and the Baldwin Kiln Road.

All ore above the fourth level is now considered available, while in the previous year 1,424,550 tons was considered unavailable. This, with the increase in tonnage shown above the third level, accounts for the large increase in available ore reserves.

Including the product from the Maas, exclusive of the Race Course, reserves increased 505,863 tons in 1928.

No estimate has been included in this report of the probable ore on the Race Course. The Tax Commission estimate of previous years was 1,500,000 tons, and development work has not advanced far enough to warrant any decided change in these figures.

No probable ore is estimated below the fourth level on the Maas Mine property. This is in line with the policy of reporting developed ore only. Including a tonnage of 1,500,000 tons on the Race Course and 2,238,080 tons of prospective ore below the fourth level on the Maas, gives a total ore reserve of 8,525,504 tons.

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4. ESTIMATE OF ORE RESERVES:

c. Estimated Natural Analysis:

Ore Reserves: Approximate Expected Natural Analysis.

	Iron	Phos.	Silica	Mang.	Alum.	Lime	Mag.	Sul.	Igni.	Moist.
Maas & R. C. Bessemer	53.39	.040	6.56	.195	1.80	.612	.225	.008	1.15	12.50
Maas & Race Course	52.25	.100	6.63	.208	2.20	.850	.380	.010	1.80	12.75

Ore in Stock: Average Natural Analysis.

	Iron	Phos.	Silica	Mang.	Alum.	Lime	Mag.	Sul.	Igni.	Moist.
Maas & R. C. Bessemer	54.56	.041	6.70	.195	2.03	.652	.225	.008	1.15	11.50
Maas & Race Course	52.06	.090	6.82	.206	2.08	.875	.412	.011	1.76	12.50

It is assumed that the ore from the Race Course will average the same as the ore from the Maas Mine.

5. LABOR AND WAGES:

a. Comments:

(1) Labor:

Labor conditions at the mine were satisfactory during the year. There has been an excess of labor available in the Negaunee District all through 1928.

(2) New Construction:

The following is a list of the E. & A's on which work was done during 1928:

E. & A. #504 - Moving 21 Race Course Houses. Uncompleted at the end of the year.

E. & A. #513 - Moving 44 Additional Race Course Houses. Uncompleted at the end of the year.

E. & A. #527 - (a) Construction of 2 shipping pockets. 50% completed.
(b) Erection of steel stocking trestle. Completed.
(c) Installation of new pump station on fourth level. 75% completed.

E. & A. #533 - Painting 30 Houses in New Location. 20% completed at the end of the year.

All the E. & A's will be taken up in detail under the heading #12, "New Construction and Proposed New Construction."

6. SURFACE:

b. Comparative Statement of Wages and Product:

	1928	1927	INCREASE	DECREASE
PRODUCT	261,454	270,006		8,552
No. Shifts and Hours	1-8	1-8		
AVERAGE NO. MEN WORKING:				
Surface	37	37		
Underground	152	160		8
Total	189	197		8
AVERAGE WAGES PER DAY:				
Surface	4.40	4.34	.06	
Underground	5.02	5.09		.07
Total	4.90	4.94		.04

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5. LABOR AND WAGES:

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

	1928	1927	INCREASE	DECREASE
WAGES PER MONTH OF 25 DAYS:				
Surface	110.00	108.50	1.50	
Underground	125.50	127.25		1.75
Total	122.50	123.50		1.00
PRODUCT PER MAN PER DAY:				
Surface	25.51	25.21	.30	
Underground	6.40	6.29	.11	
Total	5.12	5.03	.09	
LABOR COST PER TON:				
Surface	.173	.172	.001	
Underground	.784	.809		.025
Total	.957	.981		.024
TONS PER MAN PER DAY:				
Stoping	15.18	13.26	1.92	
Ore Development	6.88	6.89		.01
Total	14.37	12.95	1.42	
b. AVG. WAGES CONTRACT MINERS	5.35	5.45		.10
TOTAL NUMBER OF DAYS:				
Surface	10,248	10,712		464
Underground	40,826 1/4	42,914 3/4		2,088 1/2
Total	51,074 1/4	53,626 3/4		2,552 1/2
AMOUNT FOR LABOR:				
Surface	45,116.25	46,476.61		1,360.36
Underground	205,040.91	218,513.56		13,472.65
Total	250,157.16	264,990.17		14,833.01

Proportion of Surface to Underground Men:

1928 - 1 to 4.11 One 8-hour shift 5 days per week.
1927 - 1 to 4.32 One 8-hour shift 5 days per week.
1926 - 1 to 3.87 One 8-hour shift 5 days per week.
1925 - 1 to 3.76 One 8-hour shift 5 days per week.
1924 - 1 to 4.16 One 8-hour shift 5 days per week.

