A Model "92" Marion shovel started stripping on March 15th, the initial cut being taken along the west side of the pit. This shovel was engaged during the balance of the year in cutting down and back from this first bench.

The Model "300" shovel started work April 16th, taking its initial cut along the north and east sides of the pit. This cut was 40' in depth and the crest was in the proximity of our new road and mine buildings. Upon the completion of this first cut, the shovel was turned around and dug back to the south, taking a maximum cut until the muskeg was reached. Muskeg was encountered about 300' southeast of the shaft. There was a maximum of approximately 40' of muskeg and this was underlain by a seam of clay. The muskeg was very spongy and slid into the pit along the underlying clay. It was impossible to advance the shovel into the muskeg and it was necessary to back up several times during the two weeks that operations were conducted here. The soft material flowed into the pit and it was impossible for the pitmen to do any track work. Further than this, the muskeg was drawn in from the sides and finally pulled the loading tracks. A 250' spile bridge was constructed across the deep muskeg channel and the officials of the contracting company felt that this would not be pulled. The muskeg, however, broke the timbers as though they were matches and it was finally decided to abandon operations at this point for the year.

The "300" shovel was turned back from the muskeg August 30th and spent the balance of the year in cutting down and back along the north and west sides of the pit. This machine was shut down for repairs the early part of December, having extended a cut along the west side of the pit to the approach. It is the intention to dig through the muskeg on the approach side of the pit during the winter months. The "300" shovel will resume work early in January and we are in hopes of getting at least one, if not two, cuts through the muskeg before the spring breakup. Mr. Holladay, of the Winston-Dear Company, feels that we can handle the muskeg to much better advantage in the winter and that if we once get a cut through, we will be able to stop the lateral pulling.

BOEING MINE.

The 100-ton shovel removed the high ground, commonly known as an island, along the center of the pit, before it was tied up for repairs on December 24th. The island was merely a shell and the frost going in from both sides would have made it very difficult to handle in the spring.

While the Winston-Dear Company officials and ourselves felt that we had ample dump ground, the muskeg soundings were found to be very inaccurate. Where we had figured on from 4' to 5' of muskeg, we found approximately 35' and the main high trestle could not be used to any extent. We filled the trestle for a short distance and the material than started swelling the ground ahead and the bents were wrecked for a distance of approximately 400'.

We secured permission from the Rogers-Brown Iron Company to fill the triangular piece of ground to the south of the highway bridge and this afforded us a dump while secondary trestles were being constructed to fan over to the high trestle. A trestle was built around and to the south of our main dump, to afford an impounding basin for the spongy muskeg, and we extended the main dump eastward and fanned back to the high trestle. This latter work was very slow and the continual settlements made it very dangerous from an operating standpoint. It was not until the end of the year that the material placed along the east end of our dump came to rest and we felt that it was safe to resume dumping from the high trestle. The necessary connections are now made and we will start dumping from the high trestle as soon as the material is suitable for this purpose. We do not care to dump any of the soft muskeg material from this high trestle.

The Oliver Iron Mining Company allowed us to waste our stripping along the old Sellers dump when we were restricted for adequate dumping ground.

The 1,300' of 20' trestle, which was built in connection with our muskeg impounding basin, was constructed in September and filled with gravelly clay material during the following month.

The Oliver Iron Mining Company allowed us to start a fill on their ground to the muskeg hole. The contractor intends to fan a dump to the north from this solid ground and eventually connect with the fill from the high

trestle.

The following table shows the shifts worked by the two shovels and the yardage handled by each during the past year:

	10-HOUR SHIFTS WORKED.	YARDAGE HANDLED	PERCENTAGE	AVERAGE YARDS PER HOUR.
Model "300" Marion--	329	705,057	53	214
Model "92" Marion--	404	627,600	47	155
TOTAL- - - - - - - -	733	1,332,657	100	182

Other equipment used by the contractor consisted of six 18" x 24" American locomotives, thirty Kilbourne & Jacobs 20-yard cars, one Jordan dump plow, one track shifter and twenty 12-yard automatic dump cars.

The following table shows the monthly bills submitted by the Contractor, the yardage handled per month and the cost per yard:

	WINSTON-DEAR BILLS.	CUBIC YARDS	-----COST PER YARD--- FOR MONTH	FOR YEAR
Previous to March 1st--	$62,883.96	-------	----	----
March----------	40,063.67	12,313	$3.254	
April----------	58,627.41	70,284	.834	$1.950
May----------	70,294.37	168,743	.417	.922
June----------	66,115.59	118,164	.559	.806
July----------	78,137.69	189,368	.412	.673
August----------	63,397.01	136,364	.465	.632
September----------	65,888.32	146,671	.449	.600
October----------	73,324.55	174,974	.413	.568
November----------	81,331.49	196,215	.414	.547
December----------	81,868.25	119,561	.685	.557
TOTAL- - - - - - - - -	$741,932.31	1,332,657	---	.557

There are, of course, a number of accounts which should be divided into the total yardage to be stripped. The following accounts come under this head: Approach Cut, Buildings, Dump Trestles, Highway Bridge and Track Material. The total charge for these items amounts to approximately $161,000. Dividing this charge by the total yardage to be handled on the job, would give 3¢ per yard. The charge of $161,000 was, however, taken up in our 1920 costs and affected the price per yard by 12¢. Our total cost for 1920 would have amounted to 47¢ per yard, if we had spread the permanent construction account of $161,000 over the entire yardage to be handled.

STOCKING

Our stocking trestle was erected and the top tram equipment installed by the 24th of May and the ore encountered in our underground development work has been placed in stock. Prior to May 24th we did not encounter any ore above 50% in iron content.

We have used the material running between 40% and 50% iron as a floor covering for our stockpile and it will not be necessary to lay any planks. Following is the tonnage in stock and the average analysis of same on December 31st. 1920:

	Tons.	Fe.	Phos	Mn.	Sil.	Alumina
Merchantable Ore----------	1,989	57.12	.076	1.38	8.81	2.31
Lean Ore----------	6,894	52.60	.083	1.09	13.13	2.39

UNDERGROUND OPERATIONS

The shaft which had been sunk to a depth of 200' by January 1st., was bottomed on January 28th, 237' below the collar. According to our original time schedule, the shaft should have been bottomed January 1st, but due to difficulties encountered with the quick sand, the job was completed practically one month late. We placed 12" x 12" x 18' bearing timbers in concrete at an elevation of 210'. The rock is solid here, but was shattered somewhat by blasting and it was deemed advisable to place concrete around the timbers.

The first level plat was cut at an elevation of 190' below the collar and drifting started with four headings the forepart of February. The first heading was toward the ore body, the second for the tail track, the third for the pumphouse and the fourth for the timber track, leading out from the cage compartment. The tail track was finished February 28th, being pushed in 48' from the shaft, the 6' x 8' drift to the pumphouse was extended 37', and the pumphouse opening started in March. The heading from the cage compartment holed to the main level drift in February. While all of this work was done in rock, there were painty seams and it was necessary to timber and lag the sides as well as the back.

The pumphouse, which is 10' high, 20' wide and 50' long, was finished on March 25th. This room had to be timbered and lagged on top. No side lagging was necessary here. A raise was put up from the pumphouse for 45' and a 40'connecting drift was driven to the shaft, to provide a traveling road for the pumpmen in case of a flood. A concrete bulkhead cuts off the pumphouse from any connection with the first level.

A sump 10' x 10' and 275' long was cut to the north side of the shaft, leaving a 25' pillar between. A clean out drift was provided 9' below the sump and holed to the shaft. All of these jobs were completed and the necessary bulkheads for protection against floods, were completed by May 29th.

The main first level drift was pushed out to the southwest from the shaft for 155'. At this point the drift was split, one heading being driven to the northwest and the second to the southeast on 75' radius curvatures. These drifts were connected, so as to form a "Y", to enable us to switch around our trains. The ground at our shaft was quite slabby and we considered it advisable to switch around on a "Y", rather than to provide a double track drift along the shaft. The headings had progressed to the ore by June 1st, the connecting link of the "Y" driven, the rotary dump installed and the skips hung. Previous to June 1st. our hoisting was done with a bucket hung in the cage road. On June 1st. the northwest and southeast development drifts were started from the ends of the "Y", an Armstrong underground loader being used for mucking the blasted material. Our underground electrical installation was not completed until August 4th, and hand tramming was resorted to until this time.

The progress of our main drift from June 1st. to December 31st. was as follows:

	NORTHWEST DRIFT	SOUTHEAST DRIFT
JUNE----------	180'	207'
JULY----------	198'	134'
AUGUST---------	189'	172'
SEPTEMBER------	168'	148'
OCTOBER--------	154'	182'
NOVEMBER-------	201'	149'
DECEMBER-------	101'	126'
TOTAL----------	1191'	1118'

In the northwest drift, we cut 240' of lean ore with seams of taconite

and 951' of rock, while in the southeast drift we encountered 300' of ore and 818' of fairly hard rock.

Crosscuts were driven from these drifts across the bottom of the ore channel. Later raises will be put up from these crosscuts to drain the open pit. Several raises have been started, but as the open pit operations had not been conducted below the water level, it has not been necessary to push them through to the surface material. This work will be completed as soon as the question of pit drainage makes it necessary.

Nos. 2, 4 and 6 crosscuts were driven westward from the southeast heading, No. 2 being pushed out 155' in ore, No. 4, 120' in ore and No. 6, 60' in taconite. From the northwest drift, No. 1 crosscut was extended westward 139' in ore and No. 3, 144' in ore.

A resume of the first level drifting, exclusive of the pumphouse, sump, and pumphouse raise, was as follows:

	ORE	ROCK	TOTAL
Main Drift to "Y"-------		155'	155'
Tail Drift-------------		48'	48'
Timber Drift-----------		40'	40'
"Y" -------------------	110'	155'	265'
Northwest Drift--------	240'	951'	1191'
Southeast Drift--------	300'	818'	1118'
Crosscuts--------------	538'	74'	612'
Switch Turnouts--------	26'	93'	119'
TOTAL------------------	1214'	2334'	3548'

The 6" air line was extended from the compressor down the shaft to the first level and 4" lines were carried out to the northwest and southeast drifts. Two inch lines were provided in the crosscuts.

An Aldrich vertical triple plunger pump, 800 gallon capacity against a 200' head, was installed in the pumphouse. A centrifugal pump of 800 gallon capacity against a 350' head was installed as an auxiliary to the Aldrich. These pumps are electrically operated.

As a precautionary measure, two No. 10 Cameron pumps were installed in the pumphouse and the necessary steam connections made with our 125 HP heating boiler. A small electrically operated bilge pump was placed in the shaft to take care of the water draining into the skip pit. The flow of water from the shaft is approximately 90 gallons per minute and the flow from the

southeast drift is close to 100 gallons per minute, making a total of 190. We have encountered no water in the northwest drift and it is our opinion that most of the flow will come along the contact between the ore and underlying taconite.

The northwest drift is now nearing completion and we will be engaged in raising and sub-level development work during the months of January and February. We now expect to have sufficient gangs on ore to warrant placing the mine on an operating basis March 1st., or soon thereafter.

Progress in the southeast drift has been somewhat slower, and as we do not anticipate extensive underground mining at this end of the property for some time, it is not necessary to complete this drift prior to going on an operating basis. The most important feature of the southeast drift has been the question of pit drainage and the proposed crosscuts for this purpose have been finished.

ACCIDENTS

Following is a list of the accidents which occurred at the Boeing Mine during the past year and were of a nature serious enough to be reported:

EMIL AHO

Injured----------February 13th, 1920.
Occupation----------Miner.
Nationality----------Finnish.
Time Lost----------17 Days.
Compensation Paid----------$27.50.

Remarks: Aho was removing drills from a bucket and ran a metal sliver into his finger. He did not report to foreman or physician until 2/21/20, after infection had set in on Terminal Phalanx of middle finger of left hand.

JACK TREMBATH

Injured----------March 19th, 1920.
Occupation----------Electrician.
Nationality----------American.
Time Lost----------15½ Days.
Compensation Paid----------$21.25.

Remarks: Trembath was wiring underground. The staging on which he was working gave way, due to defective construction, and in falling, his hand came in contact with a rough edge of sheet iron, which was nailed along timber to hold back water. Trembath suffered a laceration of second and third fingers of his right hand.

HANS LASSI

Injured----------January 8th, 1920.
Occupation----------Miner.
Nationality----------Finnish.
Time Lost----------19 Days.
Compensation Paid----------$37.50.

Remarks: Lassi was picking down a face of drift and struck a hard piece of ground, causing a sprain of right shoulder.

FRED COMISH

Injured----------April 9th, 1920.
Occupation----------Shift Boss.
Nationality----------English.
Time Lost----------6½ Days.
Compensation Paid----------$1.25.

Remarks: Comish was inspecting the sump chamber, when the timber, weakened by dry rot, broke and allowed several large slabs of rock to fall into the room. This timber was showing considerable weight. Comish sustained two cuts on his scalp and a bruise of the right thigh.

JACK RICE

Injured----------June 14th, 1920.
Occupation----------Miner.
Nationality----------American.
Time Lost----------33½ Days.
Compensation Paid----------$68.75.

Remarks: Rice was sitting down drilling bottom holes, when a chunk of rock fell from the back. He sustained two scalp cuts, a severe bruise of left foot and lower part of thigh.

JOHN MAKI

Injured----------June 21st, 1920.
Occupation----------Miner.
Nationality----------Finnish.
Time Lost----------23 Days.
Compensation Paid----------$42.50.

Remarks: Maki was trimming back preparatory to drilling, when a small chunk fell from the back, causing a bruise of lower part of back over sacro-ilice joints, also a slight break of skin on his left side.

CLARENCE HALTER

Injured----------November 10th, 1920.
Occupation----------Miner.
Nationality----------American.
Time Lost----------46 Days to Dec. 31st.
Compensation Paid----------$97.50 to Dec. 31st.

Remarks: Halter has infection of right 4th finger, following a blister caused by shoveling.

ERNEST PARIS

Injured----------November 17th, 1920.
Occupation----------Pumpman.
Nationality----------Canadian French.
Time Lost----------40 Days.
Compensation Paid----------$70.71.

Remarks: Paris was tightening pipe flange on electric pump. He slipped and fell backward on the pipe fitting, sustaining a fracture of his left 11th rib.

CHARLES CALGAR

Injured----------October 28th, 1920.
Occupation----------Surface Laborer.
Nationality----------American.
Time Lost----------39 Days.
Compensation Paid----------$85.00.

Remarks: While engaged in picking frozen ground, Culgar hurt his right wrist. The physician's report shows teno synovitis.

Following is a detailed statement of the Boeing Mine E & A. No. 380, covering accounts thereunder from February, 1919, to December 31st., 1920. Our underground development work has now progressed to such a stage that we can safely figure on going on an operating basis April 1st., 1921. The stripping, of course, is an entirely separate item and will continue some considerable time beyond this date.

SUPERINTENDENT'S DIVISION

GENERAL EXPENSE	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Insurance		132.94	
Engineering		9433.61	
Analysis		1447.77	
Mine Office		20372.36	
Central Office		7986.00	
District Office		5505.71	
Taxes		52664.28	
Mining Captain		4525.00	
Legal		851.20	
Personal Injury		1515.50	
TOTAL	89200.00	104434.37	15234.37
MAINTENANCE			
Tracks & Cars		622.78	
Buildings		27.40	
Shop Machinery		7.57	
Boilers		52.07	
Hoisting Machinery		216.70	
Compressor & Air Pipes		415.76	
Pumps		1464.24	
TOTAL	3200.00	2806.52	393.48
SINKING IN SAND			
Sinking todate 110'		9597.26	
Timbering		6896.22	
Prop. of Acct. #7		5493.99	
TOTAL	17000.00	21987.47	4987.47
SINKING IN ROCK			
Sinking todate 127'		13329.64	
Timbering		6275.73	
Prop. of Acct. #7		10324.23	
TOTAL	29800.00	29929.60	129.60
DRIFTING TO ORE BODY			
Drifting todate 3548'		77069.72	
Timbering		21634.57	
Prop. of Acct. #7		45148.26	
TOTAL	79980.00	143852.55	63872.55
PLATS AND POCKETS		3854.89	
Prop. of Acct. #7		1137.06	
TOTAL	5000.00	4991.95	8.05

PREPARING SITE	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Building Roads		3767.43	
Clearing Land		610.27	
Grading & Ditching		29777.90	
TOTAL	20650.00	34155.60	13505.60
TEMPORARY EQUIPMENT			
Surface Tracks & Cars		1514.85	
Undg. Tracks & Cars		416.16	
Derricks & Buckets		954.59	
Miscellaneous		184.66	
Tools in General Use		969.74	
TOTAL	4550.00	4040.00	460.00
PERMANENT CONSTRUCTION AND EQUIPMENT			
Timber Tracks & Cars		968.84	
Undg. Tracks & Cars		1281.64	
Electric Haulage Tracks		5377.39	
Power Drills		6689.92	
Pump House and Sump		12544.47	
Team and Teaming Equipment		1000.89	
Underground Loader		2843.60	
Ventilating Equipment		2519.00	
Auto Truck		3992.03	
TOTAL	31400.00	37217.78	5817.78
WATER SUPPLY			
Water Supply		2034.50	
Sewers		1885.50	
TOTAL	6000.00	3920.00	2080.00
OFFICE FURNITURE AND FIXTURES	750.00	730.99	19.01
EXPLORING (1)	21000.00	95155.66	74155.66
TOTAL	308480.00	483222.49	174742.49
10% for Contingencies	30848.00		30848.00
TOTAL SUPERINTENDENT'S DIVISION	339328.00	483222.49	143894.49

(1) $75,503.82 Explorations charges transferred to Opening Mine, as per letter of C. D. M. Dated 5/18/20.

CHIEF MECHANICAL ENGINEER'S DIVISION

TEMPORARY EQUIPMENT HOISTING PLANT	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Machinery		1505.55	
Foundations		395.38	
Wire Rope		51.56	
Erecting		1193.85	
Electric Wiring		256.67	
Bell Lines & Signals		99.42	
TOTAL	2400.00	3502.43	1102.43
SHOP EQUIPMENT			
Installing		104.95	104.95

CHIEF MECHANICAL ENGINEER'S DIVISION
CONTINUED.

SINKING PUMPS	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Pumps		975.00	
Steam and Water Lines		1035.44	
Installing		556.56	
TOTAL		2567.00	2567.00
HEATING SYSTEM		571.75	571.75
SURFACE LIGHTING		81.85	81.85
PERMANENT EQUIPMENT			
HOISTING PLANT			
Skip Hoist		4850.00	
Motor and Control		4808.34	
Foundations		702.46	
Skips and Cages		1554.79	
Bell Lines & Signals		445.75	
Sheaves		432.54	
Wire Rope		263.13	
Erecting		4020.42	
TOTAL	15200.00	17077.43	1877.43
COMPRESSOR PLANT			
Comp. & Motor		8752.31	
Foundations		358.05	
Receiver		1064.03	
Piping A		41.06	
Air Line In Shaft		2840.64	
Erecting		941.53	
TOTAL	11650.00	13997.62	2347.62
SHAFT HOUSE			
Foundations		287.26	
Head Frame		14713.32	
Heating & Lighting		336.98	
Pockets		3366.54	
TOTAL	16100.00	18704.10	2604.10
SHOP EQUIPMENT			
Equipment		6611.33	
Installing		1039.45	
TOTAL	10500.00	7650.78	2849.22
TOP TRAM PLANT			
Engines & Motors		1600.00	
Foundations		119.16	
Tram Equipment		4956.64	
Erecting		1764.87	
TOTAL	7850.00	8440.67	590.67
ELECTRIC HAULAGE			
Machinery		3927.00	
Locomotives (Two)		9734.60	
Cars		3726.00	
Wiring		2709.10	
Rotary Dumps - Installed		5014.00	
Erecting		2589.80	
TOTAL	29400.00	27700.50	1699.50

PUMPING PLANT	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Pumps, Motor & Control		10972.07	
Water Columns & Station Piping		3042.27	
Electric Lines in Shaft		360.20	
Erecting		3306.57	
TOTAL	15200.00	17681.11	2481.11
SAFETY APPLIANCES		302.04	302.04
HEATING SYSTEM			
Boiler		893.99	
Pipe Covering		153.18	
Piping & Radiation		2487.30	
Ditching and Erecting		4013.28	
TOTAL	5000.00	7547.75	2547.75
FIRE PROTECTION	1000.00	901.33	98.67
RECORDING GAUGES	100.00		100.00
TESTING MACHINERY	250.00		250.00
OIL STORAGE TANKS	450.00	635.08	185.08
TELEPHONE SYSTEM	500.00	269.76	230.24
SURFACE ELECTRIC LIGHT	1500.00	1704.17	204.17
COOLING TOWER		649.54	649.54
TRANSMISSION LINE		7541.10	7541.10
UNDERGROUND LIGHTING		1493.22	1493.22
TOTAL	117100.00	139124.18	22024.18
10% For Contingencies	11710.00		11710.00
TOTAL CHIEF MECHANICAL ENGINEER'S DIVISION	128810.00	139124.18	10314.18

MASTER CARPENTER'S DIVISION

TEMPORARY BUILDINGS	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Boiler House		248.31	
Engine House		274.29	
Compressor House		433.95	
Shop Buildings		1080.64	
Dry House		362.62	
Office & Warehouse		429.18	
Launder		1.17	
Barn, Garage & Storeroom		1224.36	
TOTAL	4000.00	4054.52	54.52
PERMANENT BUILDINGS			
Power House - Brick		5177.93	
Concrete Floors		422.88	
Wiring		180.60	
TOTAL	5500.00	5781.41	281.41

OFFICE & WAREHOUSE - WOOD	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Building		7223.46	
Radiators & Piping		343.44	
Wiring		68.25	
Water & Sewer		150.78	
TOTAL	7400.00	7785.93	385.93
SHOP BUILDING			
Buildings		6354.50	
Electric Wiring		418.69	
TOTAL	6150.00	6773.19	623.19
TOP TRAM ENGINE HOUSE	1000.00	428.23	571.77
CHANGE HOUSE			
Building		10382.59	
Lockers & Wash Troughs		1055.38	
Piping		604.55	
Wiring		296.45	
TOTAL	10200.00	12338.97	2138.97
OIL STORAGE HOUSE	1000.00	1162.76	162.76
BARN AND GARAGE			
Barn		1671.14	
Garage		2023.64	
Wiring		112.23	
TOTAL	3500.00	3807.01	307.01
DOCKS,TRESTLES & POCKETS			
350' Permanent Trestle		3446.45	
300' Stocking Trestle		8862.83	
Ten tons Rail		571.51	
Stockpile Plank		199.47	
TOTAL	13400.00	13180.26	219.74
COAL DOCK	4000.00	1857.29	2142.71
PULLEY STANDS	800.00	95.62	704.38
TOTAL	56950.00	57265.19	315.19
10% for Contingencies	5695.00		5695.00
TOTAL MASTER CARPENTER'S DIVISION	62645.00	57265.19	5379.81