6. SURFACE:

a. Buildings, Repairs:

There were more than the usual repairs to buildings required in 1928. The Johns-Manville roofing on the dry building was loose due to rotting of roof boards. The roofing was removed, new roofing boards installed where needed, and the roofing nailed down securely. A strip of Tonkin metal was put on at the eaves, to prevent tearing of roofing by the ice which builds up at the eaves. The entire roof was then gone over carefully, all joints securely nailed, and covered with a strip of muslin cemented on, after which the roof was given a thorough coating with a roof preservative. This roof should require no more attention for five or six years.

The roof of the engine house and power plant was repaired and then given a coat of roof compound. This roof leaked in several places, due to ice raising the asbestos blocks and breaking the covering material. These spots were repaired before applying the roof compound.

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6. SURFACE:

a. Buildings, Repairs: (Cont.)

The old timber bulkhead at the end of the coal dock rotted and was replaced with a concrete retaining wall. The coal dock is much larger than is required for the heating plant at the mine and a small reserve for the Cliffs Power and Light steam plant, so that it was decided to use the center track for dumping coal and remove the two other tracks from the dock. This was done by the L. S. & I. Railway Company, late in the fall, as they owned the rail. Before receiving 500 tons of coal the bents were repaired under the center track.

A room, 5' x 15' in size, was built in December on the west side of the tunnel near the shaft. It will be used for a fuse cutting and capping room, and for a carbide distributing room. Both rooms have been made as near fire proof as possible. The "Standards of Explosives" require that all fuse be cut and capped by one or more employees, and given to the miners in a lined sheet iron carrying box. Similar rooms, either on surface or underground, are being provided at all of the Company mines.

Under E. & A #527-a, "Building two shipping pockets", one pocket was completed in 1928 and was used for a short time in November. Work was started on the second pocket, which will have to be completed before the shipping season opens next spring. These two pockets were required to load the two grades of ore from the Race Course.

b. Stockpiles:

E. & A. #527-b, "Erection of steel stocking trestle", covered the cost of building and equipping a 1000' steel trestle east of the shaft, and making a rock sollar. This work was started in the fall and completed in November. It is planned to stock three grades from this trestle, Race Course Bessemer, Race Course, and Maas Bessemer. Six wooden bents were erected on the end of the south track for stocking rock.

The wooden portable trestle east of the shaft was erected in the fall for stocking Maas ore. The wooden stocking trestle southeast of the shaft from which rock was stocked was dismantled late in the fall. A small amount of rock stocked from this trestle will have to be removed in the spring to clean up the steel trestle stocking grounds.

A large amount of rock was removed during the fall from the rock pile near the shaft and used in making a rock sollar under the new steel trestle.

c. Tracks:

To facilitate unloading steel for the new trestle and for erecting and concreting the pillars, a track was installed by the L. S. & I. Railway, the full length of the new trestle. This track was removed when work on the trestle was completed. The railroad company has considerable work to do next spring getting in loading tracks to the stockpiles under the steel trestle. They have to make an entrance from the east, and some cutting will be required to get the proper grades.

7. UNDERGROUND:

a. Shaft Sinking:

There was no shaft sinking at the Maas Mine during the year.

b. Development:

Development work done during 1928 was confined to drifting and raising on the second, third, and fourth levels.

Second Level:

During the year there were six raises put up from the second level to subs above. Four of these raises, each 40' in height, were put up in ore to the 550' sub. The other two were in rock, one was 30' in height, the other 40',

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7. UNDERGROUND:

b. Development: (Cont.)

to the 540' and 550' sub levels.

There was also 100' of ore drift on the main level which was connected to #116 raise, and 50' of rock drift to connect to #46-A raise.

Third Level:

Considerable development work was done here during the year. The new foot wall drift was started and advanced 430' in rock during the year. Owing to its being impossible to handle rock on surface while the new steel trestle was being erected, work in this drift was stopped in November, and not resumed until in January, 1929. The drift has 115' to advance to hole to the Negaunee Mine. Ore was encountered on one side of the drift soon after it started, and it was then turned more to the north into the foot wall. The ground tends to slab, and the greater part of the drift has been timbered. During the year four raises were put up from this drift to intersect the old raises from the former third level ore drift. Three of these raises were completed and connected to the old raises; the fourth was being put up at the end of the year. One raise was put up to the second level near the foot wall.