STRIPPING

	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Total to-Date 1,332,657 Yds		747057.67	
Stripping Clerk		1575.00	
TOTAL	1,815,000.00	748632.67	1,066,367.33
10% for Contingencies	181,500.00		181,500.00
TOTAL STRIPPING	1,996,500.00	748632.67	1,247,867.33

SUMMARY	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Superintendent's Division	339,328.00	483,222.49	143,894.49
Master Carpenter's "	62,645.00	57,265.19	5,379.81
Chief Mech. Engr's "	128,810.00	139,124.18	10,314.18
TOTAL	530,783.00	679,611.86	148,828.86
Stripping	1,996,500.00	748,632.67	1,247,867.33
Tracks, Main Line to Mine	23,000.00		23,000.00
Improvement Work		1,955.18	1,955.18
TOTAL	2,550,283.00	1,430,199.71	1,120,083.29
Amount Paid Arthur Iron Mining Company		1,492.90	1,492.90
Depreciation Supply Inventory		122.17	122.17
Depr. Supt's Automobile		26.87	26.87
GRAND TOTAL	2,550,283.00	1,431,841.65	1,118,441.35
Sale of Equipment		25.00	
Ore Produced in Development		33,311.25	
BALANCE		1,398,505.40	

BOEING MINE DWELLINGS

MASTER CARPENTER'S DIVISION

TWO BOARDING HOUSES	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Grading & Clearing Grounds		1028.23	
Buildings		10610.35	
Two Sheds		526.00	
Wiring		119.90	
Water & Sewer Lines		704.47	
Fencing & walks		113.38	
Furnishings		1407.60	
TOTAL	13600.00	14509.93	909.93
CAPTAIN'S HOUSE			
Buildings		4673.48	
Heating System		459.65	
Wiring & Fixtures		69.85	
Water & Sewer Lines		147.68	
Grading		400.71	
Fencing & Walks		91.57	
TOTAL	5500.00	5842.94	342.94
TENEMENT HOUSES			
Grading & Clearing Grounds		935.16	
Four 6-room Cottages		15977.59	
Heating System		1714.12	
Wiring & Fixtures		242.48	
Water & Sewer Lines		896.82	
Fencing & Walks		698.28	
TOTAL	17800.00	20464.45	2664.45
TOTAL DWELLINGS	36900.00	40817.32	3917.32
10% for Contingencies	3690.00		3690.00
GRAND TOTAL DWELLINGS	40590.00	40817.32	227.32
Depreciation		1292.56	
BALANCE		39524.76	

BOEING MINE.

Since preparing E & A No. 380 during the winter of 1918-1919, the cost of equipment and labor increased decidedly and this resulted in an overrun in almost all of the accounts. There were other reasons entering into the increases in certain captions and will be taken up under the following headings.

"GENERAL EXPENSE"

As the Boeing Mine will not be put on an operating basis for at least two months, the overrun of $15,234.37 on December 31st. will be further increased. Our District Office charge has been greater than we had anticipated and the engineering item has exceeded our expectations quite appreciably. The largest item, however, entering into the overrun is that of Taxes. The valuation at the Boeing Mine was increased by the Tax Commission and the rate of taxes was also made higher. More than 50% of our overrun for "General Expense" will be due to the increase in taxes, by the time the mine is put on an operating basis.

"SINKING IN SAND"

This increase of $4,987.47 was due to the difficulties met with in sinking through the quick sand. It was necessary to discontinue sinking operations for a time in order to jack the sets back to place. When we resumed sinking operations, the work had to be prosecuted very carefully in order not to disturb the blocked shaft. We drove spiling through the sand and underlying clay, in order to keep the material from running into the shaft and pushing it out of plumb.

"DRIFTING TO ORE BODY"

This account has exceeded the estimate by $63,872.55 by January 1st. and there will be a further expenditure of approximately $30,000 before we go on an operating basis.

Our cost per foot for drifting has exceeded the original estimate very materially. This has been due to our inability to secure and hold good rock drillmen and the fact that the seamy ground is very difficult to drill. We would have made better progress if our drifts had been in solid taconite. The soft material in the seams clogs the bits and the back of the drifts break to a hard seam, sometimes from 3' to 5' above the timber. This latter condition

necessitates considerable timbering.

We have used an Armstrong Loader in mucking our main headings. If this machine had given uninterrupted service, our costs would have been materially lower. The loader has not operated a week without some breakdown and in several instances this has been of quite a serious nature, putting the machine out of service for as long as a week. The men were accustomed to the loader and we did not get as good results from hand mucking as we otherwise would have.

"PREPARING SITE"

This account has overrun the original estimate by $13,505.60. This has been due to the fact that we were obliged to construct and maintain approximately one-half mile of road and enlarge upon our grading program, in line with Mr. Manning's recommendations.

"PERMANENT CONSTRUCTION & EQUIPMENT"

An overrun of $5,817.78 in this account was due to the fact that our equipment cost more in practically all cases than we had anticipated. There was also some increase in the cost of providing our pumphouse and sump. The capacity of the sump was increased after we had prepared the E & A.

"EXPLORING"

Our original estimate covered only the actual cost of our explorations, whereas the bonus paid for the property was charged off under this heading. The overrun of $74,155.66 to this account is explained by the bonus charge.

"MASTER CARPENTER'S DIVISION"

There have been small overruns in most of the Master Carpenter's estimates, the largest one, amounting to $2,138.97 for "Change House", being due to the fact that the letting of this contract was held up sometime, and the bids submitted had increased materially and were out of line with those for the other buildings.

Our Coal Dock cost to-date $2,142.71 less than was estimated and there is only a small charge yet to be made here.

Without considering the 10% for contingencies, the Master Carpenter's Division had only exceeded the estimate by $315.19, as of December 31st. 1920.

"CHIEF MECHANICAL ENGINEER'S DIVISION"

With the exception of "Shop Equipment" and "Electric Haulage", all of the Chief Mechanical Engineer's estimates were exceeded. This was due to the material increase in the cost of equipment subsequent to the time the estimate was made. Including the 10% for contingencies, the Chief Mechanical Engineer's estimate had been exceeded by $10,314.18 on December 31st., 1920. There are some further charges to be made and this overrun will be increased by approximately $10,000 additional.

"LOCATION BUILDINGS"

The charges to our Location Buildings had exceeded the estimate by $3,917.32 on December 31st. This is exclusive of the 10% for contingencies.

The overrun is largely due to the amount expended in grading and improving the location grounds, in line with Mr. Manning's suggestions. The cost for tying into the Village water and sewer mains was also larger than we had anticipated.

BOEING MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1920.

GRADE	IRON	PHOS.	SILICA	MANG.	ALUM.
Boeing,	57.02	.074	8.81	1.41	2.30
Boeing Lean Ore,	52.64	.083	13.12	1.54	2.37

(No shipments from the Boeing Mine in 1920).

ORE STATEMENT FOR YEAR - 1920.

	MERCHANTABLE ORE	LEAN ORE	TOTAL
On hand Jan. 1st, 1920,	0	0	0
Output for year,	1,989	6,894	8,883
Total,	1,989	6,894	8,883
Shipments,	0	0	0
Balance on hand,	1,989	6,894	8,883

1920 - 3-8 Hour Shifts Jan. 1st to July 1st

2-8 " " July 1st to Dec. 31st.

BOEING MINE.

WADE AND HELMER MINES

ANNUAL REPORT FOR 1920.

The total production from the Wade and Helmer Mines for the year 1920 amounted to 240,143 tons, of which 197,421 tons came from the Wade and 42,722 tons from the Helmer.

Underground operations at the Wade Mine were conducted throughout the year, the scarcity of miners and the limited number of working places being the controlling factors governing the production. The Wade open pit was worked intermittently from May 1st. to October 22nd. The Great Northern car service was most unsatisfactory and at times no cars were furnished for our open pit ore. Aside from this, the year's requirements of Wade Grade were cut down and this curtailment was made from the open pit tonnage. With adequate car service, we could have produced considerably more open pit ore from the Wade Mine, provided an additional tonnage had been required.

Owing to the scarcity of underground miners and the danger of tramming in and out of the portal, very little underground mining was undertaken at the Helmer from the middle of March to the first of October. With the exception of some very lean material, the Helmer stockpile was loaded out and as much open pit ore was mined as could be graded.

The average analysis of the ore produced during 1920 from the Wade and Helmer Mines was as follows:

	Tons.	Fe.	Phos	Sil.	Mn.
Wade Mine----------	197,421	58.62	.060	7.78	.81
Helmer Mine----------	42,722	56.92	.058	9.99	.95
TOTAL AND AVERAGES----------	240,143	58.31	.060	8.17	.83

The estimate of production from November 15th, 1920, to November 15th, 1921, with the expected analysis, is as follows:

	Tons.	Fe.	Phos	Sil.	Mn.	Fe.Nat.
Wade Mine----------	250,000	58.30	.062	8.50	.85	51.00
Helmer Mine----------	25,000	56.00	.065	11.00	1.00	49.00
TOTAL AND AVERAGES----------	275,000	58.09	.062	8.73	.86	50.82

We figure on producing 120,000 tons from the Wade underground and 130,000 tons from the open pit. The open pit output could be increased, but it

is not advisable to push shipments here on account of grading. The Wade open pit ore averages better than a point above the underground and it is necessary to use it for sweetening the lower grade material from the Helmer, as well as to maintain a higher average at the Wade Mine itself over a longer period of years.

The general labor situation in the Kinney District should be considerably better during 1921. While there has been no reduction in wages at this writing, the efficiency of the men has improved to a considerable extent and we are securing better results. The tons per man shows a decided increase in December, as compared to November.

WADE MINE ORE ESTIMATE OF JANUARY 1ST.,

1 9 2 1.

Following is an estimate of the ore in sight at the Wade Mine on January 1st., 1921, the tonnage reported January 1st., 1920, and the amount mined during the past year.

A factor of 13 cubic feet per ton was used in this estimate and a 10% deduction made to cover mining loss:

	Tons.
Ore in sight Jan. 1st., 1920 (West Deposit)----------	1,590,000
Ore in sight Jan. 1st., 1920 (East Deposit)----------	1,515,000
Ore in sight Jan. 1st., 1920 (Deacon Deposit)----------	175,000
TOTAL- -	3,280,000
Ore mined during 1920 (West Deposit)----------	197,421
BALANCE FROM THESE FIGURES- - - - - - - - - - - - - - - - - - - -	3,082,579
Ore in sight Jan. 1st., 1921 (West Deposit)----------	1,421,000
Ore in sight Jan. 1st., 1921 (East Deposit)----------	1,515,000
Ore in sight Jan. 1st., 1921 (Deacon Deposit)----------	175,000
TOTAL- -	3,111,000

No ore was mined from the East or Deacon deposits during the year and as no new development work of any nature was undertaken here, the estimates remain the same as on January 1st., 1920.

There is an increase of 29,000 tons in the West Deposit. The rock intrusions on the 1400' Sub-Level caused a reduction of 12,000 tons in this area, but there was an increase of 41,000 tons as a result of the development of the high ore chimney at the northwest corner of the underground deposit.