Following is a record of the raises put up during the year:

Raise No.	Total Height	Advance	Material	
#109 Double comp.	205'	205'	40' jasper, 165' ore.	Completed.
#111 " "	83'	83'	83' ore.	Completed.
#112 " "	94'	94'	50' jasper, 44' ore.	Completed.
#113 " "	113'	113'	30' jasper, 83' ore.	Completed.
#116 " "	43'	43'	38' jasper, 5' ore.	Uncompleted.
Total -		538'	158' 380'	

Fourth Level:

Development of the Race Course was started in March and continued for the balance of the year. A drift has been driven in ore paralleling the south boundary and two crosscuts have been started to the north into the Race Course property. The foot wall drift has advanced beyond the first crosscut and the crosscut has been driven to the south through the foot wall into the main ore body. This drift passed out of the foot wall into ore, then dike, then ore again, then jasper and finally encountered the main ore body near the end of the year. The geological conditions here were unexpected and indicate a decided drop in the hanging wall near the dike which parallels the foot wall. This is probably a fault dike. Interesting information will be obtained here during the next several months as the foot wall drift and the second crosscut advance.

It was decided to mine a pillar on the Maas property immediately east and south of the Race Course on an angle of 70 degrees, so that this pillar would reach the Race Course boundary on the foot wall. This would insure a stable condition for contact between the mined areas on the Race Course and the surrounding pillars left on the Maas property.

Raises were put up on an angle of 70 degrees from the main haulage drift to the shaft which parallels the east boundary of the Race Course, and mining from five of these raises was under way at the end of the year. Three of these raises near the foot wall encountered the jasper hanging at a much lower elevation than was expected, and were stopped until this area had been explored.

The fourth level pumping plant was not adequate to handle the increase in mine water expected from the increase in mining operations in this territory. A new pump house was excavated just south of the present pump house, and the new pump was being installed at the end of the year.

The progress of development of the Race Course ore body was delayed due to opposition of the Negaunee Common Council to the vacating proceedings.

Further delay occurred in November while the steel trestle was being erected, during which time no rock could be hoisted or any Race Course ore stocked.

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7. UNDERGROUND:

b. Development: (Cont.)

The following is a record of drifting and raising on the fourth level:

Raise No.	Total Height	Advance in 1928	Material Ore	Material Jasper	
219	225'	60'	40'	20'	Completed.
240	115'	115'	60'	55'	"
241	67'	67'	48'	19'	"
242	66'	66'	38'	28'	"
245	115'	115'	110'	5'	"
246	40'	40'	40'		Uncompleted.
248	67'	67'	67'		Completed.
249	67'	67'	67'		"
250	67'	67'	67'		"
251	67'	67'	67'		"
253	67'	67'	67'		"
510	20'	20'	20'		Abandoned.
602	50'	50'	50'		Uncompleted.
Total		868'	741'	127'	

Lease	Rock Drifting	Ore Drifting	Total
Maas	0	320'	320'
Race Course	330'	45'	375'
Total	330'	365'	695'

c. Stoping:

Mining has been carried on during 1928 to a large extent in the same areas that were being mined in 1927. The foot wall pillar above the second level has been mined on a number of sub levels. The east part of this pillar is cut by dikes and the ore is low grade, except on the hanging side. The foot wall side of the pillar, especially at the west end near the old workings, is very wet, and the ore is still handled with tram cars and shovels. Mining of the west end of the pillar at the elevation of the second level was started the last of the year, and development is under way for mining this area at lower elevations.

Mining has been continued on the foot wall pillar between the third and fourth levels on the 280', 270', and 260' sub levels. Practically all of this ore has been handled on the 245' transfer sub level and again on the fourth level.

One isolated area, due to a roll in the hanging close by the above area, was mined out on the 300' sub level and is now being mined on the 280' sub level.

Mining under the hanging on the 215' and 200' sub levels was under way during the year, except in the months of September and October, when work was temporarily stopped due to the delay in the vacation proceedings of the streets and alleys on the Race Course.

Mining was started late in the year on the 170' sub level in an area adjacent to the Race Course. This area had been mined on the 185' sub level several years ago.