The average grade of the ore in the several deposits as of January 1st., 1921, is as follows:

	Tons.	Fe.	Phos	Mn.	Sil.	Mois.
West Deposit-------	1,421,000	57.96	.074	1.05	6.74	13.25
East Deposit-------	1,515,000	56.91	.075	1.83	7.44	13.50
Deacon Deposit-----	80,000	56.65	.045	1.16	8.04	12.50
" " -----	95,000	55.77	.053	.42	8.43	12.50

Following are the tonnages and grades of ore in the West Deposit above and below the main haulageway:

	Tons.	Fe.	Phos	Mn.	Sil.
Above Main Level-----	1,235,000	57.93	.074	1.33	6.32
Below Main Level-----	186,000	58.11	.073	.74	7.03

The Wade Mine is now quite thoroughly developed and we do not anticipate showing up any appreciable tonnage by future operations.

HELMER MINE ORE ESTIMATE OF JANUARY 1ST., 1921

Following is an estimate of the ore in sight at the Helmer Mine on January 1st., 1921, the tonnage reported a year ago and the amount mined during 1920.

A factor of 13 cubic feet per ton was used in this estimate, with a 10% deduction for mining loss in the case of the underground ore, a deduction of 20% for rock in the open pit ore and a deduction of 25% for rock and mining loss in the case of the ore to be scrammed along the open pit banks:

	Tons.
Open Pit Ore in Sight January 1st., 1920----------	32,000
Scram Ore in Sight January 1st., 1920----------	34,000
Underground Ore in Sight January 1st., 1920----------	100,000
TOTAL ORE IN SIGHT JANUARY 1ST., 1920----------	166,000
Open Pit Ore Mined During 1920----------	17,073
Scram Ore Mined During 1920----------	8,268
Underground Ore Mined During 1920----------	17,381
TOTAL ORE MINED DURING 1920----------	42,722
Open Pit Ore in Sight January 1st., 1921----------	15,000
Scram Ore in Sight January 1st., 1921----------	26,000
Underground Ore in Sight January 1st., 1921----------	82,000
TOTAL ORE IN SIGHT JANUARY 1st., 1921----------	123,000

There has been no change in the estimated tonnage at the Helmer Mine as compared to the previous year, other than deducting the tonnage mined during 1920. On account of the extremely poor grade of the Helmer ore, it is very questionable whether we will be able to mine all of the tonnage shown.

The average analysis of the ore in sight at the Helmer Mine on January 1st., 1921, is as follows:

Tons.	Fe.	Phos	Mn.	Sil.	Mois.
123,000	56.00	.070	1.35	9.50	12.50

There is no possibility of showing up any additional tonnage by further operations, as exploratory and development work on this property have been quite exhaustive.

GENERAL SURFACE

Stripping operations were discontinued the forepart of January and the more important men in this organization were employed in over-hauling the equipment until April. Some of the better class men of our open pit crew were placed underground and the balance were discharged.

The three Lima locomotives, which are used on our stripping work, were given a thorough overhauling and all badly worn parts were replaced. The repair work was done in a most thorough manner, as has been borne out by the excellent service given by the machines during the operating months of 1920. Comparatively few breakdowns of a serious nature occurred and the engines are in pretty fair shape at the end of the year. The Lima locomotive, used in hauling ore from the pit bank to the incline tramway, was put in shape for the season's work during April. This locomotive is not subjected to very severe service and the repair work was quite light. It will be necessary to renew some of the worn parts on this machine before ore operations are resumed next spring.

The Model "60" shovel was given a very thorough overhauling in our shops during the winter. This machine has handled all our stripping work at the Wade and Helmer Mines since the properties were acquired, and as it is often impossible to blast the banks to any extent, the service is particularly hard. We had very few delays from breakages on the machine during 1920 and it will go into our shops this winter in much better than than a year ago.

The necessary repair work was done on the Model "36" machine, which is used in loading out the ore from the open pit and also the Helmer stockpile. The Model "28" Marion was overhauled during the early spring. This machine was used for casting and sorting work in the pit, as well as hoisting in connection with the Helmer stocking operations.

The boiler of the Thew shovel was re-flued and other minor repairs made. This machine finished loading out the Helmer lean ore dump and the small Helmer drainage shaft stockpile. We will probably have no further use for the Thew machine at the Wade and Helmer Mines.

The twenty-eight 7-yard stripping cars were repaired during the winter

months. Twenty-four of these cars are used on the stripping job and four on ore operations in the pit. The handling of the frozen material during the winter and the large amount of boulders results in rather severe service for these wooden cars, but they have stood up remarkably well the past year. The necessary repairs on these cars for 1921 operations will be undertaken in the early spring.

The Helmer incline hoist was changed over from steam to electricity. This work was started in January, but was not completed until April, due to a delay in the delivery of some of the electrical equipment. The estimate on the installation was $6,121, but the total cost amounted to $8,845, or an overrun of $2,724. The 200 HP motor, with secondary control, cost $1,757.30 more than was estimated and the mechanical and electrical changes overran $1,033.93.

We effected a very substantial saving by changing over to electricity. The hoist operated very satisfactorily during the ore season.

A small headframe for the handling of mining supplies was erected over our timber shaft during the latter part of February and the forepart of March. The timber shaft was also lined with hardwood plank. All of the timber used in our Wade Sub-Levels is handled through this shaft.

On account of caves developing along the old Deacon right of way, it was necessary to alter the course of the drainage water. Quite a little ditching was done to the south and west of the Wade shaft during the spring months. The earth dike, impounding the flood waters along the north side of the Helmer property, was repaired and the large volume of water was diverted into the Wade drainage ditch. The caving of the Helmer underground workings necessitated the diversion of this water.

As the Wade underground workings are carried northward, and caves develop, it will be necessary to take care of the surface drainage around the north and west side of the Helmer property. We were unable to handle all of the flow during the spring months and during severe cloud bursts through the Wade drainage ditch and it was decided to provide a drainage ditch leading west from the pond and to the north of the Helmer underground ore body. Henderson & Murphy, Contractors of Mountain Iron, were given this job. Work

was started in July and completed the forepart of September. The total excavation amounted to 2,771 cubic yards. This ditch now enables us to divert all the drainage water from the north without crossing over the Wade or Helmer ore bodies and we can proceed with caving operations with safety. In order to insure this drainage system, it was necessary to clean out and repair an old tunnel, which passed under the approach to the Kinney Dump. Two men were employed on the tunnel work for the better part of three months.

Our mine carpenters erected a garage in April to replace the one destroyed by fire during the winter of 1919. The new structure has four stalls and a concrete floor.

The mine carpenters also erected a warehouse for heavy repair parts during the summer. Material salvaged from several old temporary buildings was used in this structure. It was plastered outside with concrete and has a very neat appearance.

Small buildings were erected for the housing of the machinery operating the top tram and for the protection of the men employed on the head-frame. These structures were plastered with concrete and were equipped with stoves.

Considerable road work was done around the Wade location during the summer months. Material from our rock dump was used for surfacing the roads and Mr. Manning's ideas were followed out as to the location of the driveways around the mine buildings.

Shrubbery, ordered by Mr. Manning, was planted around the office and mine buildings and the grounds immediately surrounding the office, power house and cooling tower were sodded. This improved the appearance of the grounds very materially and an extra effort is being made to keep them clean and attractive.

Some grading was done on the location yards, fences were constructed and wooden sidewalks laid along the front and leading into all of the houses. A good start was made on the seeding of the lawns and this work will be carried to completion next summer.

A strip of land was cleared to the north of the Wade location and plotted for garden purposes. This was part of Mr. Manning's plan of improve-

ment and it is the intention to do some planting here at a later date. The clearing of brush from this tract also lessens the danger from forest fires.

An endless rope tram was installed at the Wade Mine in connection with our stocking operations, during the latter part of September and the forepart of October. We previously used a motor in connection with our stocking and this machine was released for service on our first level. The stocking trestle was erected and the Wade underground output was handled by the new installation subsequent to the close of the shipping season, October 29th.

SWALLOW & HOPKINS LEAN ORE PILES

The Thew shovel was moved into the old Swallow & Hopkins lean ore dump on May 21st. and was operated here off and on until July 30th, when all of the ore was cleaned up to the satisfaction of the Fee Owners. It was inadvisable to load this ore very rapidly, on account of its low grade and our inability to ship sufficient sweetening ore to carry it. We figured that 1,500 tons remained in this pile at the close of last year's work. The estimate, however, was an extremely difficult one on account of not knowing the exact slope of the dirt dump upon which the ore had been placed. We loaded 3,716 tons from this lean ore dump during 1920 and handled 7,814 tons during 1919, making a total of 11,530 tons.

It was necessary to extend the coal dock track to the old Helmer drainage shaft, in order to load out the stockpile accumulated there by Swallow & Hopkins. The track extensions were completed and we started loading the pile with the Thew shovel on August 3rd. We cleaned up all of this ore to the satisfaction of the Fee Owners by October 7th, having loaded out 2,005 tons. Shipments of this very lean material could only be made as we had sufficient sweetening ore in dock to carry it.

The job of loading the ore, trimmed in the Helmer railway yards, was completed during the summer of 1920. Most of this ore was loaded by hand into ore cars during 1919, but the Fee Owners thought that it should be cleaned up more carefully. The several railway cars loaded in 1920 completed the work to the entire satisfaction of the Fee Owners.

STRIPPING

The Model "60" shovel was engaged the first five days of January in completing the last cut around the top bench. Due to the unfavorable working conditions, operations were then suspended and the equipment taken to the shops for repairs.

Some track work was undertaken in March and the bottom of the top bench blasted with vertical holes. We resumed stripping on the 25th of March and continued the job throughout the year. The yardage handled during August and September was comparatively light, as it was largely in the nature of clean-up work. During the months of October, November and December, we operated day shifts only and the results have been quite satisfactory, as compared to previous operations.

The following table shows the yardage secured each month during the past year:

January----------	8,540	Cu. Yds.
February----------	-----	
March----------	4,494	" "
April----------	37,758	" "
May----------	37,392	" "
June----------	34,314	" "
July----------	38,360	" "
August----------	16,567	" "
September----------	20,972	" "
October----------	36,035	" "
November----------	38,294	" "
December----------	40,436	" "
TOTAL----------	313,162	Cu. Yds.

The total stripping removed from the property now amounts to 742,406 cubic yards.

The top bench, averaging 30' in depth, has now been removed to the proximity of the open pit limits. We have found that it is advisable to work with very wide benches, so as to gain the maximum headway from our switch backs. We anticipate completing the top bench by the middle of January, 1921, and we will then lay up the equipment for repairs, and figure on resuming stripping work when the weather moderates sufficiently in the spring. We have not gained much in the past by starting our stripping job before the first of April.

OPEN PIT OPERATIONS

We mined with the "36" steam shovel and hoisted on the Helmer incline 82,109 tons from the Wade pit and including the Helmer stockpile, 36,686 tons from the Helmer pit. Aside from this, we loaded directly into Great Northern ore cars 14,575 tons of Wade ore from the top ore bench. The ore loaded direct was handled by the Model "60" shovel, whereas the product hoisted on the incline was loaded out with the Model "36" machine.

Following are the tonnages and analyses of the Wade and Helmer open pit ore shipped during the 1920 season:

	Tons.	Fe.	Phos	Mn.	Sil.
Wade Mine----------	96,681	59.20	.060	.71	7.36
Helmer Mine---------	20,773	57.80	.053	.66	9.49
TOTAL AND AVERAGES--	117,454	58.95	.059	.70	7.67

In order to secure the desired tonnage and hold the grade above 57% iron, it was necessary to work the shovel pretty well over the bottom of the Helmer pit. We also mined out the Helmer ore standing at the northeast and southeast corners of the pit. This latter ore was the best grade of any mined from the Helmer side.