During the year ore was mined on the Maas Lease, the Roman Catholic Cemetery Lease, the Cleveland-Cliffs Iron Company right-of-way, the City of Negaunee Lease of the Baldwin Kiln Road, the American Mining Company right-of-way, and the Race Course.

The detail of the mining on the various levels and sub levels is as follows:

Subs above the second level:

575' Sub Level:

Mining in this sub level in the Roman Catholic Cemetery and Railroad Pillars was started in March, 1926, and was finished in August, 1928.

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7. UNDERGROUND:

c. Stoping: (Cont.)

565' Sub Level:

This sub level was re-opened in December, 1926, after having been abandoned for several years, and mining has been in progress to the present time. One contract is now mining the last pillar on this sub level. The area mined on this sub level is mainly in the Roman Catholic Cemetery and Railroad Pillar.

550' Sub Level:

Mining on this sub level started in January of this year in the Cemetery and Railroad Pillars, and continued all year. Three contracts were stoping here in December.

535' Sub Level:

This sub in the eastern area was opened in 1927 as a transfer sub, but the area above was too wet, and the transfer system had to be abandoned. In August of this year there were three new raises put up to this sub from the second level and mining started. Three contracts were slicing with scrapers in December in the Roman Catholic Cemetery and Railroad Pillars.

525' Sub Level:

Mining was started on this sub level in March, 1927, and was completed in December of this year. The territory mined on this sub level was located at the west end of the foot wall pillar adjacent to old workings. It was very wet and the ore is handled by shoveling and tram cars.

Second Level:

Early in the year a crosscut was driven south to #116 raise from the third level. Later in the year three raises were put up to the 550' sub level, where the ore is mined by scrapers.

The middle drift under the Roman Catholic Cemetery was repaired and advanced to the east 50' in jasper, and a raise put up to the 565' sub level to mine the ore north of the dike on the foot wall. During the year one raise in this drift and two in the old hanging wall drift were put up to the 535' sub level.

Considerable repairing has been done during the year in the hanging wall drift in the area west of the cemetery, as this area is very heavy. It is the only means of access for men and supplies to the contracts mining from raises #108 to #113 from the third level. A sub level is now being opened up 50' below the second level, which will take the place of this drift as a traveling and timber road.

Two contracts have started mining at this elevation in November.

465' Sub Level:

Mining on this sub was stopped several years ago. In November of this year it was decided to open this sub level and connect all the raises from the third level for a traveling and timber road for the sub levels above. A crosscut will be extended into the foot wall and a rock raise put up to the second level for a traveling road and timber slide. It is also planned to extend this drift to the east beyond #116 raise and put up several transfer raises to the second level in the territory south of the dikes and under the hanging. It is hoped that this area will be dry, so that the ore can be mined with scrapers. Foot wall raises from the third level will be put up independent of this system to catch the water near the foot wall.

401' Sub Level:

This sub level was opened several years ago and then abandoned, until in 1926, when a drift was driven to connect the new raises from the third level. In 1928 this drift was repaired and bulkheads built at every raise, as the raises from the new foot wall drift intersect the old raises near this elevation.

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7. UNDERGROUND:

c. Stoping: (Cont.)

Third Level:

The new foot wall drift was started in January of this year, and drifting has been under way since, except for the last two months while it was not possible to handle rock on surface. Two contracts have been raising practically the entire year. #111, #112, and #113 have holed to the old raises, and #109 has been put up to the second level. #116 raise is now being put up, and at the end of the year was up 40' above the third level in jasper. One contract is also cutting out for #117 raise.

The new third level foot wall drift was to be well back in the foot wall, it was planned, but the south side of the drift encountered lean ore and the drift was turned more to the north. The rock through which the drift passed tended to slab off, and it was necessary to timber the entire drift. This work was done in November and December.

Subs between third and fourth levels:

300' Sub Level:

One contract opened up this sub level in a new area under the hanging in November, 1927, and mining of this small area was completed in October of this year. The ore was handled through a raise from the fourth level. Nearly all the ore mined here was of Bessemer grade.

280' Sub Level:

With the exception of the new area under the 300' sub level, this sub level was completed early in the year. There was one contract stoping here in December.

270' Sub Level:

This sub level has been worked the entire year, and in December seven contracts were stoping. With the completion of this sub, these contracts will all be moved to the Race Course territory. This will eliminate the transfer on the 245' sub level.