The "36" shovel was moved back and forth along the high Wade bank at the east end of the pit. The grade of this ore continued to be very satisfactory and we encountered less chunks than during 1919. We were obliged, however, to blockhole to quite an extent and it was necessary to maintain a force of four men on the incline pocket grizzlies.

The Helmer open pit ore has been mined down to the bottom rock over the greater part of the pit, but with the exception of the area adjacent to the Wade drainage tunnel, no rock has been encountered in the bottom Wade cuts. It will not be advisable to extent the Wade cuts to the rock until the ore has been mined back some distance to the east, on account of its irregularity. As far as possible, we desire to maintain good haulage grades to minimize our track work and avoid derailments from sharp curves and bends in the track.

Besides loading out the 14,572 tons of ore directly into Great Northern cars, the Model "60" machine did considerable casting into the pit.

The berm was rather narrow and it was necessary to do this in order to complete the deep surface stripping at the north end of the pit. The ore at the north end of the deposit rises quite abruptly toward the east and succeeding cuts can be taken to better advantage, that is, the top of the ore will not be so irregular and it will not be necessary to cast ore cuts in order to accomplish the clean up work.

We anticipate mining 130,000 tons of open pit Wade ore during 1921 and we will be able to accomplish this without pushing our operations on the heels of the stripping job. The stripping will be handled exclusively along the Oliver berm next season and the clean up cuts on the ore will be kept an appreciable distance ahead of ore operations at the bottom of the pit.

We only show 15,000 tons of ore in the Helmer pit on January 1st., 1921. The grade is rather low and it is doubtful whether we will mine more than 5,000 or 6,000 tons during the coming year. The quantity of ore secured here will depend quite largely on our results from Helmer underground operations. Provided we can secure sufficient miners and we have no difficulty in tramming through our portal, we will be able to secure practically all of our 1921 Helmer tonnage from underground.

STOCKING

Stocking operations were continued during the winter and spring of 1920 with an underground locomotive and an end-dump car. The ground, which had been graded for stocking, had been completely filled by the opening of navigation and we had been enforced to side dumping to some extent.

When shipments were started, we had accumulated 55,047 tons of Wade ore and we loaded out from stockpile during the past season 50,962 tons.

Following is the average analysis of the ore obtained in making and loading the pile:

	Tons.	Fe.	Phos	Mn.	Sil.
In Stock At Opening of Navigation----	55,047	58.14	.064	.92	7.92
Shipped from Stockpile----------	50,962	58.20	.066	.82	7.80

We contemplate doing some additional grading at the east end of our present stocking ground. We will be able to accommodate this winter's stockpile

without extending the grounds, but this matter should be attended to next summer, or fall, in order to provide for the expected increase in our underground production during the winter of 1921 - 1922.

We installed an endless rope tram plant at the Wade Mine during the fall of 1920. The trestle was erected and when shipments were suspended, stocking with the new arrangement was begun. It has worked very satisfactorily and we have been able to cut our costs here.

Following is the tonnage of ore in stock on January 1st., 1921, and the average analysis of same:

Tons	Fe.	Phos	Mn.	Sil.
21,684	58.38	.062	.90	7.60

The output from the Helmer underground workings was trammed through the open pit portal and stocked at the west end of the pit. The hoisting engine on the Model "28" Marion steam shovel was used to haul a one-yard side dump car onto the stocking dump. We do not use any trestle for this operation, the stockpile being raised and built out, as the ore accumulated. It is necessary to employ two trammers to push the cars out from the raises to the mouth of the portal and these men also laid and raised the tracks on the stockpile.

Stocking operations were conducted from the Helmer portal during the months of January, February, March, April, September, October, November and December. We are stocking the underground Helmer product in the same manner this winter.

The following is an average analysis of the Helmer ore in stock on January 1st., 1921:

Tons.	Fe.	Phos	Mn.	Sil.
6,419	56.57	.065	1.50	9.37

The Helmer stockpile is loaded out with the Model "36" revolving shovel, is trammed to the Helmer incline pocket with one of the Lima locomotives and is hoisted and loaded into railroad cars. We do not report the Helmer ore dumped in the pit as on stockpile, to the Tax Commission, due to the fact that it has to be hoisted out of the pit.

UNDERGROUND OPERATIONS

Underground operations at the Helmer Mine were conducted during the months of January, February, March and April. It was then necessary to discontinue work on account of the danger in tramming in and out of the portal. It was also necessary to change the course of the surface drainage before a development of caves to surface along the north shore line. Underground activities were resumed the latter part of September and were gradually increased during October, November and December.

The production by months from the Helmer underground workings was as follows:

	Tons.
January----------	4,100
February----------	3,698
March----------	2,812
April----------	1,570
September----------	756
October----------	955
November----------	1,567
December----------	1,923

The Helmer underground deposit is quite limited in extent and it has only been possible to work a maximum of six gangs. The labor shortage has been quite a serious handicap and we have not been able to average better than five gangs in any one month. We operated day shifts only from the latter part of March until the 21st of April. This was made necessary by the danger of boulders becoming dislodged and rolling down the stripping face in the vicinity of the open pit portal.

Two gangs were employed in cleaning and retimbering the workings during September. Slicing work was inaugurated in October, and three gangs were engaged during that month and four during November, day shifts only. The mine was put on double shift the latter part of December, five contracts being employed.

At the end of the year, we had working places for six contracts and this force will be employed as soon as the old rooms have been blasted down and filled. There is a tendency for the surface material to arch over a so-called caved area and we hesitate to prosecute mining very vigorously on the sub below until we are sure that the settlement has extended through

the surface.

There is considerable lean ore in the vicinity of the shore line and some of our most profitable working places are handicapped in that we are obliged to sort out a considerable quantity of lean ore.

"1453 Foot Sub-Level"

This sub had been developed during the latter part of 1919. The lens was entirely worked out and caved by April, 1920. This room, which is along the north shore line, was 180' long and averaged 35' in width. We were unable to blast it in until the new drainage ditch had been dug, diverting the water to the north thereof.

"1443 Foot Sub-Level"

While this sub had been opened up during the winter and spring of 1920, we were unable to start slicing operations until the room above was blasted in and filled. This sub was opened from No. 2 raise and the product is being trammed into Nos. 2 and 3 raises. The sub is 170' long and averages 70' in width. The ore is mined to the shore line on the north and the sand capping on the south.

Slicing operations were started here in November and at the first of the year two contracts, Nos. 2 and 5, were engaged in slicing and caving operations. The present force will be occupied on this sub during the next several months. The ore is of fair grade only, averaging about 55% iron.

"1433 Foot Sub-Level"

Very little work has been done at this elevation during the past year, it being necessary to maintain the pillars in the vicinity of Nos. 1, 2 and 3 raises until the subs above have been mined out.

Contract No. 1 sliced out a 35' x 45' pillar along the sand capping at the southeast corner of the sub and No. 1 robbed and caved for a few weeks through the old workings to the west of No. 3 raise.

The 1433' Sub is approximately 300' in length and varies from 20' at the westerly limits to 150' along the open pit face. Approximately one-half of the ore has been extracted, but the remaining pillars will not be attacked

for the next several months. This ore averages somewhat better than that on the 1443' Sub.

"1420 Foot Sub-Level"

From one to two contracts were employed at this elevation during January, February, March and December. The lens of ore lying between the open pit face and the sand capping was mined back to a line 30' south of Nos. 1 and two raises, and the ore at the west end of the sub was drawn back as the work above would allow.

At the end of the year, two contracts were employed at this elevation, gouging and slicing back along the sand capping to the south of Nos. 1 and 2 raises. There is a block of ore to the north and east of Nos. 1, 2 and 3 raises, 180' long and averaging 85' in width, which has not been developed. When the deposit on the 1433' and 1443' Subs has been exhausted, this block of ore will be attacked.

The 1420' Sub ore body averages close to 57% in iron content. Less than one-half of the ore has been extracted todate. The deposit is 370' in length and varies in width from 15' at the west end to 240' adjacent to the open pit face.

"1410 Foot Sub-Level"

With the exception of a 40' x 45' pillar to the west of No.3 raise, which is now being mined, and a 40' tramming drift from No. 3 raise to the old south workings, there have been no mining activities at this elevation during the past year. No work will be done along the north shore line or in the heart of the deposit for some little time, but the lens of ore extending along the open pit limits to the southeast will be attacked as soon as the settlement of the ground, which has been quite noticeable during the past two months, subsides. We now figure on working at least one gang at this elevation during the coming year.

WADE UNDERGROUND OPERATIONS

Underground operations at the Wade Mine during the past year have been somewhat handicapped by several factors. First, the epidemic of influenza was especially severe in the Kinney District and we were very shorthanded during the

months of January and February, as a result. During the summer months the labor shortage in the Kinney District was quite acute and we were unable to keep our contracts filled. The third item was the development of a high pocket of ore, which forced us to discontinue mining operations over a considerable area. It was necessary to mine the high ore before we could proceed with operations on the 1400' Sub. Based on our drill records, we figured on mining the ore in this area from the 1400' Sub. The ore, however, extended over 50' above the 1400' Sub in the vicinity of the open pit limits and operations here during 1920 were confined to the 1420', 1440' and 1450' Subs. The top two subs were very limited in extent and we could only employ from two to three gangs. As we drop down, the subs increase materially in size.

The labor situation at the end of the year had improved considerably and underground operating conditions are much better than at any time since we opened the mine. We now have a good mat and our caves have extended through to surface. While there is considerable weight over certain areas, we are not encountering any bad sand runs and the timbering expense should show a marked reduction.

The production by months from underground operations during 1920 was as follows:

	Tons.
January----------	9,015
February----------	8,564
March----------	8,993
April----------	7,887
May----------	7,256
June----------	8,087
July----------	8,357
August----------	8,021
September----------	8,839
October----------	8,735
November----------	7,196
December----------	9,790

While we had working places for from 13 to 15 gangs during the year, we averaged only 11 contracts. The maximum monthly production was realized during December and we are in hopes of maintaining this as an average during 1921.

"1450 Foot Sub-Level"

Development work from No. 903 raise demonstrated a chimney of ore in the vicinity of the open pit limits along the north shore line.

From two to three gangs were employed at an elevation of 1450' for several months and mined out a deposit 170' in length and varying from 20' to 88' in width. The back of the workings varied from 9' along the north shore line to 5' under the sand capping. The ore was of fair grade only, averaging under 57%. The back was a free running sand and in spite of all that could be done, several bad runs occurred. There is no water with the sand and for this reason the runs did not spread over very large areas.

The 1450' Sub was developed from three raises put up from the 1420' Sub. The product from the 1450' Sub was trammed from these raises on the 1420' Level to No. 903, main level raise.

"1440' Sub-Level"

As operations were concluded on the 1450' Sub, the gangs dropped down in their raises and started work on the 1440' Sub.

With the exception of several small pillars at the east end of the Sub, the ore at this elevation had been drawn off by the end of the year. Two contracts, Nos. 3 and 17, were engaged in attacking the pillars January 1st., 1921, and should slice them out and move down to the 1420' Sub within the next two months. No. 4, the third gang that has been engaged here, moved down to the 1420' Sub in December.

The ore on the 1440' Sub was somewhat better than that encountered at the 1450' elevation, but it is still under the average for the mine. Less trouble was encountered with sand runs on this sub, but it was necessary to exercize considerable care at all times to avoid them. We feel that the mat should be sufficient by the time we reach the 1420' sub to minimize this trouble.

The product from the 1440' Sub was dumped into the transfer raises and trammed to No. 903 raise on the 1420' Sub.

The 1440' Sub was 205' in length and averaged 70' in width.