260' Sub Level:

It was decided to mine a small area on the foot wall near the Negaunee Boundary, and in February two contracts started here and worked through the year. There is a small pillar left to be mined, which will complete work in this area.

240' Sub Level:

The only work done on this sub level in 1928 consisted of putting up a raise to the 200' sub and driving a drift to connect #219 raise with the transfer drift for timber and ventilation.

230' Sub Level:

Mining was in progress on this sub level in 1926 and 1927. Early in 1928 the six remaining pillars were mined and the contracts removed to other parts of the mine.

215' Sub Level:

Mining in this sub level near #417 and #422 raises was started in February, 1927, and completed in June, 1928. The only other work done here has been on a connection with the Negaunee Mine, which was started in September from the top of #425 raise. This connection will hole to the twelfth level, Negaunee Mine, through a drift and a raise early in the new year. It will provide a second outlet for the fourth level territory, and also better ventilation.

200' Sub Level:

Three gangs were working here in December, 1927, when this old sub level took weight and crushed most of the drifts. It was reopened, and during most of the year seven contracts worked here. At the end of the year three gangs were mining the remaining pillars. This sub level was located at the top of the southerly pillar left to support the Baldwin Kiln Road and the

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7. UNDERGROUND:

c. Stoping: (Cont.)

Race Course. This area will also be mined on the 185' sub level to provide working places until the Race Course and adjacent areas are ready for mining.

The ore mined here has been nearly all Bessemer grade. To the west and north of this area, one contract is exploring at this elevation under the hanging from 245 raise near the Race Course. The enrichment seems to be incomplete in this area, and work is now nearly finished. This gang will drop down and open the next sub level below.

The last of the year a contract started opening out on this sub level from #417 raise. The area directly above was mined during the past year on the 215' sub level.

170' Sub Level:

Mining on this sub level was started in September from four raises up along the east boundary of the Race Course. The mining limit along the east side of the Race Course is 80' to the east under the hanging, and decreases at an angle of 70 degrees, intersecting the boundary at the foot wall. The hanging wall jasper was encountered close to the hanging side of the raises, so that there was no mining on the Race Course at this elevation in this particular area. Mining was nearly completed here at the end of the year, and the gangs will soon drop down and open the 160' sub level. Nearly all of the ore mined here has been of Bessemer grade.

Fourth Level:

Opening of the Race Course by drifts was started in March. In June ground was removed for raises located in the main haulage drift to the shaft on the east side of the Race Course. Four contracts have worked steadily during the last half of the year on development of the Race Course.

The foot wall drift to the west on the Race Course advanced 200' in transition slate and jasper. The crosscut to the south from this foot wall drift passed out of this material into ore, 100' from the point of curve. After passing through 20' of ore, the fault dike was encountered, which proved to be 10' thick at this point. A thin seam of ore was found on the south side of the dike, then 10' of jasper and 30' of Bessemer ore. Beyond this ore, 40' of jasper was found and at the end of the year the drift was in lean ore, which it is expected will soon lead into high grade ore. The geological conditions disclosed by this crosscut indicate that the jasper south of the dike is probably hanging wall material that may possibly have been depressed on the south side of the fault dike.

The drift along the south boundary of the Race Course has advanced 250' in high grade ore. Two crosscuts have been turned off to the north, that will cross the Race Course property and connect with the foot wall drift. The first one of these crosscuts has advanced nearly to the Race Course property, the second one was just started the last of the year. The drift along the south boundary will be continued to the west line of the Race Course unless cut off by the hanging. It is planned to drill a test hole near the end of this drift to find the elevation of the bottom of the Race Course ore, which information is needed to determine the proper elevation of the new fifth level that must be opened in 1930. The new ground opened by this drift has been quite wet and shows the desirability of opening the ore body in advance of mining operations, so as to give it an opportunity to drain. Water in this drift has proven a serious handicap to rapid advance, as it was not possible to use a scraper and slide for loading the ore in cars. An Armstrong loader was used for a while, but would not operate successfully. Hand shoveling is again in use.

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7. UNDERGROUND:

c. Stoping: (Cont.)