"1420 Foot Sub-Level"

Development work from No. 903 raise was carried to the open pit limits and the north shore line. Raises put up along the shore line to determine the height of the ore demonstrated that it extended 50'. Other than the

development drifting, no mining was undertaken here until No. 4 was moved down from the 1440' Sub in December. This gang has started to slice back the deposit along the open pit limits. A second crew has now been added and step slicing is in progress. A third contract will be added within another month and we should have from three to four gangs working in the 903 raise territory during the first half of 1921.

The ore here is of better grade than that mined above. The north shore line rock dips to the south and the northerly limits of the 1420' Sub workings are restricted as a result thereof. The sand capping does not extend to this elevation and the workings to the south will, therefore, be extended further out than is the case on the subs above. The ore to the south is cut out at this elevation by a horse of taconite.

Six contracts, Nos. 3, 6, 8, 9, 14 and 17, were engaged in slicing and caving operations in the vicinity of Nos. 801, 802 and 10 raises at the beginning of the year. As the pillars were exhausted the gangs dropped down in their raises and started development work on the 1410' Sub. All of the pillars here were removed by the middle of the year. The ore was of a very satisfactory grade and practically no rock was encountered. In spite of the fact that the back was carried up to a height of 18', we had no bad sand runs, nor did we lose any ore on account of crushing.

"1410 Foot Sub-Level"

This sub-level was opened from Nos. 900, 901, 902, 10, 801, 802, 601, and 602 raises. At the beginning of the year, contracts Nos. 2, 4, 5, 7, 10 and 11 were engaged in development work. Slicing operations were inaugurated during January and the bulk of our 1920 underground ore was secured here. As many as eight contracts were engaged in slicing and caving during the summer months.

At the end of the year, but one gang, No. 6, remains at this elevation. No. 6 is taking the final pillars around No. 901 raise and should complete the work within another month. The back here is a taconite capping and it will be necessary to drill it in order to cave a room 40' wide and 70' long.

The ore mined on the 1410' Sub averaged better than 58% and was practically free from seams of taconite.

"1400 Foot Sub-Level"

On account of the development of the ore above the 1420' Sub in the vicinity of No. 903 raise, operations at the elevation of the 1400' Sub had to be discontinued in the neighborhood of Nos. 902 and 903 raises.

As the pillars were exhausted on the 1410' Sub, the gangs dropped down in their raises and started development work at this elevation. With the exception of the deposit in the vicinity of No. 901 raise, this Sub has now been entirely developed. As soon as No. 6 room has been blasted in, the work near No. 901 raise will be pushed at this elevation.

Slicing was started along the track pillar and the Oliver Iron Mining Company's boundary several months ago. At the end of the year we have nine contracts, Nos. 1, 2, 7, 8, 9, 10, 11, 12 and 15, slicing and caving. The deposit has been drawn back 75' from the track pillar, with the exception of two small pillars, 100' from the Oliver boundary. The force will be reduced from time to time and operations to the north on this and the 1420' Sub increased. We are endeavoring to bring our workings to a common elevation and this should be effected during 1921.

A horse of taconite was found to run in an east west direction through the center of the deposit at this elevation. This rock was not encountered on the sub above, nor on the main level, 50' below. The rock varies from 25' to 40' in width.

We also encountered a 3' seam of taconite in the bottom of the workings in the vicinity of the Oliver boundary. We know, however, from our drill records that the maximum thickness of this seam is not over 5', and we figure on carrying the back of our 1390' sub to the rock.

"1390 Foot Sub-Level"

No work was done on the 1390' Sub to the north and west of the track pillar during the past year. It was necessary to discontinue operations in this area pending the mining out of the higher ore to the south and west. It is our intention to bring our mining down to a common level and for this reason we will not resume work here until the 1400' Sub is about exhausted. This will probably be about the middle of 1921.

Contracts 15 and 16 spent the first two months of the year in slicing out the small pillars to the south of the track pillar at this elevation. This ore was trammed into Nos. 202 and 203 raises.

"1378 Foot Sub-Level"

Contracts Nos. 15 and 16 dropped down in their raises to this elevation after exhausting the pillars on the sub above. The gangs developed the ore between the track pillar to the south foot wall, but exploratory drifts to the eastward were stopped on account of the very wet condition. It was hoped that the workings would drain and we could resume operations within a few months. We have not done any work here for the past six months and there is still a very considerable flow of water.

We were very shorthanded during the summer and as it was almost impossible to keep men in these workings, we decided to postpone the further development of this area. Men are now more plentiful and we intend to start one gang on development work shortly.

"Main Level"

Development work on the subs demonstrated the advisability of putting up additional raises from the main level. We drove No. 8 crosscut ahead 20' and put up No. 802 raise to the 1410' Sub. Raises 801 and 901 were 150' apart, and as No. 10 raise was some distance to the west and very close to the open pit limits, it was necessary to provide additional outlets for the handling of product from the 1410' and 1400' Subs. We pushed through raises Nos. 9, 800 and 900. Our ore body is approximately 500' wide along the open pit limits and we now have ten raises from which to conduct development work and step slicing.

SHIPMENTS

Following are the cargoes of Wade Grade shipped during the past year and the analysis of same as obtained at the Mine and by the Lower Lake Chemists. This grade is made up of 42,407 tons of Helmer and 200,841 tons of Wade ore:

	Fe.	Phos	Sil.	Mn.	Mois.	Fe.Nat.	Tons.
CADILLAC							3,133
Mine	57.84	.063	8.42	.95	-----	------	
Oscar Textor	57.75	---	----	--	12.34	50.624	
CLETUS SCHNEIDER							1,903
Mine	57.89	.059	8.72	.85	-----	------	
Emmerton	58.40	---	----	--	10.95	52.005	
ANGELINE							2,974
Mine	58.36	.059	8.35	.81	-----	------	
Crowell & Murray	58.50	---	----	--	11.53	51.755	
WM. G. MATHER							10,717
Mine	57.90	.060	8.30	.94	-----	------	
Emmerton	58.23	---	----	--	12.34	51.044	
THOS. WILSON							7,160
Mine	57.74	.060	8.43	.88	-----	------	
Crowell & Murray	58.05	---	----	--	12.05	51.054	
WM. P. SNYDER							10,272
Mine	58.37	.061	8.15	.79	-----	------	
Cremer & Case	58.30	---	----	--	12.73	50.880	
GRAND ISLAND							5,683
Mine	57.73	.065	8.49	.90	-----	------	
Cremer & Case	57.70	---	----	--	13.18	50.100	
J. H. SHEADLE							3,589
Mine	57.41	.065	9.01	.89	-----	-------	
Crowell & Murray	58.05	---	----	--	14.32	49.737	
MUNISING							2,844
Mine	57.70	.064	8.56	.98	-----	------	
Oscar Textor	58.45	---	----	--	13.64	50.480	
PIONEER							9,843
Mine	57.69	.061	8.53	1.08	-----	------	
Crowell & Murray	57.95	---	----	----	13.31	50.240	

	Fe.	Phos	Sil.	Mn.	Mois.	Fe.Nat.	Tons.
GRAND ISLAND-							5,707
Mine	58.44	.061	8.06	.79	-----	-----	
Crowell & Murray	58.30	---	----	--	12.84	50.81	
WILPEN-							5,671
Mine	58.23	.065	8.08	.90	-----	-----	
Oscar Textor	58.00	---	----	--	11.66	51.24	
J. H. SHEADLE-							10,867
Mine	58.44	.064	7.96	.90	-----	-----	
Cremer & Case	58.20	---	----	--	12.42	50.97	
GRAND ISLAND-							6,483
Mine	58.60	.065	7.73	.91	-----	-----	
Oscar Textor	58.25	----	----	--	12.80	50.79	
ISHPEMING-							11,106
Mine	58.95	.066	7.16	.79	-----	-----	
Oscar Textor	58.70	---	----	--	12.66	51.27	
GRAND ISLAND-							5,182
Mine	58.10	.068	8.25	.91	-----	-----	
Cremer & Case	58.10	---	----	--	12.71	50.72	
MICHIGAN-							6,873
Mine	58.16	.065	8.47	.87	-----	-----	
Cremer & Case	57.80	---	----	--	12.54	50.55	
PETER WHITE-							9,850
Mine	58.11	.064	8.33	.85	-----	-----	
Crowell & Murray	57.75	---	----	--	12.44	50.57	
MICHIGAN-							10,706
Mine	58.38	.056	8.07	.93	-----	-----	
Emmerton	58.35	---	----	--	12.25	51.20	
WM. P. SNYDER-							13,509
Mine	58.52	.060	7.88	.78	-----	------	
Oscar Textor	58.30	---	----	--	11.82	51.409	
ISHPEMING-							3,170
Mine	58.40	.063	7.34	.82	-----	------	
Crowell & Murray	57.65	---	----	--	11.87	50.807	
J. H. SHEADLE-							1,875
Mine	58.84	.068	6.89	.98	-----	------	
Cremer & Case	58.40	---	----	--	11.92	51.439	
SCHOONMAKER-							14,152
Mine	58.58	.068	7.28	.86	-----	------	
Cremer & Case	57.90	---	----	--	11.47	51.259	

	Fe.	Phos	Sil.	Mn.	Mois.	Fe.Nat.	Tons
W. G. MATHER							11,314
Mine	58.60	.060	7.95	.94	-----	-----	
Oscar Textor	59.20	---	----	--	12.43	51.84	
J. H. SHEADLE							7,732
Mine	58.47	.061	7.28	.86	-----	------	
Oscar Textor	58.00	---	----	--	12.04	51.017	
W. G. MATHER							7,064
Mine	57.68	.059	8.64	.90	-----	------	
Oscar Textor	58.70	---	----	--	12.15	51.568	
NEGAUNEE							1,775
Mine	57.00	.065	9.11	.72	-----	------	
Oscar Textor	56.30	---	----	--	10.32	50.490	
SHENANGO							4,127
Mine	58.24	.064	7.88	.80	-----	------	
Crowell & Murray	57.83	---	----	--	11.80	51.006	
WM. G. MATHER							10,859
Mine	58.10	.063	8.21	.83	-----	------	
Crmer & Case	58.70	---	----	--	11.64	51.867	
WILPEN							5,499
Mine	58.53	.059	8.05	.98	-----	------	
Cremer & Case	59.10	---	----	--	11.25	52.451	
PONTIAC							10,287
Mine	58.42	.052	9.06	.71	-----	------	
Crowell & Murray	59.10	---	----	--	12.21	51.884	
WM. G. MATHER							10,698
Mine	57.84	.050	9.58	.64	-----	------	
Crowell & Murray	58.70	---	----	--	13.87	50.558	
WM. A. ROGERS							2,973
Mine	57.26	.054	9.23	.81	-----	------	
Oscar Textor	57.92	---	----	--	11.99	50.975	
PONTIAC							2,652
Mine	57.11	.051	10.43	.59	-----	------	
Oscar Textor	59.30	---	-----	--	13.08	51.544	
MICHIGAN							3,989
Mine	57.68	.054	8.74	.78	-----	------	
Cremer & Case	58.70	---	----	--	13.54	50.752	
WM. F. FITCH							1,009
Mine	60.28	.050	6.56	.66	-----	------	
Oscar Textor	59.70	---	----	--	14.50	51.044	

WADE AND HELMER MINES.