During the year there was 695' of drifting on the fourth level and 868' of raising. This heavy program of development work must be continued during 1929 in order to open the Race Course ore body. One contract worked from August to December excavating a pump house just south of the present one, and at the end of the year the new pump was being installed. The pump is a 800 gallon, 350' head, plunger pump purchased from the Boeing Mine.

d. Timbering:

The drifts being driven on the fourth level to open the Race Course ore body and the Maas ore body south of the Race Course account for the use of more large sizes of timber in 1928. Large sizes of timber were also used in the new foot wall rock drift on the third level and for repairing drifts on the second level. More lagging and poles were used in 1928, with a lower product, due to more thorough methods of covering down and more poles used for scraper slides on floor of drifts. The amount of treated timber used almost doubled.

Statement of Timber Used:

	LINEAR FEET	AVG. PRICE PER FOOT	AMOUNT 1928	AMOUNT 1927
6" to 8" Timber	102,719	.0430	4,422.80	4,471.23
8" to 10" "	54,896	.0642	3,522.53	3,592.49
10" to 12" "	30,992	.0920	2,851.95	2,311.84
12" to 14" "	14,600	.1134	1,656.17	368.67
12" to 14" Treated Timber	4,968	.307	1,525.44	950.91
Total Timber - 1928	208,175	.0671	13,978.89	
Total Timber - 1927	196,495	.0595		11,695.14
		Per 100'		
7' Lagging	1,059,674	.757	8,021.84	7,833.93
9½' Tamarack Poles	352,660	1.588	5,601.60	3,255.64
Total - 1928	1,412,334	.965	13,623.44	
Total - 1927	1,264,835	.877		11,089.57
1" Covering Boards, 1928	25,584	1.88	481.29	
1" Covering Boards, 1927	16,000	1.95		312.60
Total Timber, 1928 -			28,083.62	
Total Timber, 1927 -				23,097.31
Product, tons,			261,454	270,006
Feet of timber per ton of ore			.7962	.7277
Feet of lagging per ton of ore			4.053	3.905
Feet of lagging per foot of timber			5.09	5.36
Cost per ton for timber			.0535	.0433
" " lagging			.0307	.029
" " covering boards			.0018	.0011
" " poles			.0214	.0121
" " all timber			.1074	.0855
Equivalent of stull timber to board measure			369,564	298,669
Feet of board measure per ton of ore			1.41	1.11

Total Cost for timber, lagging, poles, etc., and cost per ton:

1928	$28,083.62	$.1074
1927	23,097.31	.0855
1926	22,163.56	.0906
1925	11,011.51	.0736
1924	17,199.67	.0760

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7. UNDERGROUND:

d. Timbering: (Cont.)

The cost per ton for timber, for lagging, and for poles all increased in 1928 and was the highest in the five year period, 1924 to 1928, inclusive. Several old timber piles that had been in stock for several years were cleaned up in 1928, and some loss was incurred due to rotting of this timber.

e. Drifting and Raising:

The following is a statement of drifting and raising on the main levels for the years 1928 and 1927:

YEAR	ORE DRIFTING	ORE RAISING	ROCK DRIFTING	ROCK RAISING
1928	465'	1,281'	810'	345'
1927	-	1,249'	405'	581'
Increase	465'	32'	405'	
Decrease				236'

The ore drifting was all on the fourth level, in connection with the development of the Race Course. The rock drifting was about equally divided between the third and fourth levels.

The ore and rock raising was done on the fourth, third, and second levels, but mainly on the fourth level in connection with the development of the Race Course ore body.

f. Explosives, Drilling and Blasting:

Statement of Explosives Used:

Ore Development and Stoping.

	Quantity	Average Price	1928 Amount	1927 Amount
50% Am. Gel. Powder	80,700	.1391	11,225.52	14,242.84
60% " " "	13,750	.1504	2,067.75	984.25
Total Powder - 1928	94,450	.14074	13,293.27	
Total Powder - 1927	106,300	.14324		15,227.09
Fuse	321,800	.578 C	1,859.01	2,041.44
#6 Blasting Caps	59,000	1.102	649.96	669.19
Cap Crimpers	21	.667	14.03	21.35
Powder Bags	24	1.825	43.80	
Tamping Bags				10.75
Total Fuse, etc. 1928			2,566.80	
Total Fuse, etc. 1927				2,742.73
Total All Explosives - 1928			15,860.07	
Total All Explosives - 1927				17,969.82
Product, tons,			261,454	270,006
Pounds of powder per ton of ore			.3612	.3937
Cost per ton for powder			.0509	.0564
" " fuse, caps, etc.			.0098	.0102
" " all explosives			.0607	.0666
Average price per pound for powder			.14074	.14324

Rock Development.