Following is the average analysis of the Wade Grade shipped during the 1920 season, as obtained from Mine and Lower Lake Chemists' sampling:

	Tons.	Fe.	Phos	Mn.	Sil.	Mois.	Fe.Nat.
Mine--------	243,248	58.21	.062	.86	8.19	-----	-----
Lower Lake--	240,816	58.31	---	--	----	12.38	51.09

Following is a complete analysis of the ore shipped from the Wade and Helmer Mines in 1920:

		Fe.	Phos	Mn.	Sil.	Al.	Lime	Magnesia	Sul-phur	Loss By Ignition.
Wade-----	200,841	58.56	.059	.78	7.49	2.39	.15	.15	.016	4.35
Helmer---	42,407	56.68	.056	.88	10.38	2.47	.12	.13	.014	4.08
TOTAL----	243,248	58.23	.058	.80	7.99	2.40	.14	.15	.016	4.30

Following is a division of the tonnage forwarded from the Wade and Helmer Mines during 1920, as between the several operations:

Wade Open Pit Direct Shipping--------------	14,572	Tons.
Wade Open Pit Handled on Incline Tramway---	82,109	"
Wade Underground---------------------------	104,160	"
Helmer Open Pit Handled on Incline Tramway-	20,773	"
Helmer Underground-------------------------	15,913	"
Lean Ore Dump Shipments--------------------	3,716	"
Drainage Shaft Shipments-------------------	2,005	"
TOTAL- - - - - - - - - - - - - - - - - - --	243,248	"

Shipments for the 1920 ore season were started April 14th and were discontinued for the year on October 29th.

ACCIDENTS

Following is a list of the accidents which occurred at the Wade and Helmer Mines during the past year and were of a nature serious enough to be reported:

GEORGE ANGEVINE

Injured----------January 13th, 1920.
Occupation----------Blacksmith Helper.
Nationality----------Canadian.
Time Lost----------29 Days.
Compensation Paid----------$55.00.

Remarks: Angevine sustained a rupture from lifting a jack arm.

STEVE LILEK

Injured----------January 29th, 1920.
Occupation----------Miner.
Nationality----------Slovanian.
Time Lost----------9½ Days.
Compensation Paid----------$6.25.

Remarks: Lilek and his partner were putting in a set of timber. In picking up a heavy cap, Lilek twisted his left knee.

MARTIN MALEVICH

Injured----------January 31st, 1920.
Occupation----------Miner.
Nationality----------Austrian-Slovich.
Time Lost----------81½ Days.
Compensation Paid----------$186.25.

Remarks: Malevich and his partner were completing a slice on the 1433' Sub at No. 3 raise. A chunk rolled down from between the covering boards of the adjacent slice. Malevich sustained a broken left ankle.

JOE EVANS

Injured----------February 3rd, 1920.
Occupation----------Miner.
Nationality----------English.
Time Lost----------12 Days.
Compensation Paid----------$13.75.

Remarks: Evans and his partner were removing the final pillar at the top of raise No. 203, and in picking out for a forepole, a covering board on the sub above broke, causing a run of gravel and small boulders. They started down the ladder way and Evans was struck by some of the falling material. He lost his footing and fell about 20' to the bottom of the ladder. The place was well timbered and not under great weight. They would have been safe if they had remained in their room.

ANDREW BURICH

Injured----------February 11th, 1920.
Occupation----------Top Lander.
Nationality----------Montinegrin.
Time Lost----------16 Days.
Compensation Paid----------$22.50.

Remarks: A chunk of ore fell out of the chute, missed the car and struck Burich on the right foot. The result was a considerable contusion.

SAM YOKICH

Injured----------February 24th, 1920.
Occupation----------Miner.
Nationality----------Serbian.
Time Lost----------15 Days.
Compensation Paid----------$20.00.

Remarks: Yokich was making room for a forepole, when a sand run started. He was caught by some of the falling material, sustaining a bruised right knee, left hip and chest.

JOHN HONGISTA

Injured----------February 25th, 1920.
Occupation----------Motorman.
Nationality----------Finnish.
Time Lost----------Not yet returned to work.
Compensation Paid----------$647.50 to Dec. 31st.

Remarks: Hongista was returning to the shaft with a motor and empty car. The motor jumped the track on a curve and the motor, empty car, and Hongista fell from the trestle, 18' to a rock pile below. Physician's report shows compound fracture of humerus just above and into the elbow joint, sprain of left hip, laceration of left side of scalp, and laceration of right hand.

CHARLES RANDA

Injured----------March 2nd, 1920.
Occupation----------Miner.
Nationality----------Finnish.
Time Lost----------135 Days.
Compensation Paid----------$320.00.

Remarks: A gang of miners were putting in a set of timber. In picking to make room for the cap, a piece of ground fell on the stage where Randa was standing. The staging gave way and Randa fell to the floor of the drift, sustaining a fracture of lower end of right fibula.

MIKE GLAVICH

Injured----------March 4th, 1920.
Occupation----------Blacksmith.
Nationality----------Slovanian.
Time Lost----------17 Days.
Compensation Paid----------$25.00.

Remarks: Glavich was pressing the horn coupling off from the line shaft for a locomotive with the hydraulic press, using 100 tons pressure. The coupling would not start, so he struck it with a sledge hammer. The small cross beam flew up and struck him, inflicting a deep laceration on his left cheek.

EDWARD NEIMI

Injured----------March 22nd, 1920.
Occupation----------Miner.
Nationality----------Finnish.
Time Lost----------13 Days.
Compensation Paid----------$15.00.

Remarks: Neimi was tramming on the 1420 Sub-Level. In taking out a car to the main chute, it ran over the block at the end of the rails, and the car dropped into the chute. Neimi fell into the chute on top of the car and sprained his back.

PETE SCHEMICH

Injured----------May 14th, 1920.
Occupation----------Pocketman.
Nationality----------Serbian.
Time Lost----------Still drawing compensation.
Compensation Paid----------$478.75 to Dec. 31st.

Remarks: A Water Leyner machine was being used for raising to the first level. The water line leading to this machine was knocked off the hanger. In trying to replace it, Schemich loosened the disc stopper at the pocket and it fell onto his arm. He sustained a broken radius of his right arm.

CHAS MAKI

Injured----------June 19th, 1920.
Occupation----------Skip Tender.
Nationality----------Finnish.
Time Lost----------22 Days.
Compensation Paid----------$37.50.

Remarks: In putting in a stopper, a chunk of ore fell from the disc, squeezing Maki's little finger between disc and stopper.

BUDDI KLASNICH

Injured----------June 23rd, 1920.
Occupation----------Miner.
Nationality----------Serbian.
Time Lost----------18 Days.
Compensation Paid----------$27.50.

Remarks: Klasnich was helping miners to lift a piece of timber, when it fell, catching his hand, causing a bruise and laceration of right third finger.

CHAS. SANHILL

Injured----------July 8th, 1920.
Occupation----------Miner.
Nationality----------Finnish.
Time Lost----------22 Days.
Compensation Paid----------$37.50.

Remarks: In climbing down the ladders in No. 602 raise, Sanhill slipped and fell about 10', sustaining sprain of back.

JOHN PARALLA

Injured----------August 10th, 1920.
Occupation----------Pocketman.
Nationality----------Finnish.
Time Lost----------5 Days.
Compensation Paid----------None.

Remarks: Paralla was rolling a rock off the grizzly. The man working next to him was breaking rock with a hammer and a splinter of rock struck Paralla on index finger of the left hand.

LOUIS DEVICH

Injured----------August 13th, 1920.
Occupation----------Miner.
Nationality----------Croation.
Time Lost----------15½ Days.
Compensation Paid----------$23.75

Remarks: Devich was shoveling dirt into a car, when a small piece of ore fell off the side, hitting him on the back.

GEORGE ANGEVINE

Injured----------July 20th, 1920.
Occupation----------Carpenter Boss.
Nationality----------Canadian.
Time Lost----------44 Days.
Compensation Paid----------$92.50.

Remarks: Angevine was stepping off of back porch of warehouse when heel of his left foot caught on edge of porch, causing him to fall forward, resulting in a sprain of his right knee.

JOHN SETALA

Injured----------October 10th, 1920.
Occupation----------Skiptender.
Nationality----------Finnish.
Time Lost----------18 Days.
Compensation Paid----------$27.50.

Remarks: Setala was working near the stopper in the skip pit. A chunk of ore fell from the pocket, striking the stopper and causing the handle to fly up and hit Setala's hand. He sustained a sprain of the right wrist.

AUGUST LUECK

Injured----------October 18th, 1920.
Occupation----------Miner.
Nationality----------German.
Time Lost----------Still drawing compensation.
Compensation Paid----------$140.00 to Dec. 31st.

Remarks: Lueck and his partner were mucking, and working under fore-poling that was well blocked. Their place crushed without warning, evidently due to collapse of an open cave some distance above. The place was well timbered and had been inspected by several officials of the company on day of accident. Lueck sustained bruises and contusions about arms, back and legs.

STEVE TIMINIVICH

Injured----October 18th, 1920.
Occupation----Miner.
Nationality----Austrian.
Time Lost----Fatal.

Remarks: At 3:20 P. M., on October 18th, an accident occurred, which resulted in the death of Steve Timinivich. Timinivich was an Austrian, single, age 39 years, and with no dependents.
The accident occurred in No. 6 contract on the 1423' Sub-Level. This contract was mining a small pillar lying on the shore line. They had placed two sets of timber at 3' centers in the slice and had blasted in the breast at about 9:30 that morning, bringing down the inside set and cap on the next set back. A new cap was placed on this latter set and forepoles were driven ahead to protect the men while mucking. August Lueck, Timinivich's partner, stated that on returning to their place after the noon hour, they started mucking the ground broken by the morning's blast, and during this time there were no signs of movement whatsoever. At about 3:20 P. M., without warning, their place caved in, catching both miners under the timber and dirt. Timinivich was killed, and August Lueck was extricated after 9 hours, and suffered only minor injuries.
It is believed that the back over the sub above No. 6's room had arched. When this arched back gave way, sufficient weight was thrown onto the room to break down the timber. All ordinary precautions used in mining were practiced in the working of this contract and the place was exceptionally well timbered.

JOHN ERICKSON

Injured----October 31st, 1920.
Occupation----Fireman.
Nationality----Finnish.
Time Lost----5 Days.
Compensation Paid----None.

Remarks: Erickson was engaged in washing out No. 3 locomotive, using a steam hose from No. 1 locomotive. When the steam was turned on, the hose appeared plugged and Erickson looked into nozzle, just as steam was emitted. He sustained minor burns, the eyes not being injured, fortunately.

JOHN HAUTALA

Injured----December 9th, 1920.
Occupation----Miner.
Nationality----Finnish.
Time Lost----Still drawing compensation.
Compensation Paid----$27.50 to Dec. 31st.

Remarks: An empty carbide retainer was used for storing fuse and also a cardboard box of carbide. Gas generated in the can was ignited from Hautala's lamp when the top was removed. Hautala sustained burn of face, with several punctured wounds, two lacerations on forehead, lacerated hand and some foreign particles lodged in his eyes. So far as can be ascertained, his eyes are not seriously injured.

MATT JOHNSON

Injured----------November 16th, 1920.
Occupation----------Miner.
Nationality----------Finnish.
Time Lost----------26 Days.
Compensation Paid----------$47.50.

Remarks: Johnson was engaged in widening out the manway from the ladder road around the shaft at the first level, when a piece of ore fell from the back, striking him a glancing blow on the neck and dropping onto his ankle. He sustained a bruise and strain of muscles of the neck, and a sprain to his right ankle.

ANALYSIS OF COST SHEET

The Cost Sheet for 1919 covered only Wade underground operations, whereas that for 1920 included the Helmer underground work. For this reason a comparison of the cost sheet is not as comprehensive as it otherwise would be.

Underground operations were conducted throughout the year at the Wade Mine, but they were very interrupted at the Helmer, no underground work being attempted from April until the latter part of September. The Helmer tonnage and the necessary cleaning and repair work was relatively high.