	Quantity	Average Price	1928 Amount	1927 Amount
50% Am. Gel. Powder	2,450	.1423	348.76	256.48
60% " " "	10,100	.1521	1,537.00	837.00
Total Powder - 1928	12,550	.1502	1,885.76	
Total Powder - 1927	7,200	.1519		1,093.48

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7. UNDERGROUND:

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

	Quantity	Average Price	1928 Amount	1927 Amount
Fuse	33,500	.578 C	193.62	116.01
Caps	4,500	1.08	48.58	35.16
Total Fuse, etc. 1928			242.20	
Total Fuse, etc. 1927				151.17
Total All Explosives - 1928			2,127.96	
Total All Explosives - 1927				1,244.65
Grand Total All Explosives Used - 1928			17,988.03	
Grand Total All Explosives Used - 1927				19,214.47
Average price for powder			.14186	.14379

Note: 8.2% decrease in pounds of powder per ton of ore.
8.8% decrease in cost per ton for all explosives.
1.4% decrease in cost per pound for powder; price of powder reduced in April, 1928.

The cost for explosives decreased in 1928, due to a lower price per pound for powder, and less mining in areas where the ore was tight and hard to break.

g. Mining and Loading:

There was no change in mining methods during 1928 from the slicing system which has been used for a number of years. The number of scrapers in use in the mine in 1928 increased as compared with 1927. Operating conditions prevented the use of scrapers in some areas, due to water. The mine was wetter in 1928 due to a change in the location of incoming water, further to the west, over a larger area following a cave to surface in January, 1928. The early abandonment of work on the 270' and 260' sub levels above the 245' transfer sub and the transfer of these gangs to the Race Course territory will improve operating conditions for the use of scrapers. More scraper hoists of larger horsepower will be purchased in 1929.

The following statements show the tons handled by scrapers and by hand shoveling, and the tons per man per day for 1928 and 1927.

	1928 Tons	1927 Tons	1928 % of Product	1927 % of Product
Hand Shoveling	94,074	146,988	35.9%	54.4%
Scrapers	167,380	123,018	64.1%	45.6%
Total	261,454	270,006	100 %	100 %

	Scrapers		Hand Shoveling	
	1928	1927	1928	1927
Average tons per man	17.54	18.27	11.89	10.56

Due to frequent changes in location of contracts and to water, the tons per man per day obtained from scrapers was not as high in 1928 as in 1927.

i. Ventilation:

The main ventilating system worked satisfactorily during the year.

An additional opening to the twelfth level, Negaunee Mine, was being made at the end of the year by a drift and raise on the 215' sub level about 110' above the fourth level. This will give three connections, one on the second level to the tenth level, Negaunee, one on the third level to the twelfth level, Negaunee, and one on an intermediate sub level above the fourth level to the twelfth level, Negaunee. This will insure better ventilation on the sub levels above the fourth level, where mining will be in progress for the next several years.

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7. UNDERGROUND:

j. Pumping:

The number of gallons pumped per minute in 1928 as compared with 1927 is shown by the following report:

Month	1928	1927
January	1,055	951
February	1,043	957
March	1,100	963
April	1,123	993
May	1,095	964
June	1,067	1,023
July	993	1,063
August	973	1,039
September	986	1,053
October	1,014	1,080
November	1,109	1,012
December	1,071	1,055
Average	1,052	1,013

The amount of water pumped in 1928 increased and is now higher than for any year during the previous six years. It only dropped below 1,000 gallons per minute for the three summer months, and for three months of the year exceeded 1,100 gallons per minute. The cave to surface is gradually being extended, and also the rainfall in certain months of the year was above the average of the past ten years.

The average number of gallons pumped per minute over the past six years is shown below:

Year	Gals. per minute
1928	1,052
1927	1,013
1926	970
1925	915
1924	990
1923	966

k. Underground in General:

General conditions at the mine showed some improvement in 1928, but some time will elapse before they are comparable with the Negaunee and Athens Mines. The main level interval of 200' is a serious handicap, and the over-development of the mine is another serious drawback. Present plans call for concentration of mining in two areas, one the foot wall pillar between the second and third levels, the other above the fourth level on the Race Course and adjacent territory to the east and south. The development of the fourth level will extend over the greater part of the next year, so that improvement in cost per ton will not be noticeable in 1929.

Work is now under way to cut off the water on the foot side of the second foot wall pillar which, if successful, will improve operating conditions in this territory.