The production and the charges under the several main captions for the years 1919 and 1920 were as follows:

	1920.	1919.
Tonnage----------	123,843	76,934
General Expense--	$ .220	$ .197
Maintenance------	.272	.302
Mining Expense---	2.340	2.370
TOTAL----------	$ 2.832	$ 2.869

"GENERAL EXPENSE"

There was an increase of $.023 per ton under this caption for 1920, as compared to 1919. The headings "Engineering" and "Analysis" were practically the same for the two years, there being an increase of $.004 in "Insurance", $.004 for "Personal Injury" and $.055 in "District Office" and a decrease of $.004 in "Mine Office".

Our equipment was all installed and the insurance thereon was correspondingly higher in 1920. The increase of $.004 in "Personal Injury" was the result of a larger number of accidents, as compared to the output secured. The decrease in "Mine Office" was the direct result of our handling the shipping in the District Office during 1920. The District Office was established in Hibbing during the winter of 1919-1920 and this expense was distributed to the mines on a payroll basis. The increase in "General Expense" was almost entirely the result of this charge.

"MAINTENANCE"

There was a decrease of $.03 per ton in this account for 1920, as compared to the previous year. There were slight increases to the accounts "Tracks & Yards", "Buildings" and "Underground Tracks & Cars", but this was more than offset by decreases in "Hoisting Machinery", "Compressor & Power Drills", "Pumping Machinery", "Electric Tram Plant" and "Telephone & Safety Devices". The tonnage for 1920 was in excess of that for the previous year and our repair charges were rather light on the whole, the only accounts receiving heavy charges during 1920 being "Tracks & Yards" and "Electric Tram Plant". The expenditures under "Electric Tram Plant", "Telephone & Safety Devices" and "Tracks & Yards" were quite heavy in 1919.

There should be a material decrease in the cost per ton for"General Expense" and "Maintenance" during the year 1921, as compared to 1920.

"MINING EXPENSE"

The results secured in 1920 showed some improvement over those for 1919. While the cost per ton only showed a decrease of $.03, it would have been considerably greater if the cost of labor and supplies had not increased materially. The decrease of $.035 per ton in "Hoisting" for 1920 is explained by the larger tonnage handled and the fact that our electrical equipment was in service throughout 1920. The confining of our hoisting to day shifts only during the latter part of the year was also an item. We used steam for hoisting the early part of 1919.

While we paid a higher rate for current in 1920, our electrical equipment was in service throughout the year. This explains the decrease of $.031 per ton for the 1920 cost for pumping.

No shaft repairs or rock drifting was undertaken during 1919 and in consequence the charge of $.004 per ton to "Sinking & Shaft Repairs" and $.055 for "Rock Drifting", under 1920 accounts, shows an increase of this amount.

There was a decrease of $.144 to "Breaking Ore" in 1920 as compared to 1919. A large part of our underground activities were in the nature of development work during 1919, explaining the decrease secured in 1920. The

costs for breaking ore at the Wade Mine are still high, but we are in hopes of reducing them substantially in 1921. We contemplate putting all the gangs on a contract basis and raising the standard of the work generally.

"Tramming" shows an increase of $.023 for 1920. This is largely due to the fact that we have been obliged to transfer our product from several gangs throughout the year and it has been necessary to employ extra trammers for this purpose.

An increase of $.140 in the charge to "Timbering" for 1920 is explained by the fact that in developing our caves, considerable weight was thrown onto the 1410' and 1400' Sub-Levels. This necessitated the retimbering of practically all the tramways and considerable Sunday repair work. The high ore developed at the northwest corner of the underground ore body has required special timbering. This ore is under a free running sand and we have been obliged to provide a substantial covering.

The installation of our endless rope top tram system during the fall of 1920 and the conducting of hoisting and stocking operations on one shift since March 8th of that year, are responsible for a decrease of $.041 per ton in "Top Landing & Tramming", as compared to 1919. The larger tonnage handled in 1920 was also a factor governing this decrease. The average charge to this account should be less during 1921.

We stocked our ore with a motor and end dump car in 1919, whereas a trestle was erected in connection with our endless rope tram plant during the fall of 1920. There was an increase of $.016 per ton in the 1920 charges as a result of this.

WADE MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1920.

GRADE	IRON	PHOS.	SILICA	MANG.
Wade,	58.05	.061	8.22	.92
Wade Pit,	59.42	.060	7.03	.72

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1920.

GRADE	Mine IRON	PHOS.	SILICA	MANG.	Lake Erie IRON	MOIST.
Wade,	58.19	.059	8.19	.70	58.00	12.51
Helmer,	58.03	.062	7.68	.89	58.05	11.03

ORE STATEMENT AND SHIPMENTS FOR YEAR 1920.

	WADE	TOTAL LAST YEAR
On hand Jan. 1st, 1920,	25,104	3,537
Output for year,	197,421	233,455
Total,	222,525	236,992
Shipments,	200,841	211,888
Balance on hand,	21,684	25,104
Decrease in output-15%	36,034	
Decrease in shipments-5%	11,047	
Decrease in ore on hand-13%	3,420	

1920 - Wade Mine underground - 2-8 Hour Shifts for year
" Pit- 2-10 Hour Shifts May 1st to Nov. 23rd
1919 - 3-8 Hour Shifts Jan. 1st to May 1st
2-10 " " May 1st to Nov. 1st
1-10 " " Nov. 1st to Dec. 31st.

HELMER MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1920.

GRADE	IRON	PHOS.	SILICA	MANG.
Helmer,	57.12	.057	9.96	.93
Swallow & Hopkins,	54.67	.068	11.14	1.34
Helmer Drainage,	52.85	.054	16.50	.74

(Cargoes all mixed).

ORE STATEMENT AND SHIPMENTS FOR YEAR 1920.

	HEIMER	TOTAL LAST YEAR
On hand Jan. 1st, 1920,	6,104	8,930
Output for year,	42,722	71,831
Total,	48,826	80,761
Shipments,	42,407	74,657
Balance on hand,	6,419	6,104
Decrease in output-40%	29,109	
Decrease in shipments-43%	32,250	
Increase in ore on hand-.5%	315	

1920 - 2-8 Hour Shifts Jan. 1st to May 21st, 1920
1-8 " " May 21st to Dec. 31st, 1920
1919 - 3-8 " " Jan. 1st to Sept. 1st, 1919
2-8 " " Sept. 1st to Dec. 31st, 1919.

WADE-HELMER SHAFT.

Beginning with January, 1920, the Wade-Helmer Mine was operated as two propositions - Underground and Pit. Therefore, 1919 figures are inserted for record, but are not comparative.

MINING COST FOR YEAR.

	1920.	WADE. 1919.	HELMER. 1919.
PRODUCT	123,843	76,934	71,831
General Expense	.220	.197	.082
Maintenance	.272	.302	.032
Mining Expense	2.340	2.370	.947
Cost of Production	2.832	2.869	1.061
Exploratory		.397	.024
DEPRECIATION.			
Original Purchase			.416
Equipment	.007		.072
Plant	.160		.105
Construction		.142	
Total Depreciation	.167	.142	.593
Taxes	.325	.175	.072
Central Office	.095	.029	.032
Fire Loss	.002		
Miscellaneous	.061	.003	.160
Winter Expense			.383
Total on Stockpile Includes Open Pit	3.482	1.491 .611	2.005
Loading & Shipping	.105		.091
Total on Cars	3.587	2.102	2.096
No.Days Operating	309	209	216
No.Shifts and Hours	2-8hr	2-8hr	3-8hr 2-10"
Avg.Daily Product	401	368	333
COST OF PRODUCTION.			
Labor	1.938	1.963	.708
Supplies	.894	.906	.353
Total	2.832	2.869	1.061

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MADE IN U.S.A.

WADE-HELMER UNDERGROUND 1920 SHOWN WITH
WADE FOR 1919 for record only.
Figures are not comparative.

	1 9 2 0	WADE 1 9 1 9
PRODUCT	123,843	76,934
No.Hours and Shifts	2-8hr	2-8hr
AVG. NO. MEN WORKING		
Surface	31	18
Underground	88	56½
Total	119	74½
AVG. WAGES PER DAY		
Surface	6.19	5.75
Underground	6.56	6.47
Total	6.47	6.28
WAGES PER MONTH 25 DAYS		
Surface		143.75
Underground		161.75
Total		157.00
PRODUCT PER MAN PER DAY		
Surface	12.70	11.93
Underground	4.50	4.33
Total	3.33	3.18
LABOR COST PER TON		
Surface	.487	.482
Underground	1.457	1.496
Total	1.944	1.977
AVG.PRODUCT BRK'G & TRM'G	6.55	15.35
" WAGES CONTRACT MINERS	7.03	Co.acct
" " " TRAMMERS		
" " " LABOR	7.03	"
TOTAL NUMBER OF DAYS		
Surface	9,753¼	6,448
Underground	27,496½	17,769
Total	37,249¾	24,217
AMOUNT FOR LABOR		
Surface	60365.55	37081.69
Underground	180462.58	115048.04
Total	240828.13	152129.73

Proportion Surface to Underground Men:
1920 - 1 to2.84
1919 - 1 to 3.14
1918 - 1 to 3.59

WADE-HELMER MINE

TIMBER STATEMENT FOR THE YEAR ENDING DECEMBER 31,1920.

KIND	LINEAL FEEL	AVG.PRICE PER FOOT	AMOUNT 1 9 2 0.	AMOUNT 1 9 1 9
8" to 10" Timber	47,491		4099.10	5384.04
10 to 12 "	142,473		12297.30	4470.94
Total	189,964	.0863	16396.40	9854.98
	LINEAL FEET	PER 100'		
6' Lagging	539,580	.864	4661.00	3155.18
Poles	17,680	1.03	1818.00	742.28
Total			6479.00	3897.46
Product			122,689	98,763
Ft. timber per ton of ore			1.548	1.265
Ft.Lagging "			4.4	4.048
Ft.lagging per foot of timber			2.84	3.222
Cost per ton for timber			.1336	.1000
" lagging			.0380	.0319
" poles			.0148	.0075
" timber, lagging & poles			.1864	.1394
Equivalent of stull timber to bd.measure			350,958	200,037
Feet bd.measure per ton of ore			2.861	2.034
Total cost for timber, lagging & poles - 1920				22875.40
		1919		13752.44

WADE-HELMER MINE - SHAFT

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE

KIND	QUANTITY	AVERAGE PRICE	AMOUNT 1920	AMOUNT 1919
30% Powder - - - - - -	63,350	.1572	9,964.41	8,745.70
40% " - - - - - -	4,300	.1682	723.47	4,543.58
60% " - - - - - -	150	.1922	28.84	47.80
Black " - - - - - -				3,471.90
Total Powder - -	67,800	.1580	10,716.72	16,808.98
Fuse - - - - - - - - -	151,300	8.339	1,261.73	1,533.60
Caps - - - - - - - - -	41,100	13.87	570.35	871.67
Cap Crimpers - - - - -	15	.35	5.25	11.77
Connecting Wire - - -				2.67
Electric Exploders - -				232.73
Total Fuse, Etc. -			1,837.33	2,652.44
Total Explosives -			12,554.05	19,461.42
Product - - - - - - -			122,689	305,286
Pounds Powder per ton of Ore			.553	.255
Cost per ton for Powder			.0873	.0550
" " " " Fuse, Caps, Etc.			.0150	.0087
" " " " All Explosives			.1023	.0637
Avg. Price per Lb. for Powder			.1580	.216

Year 1919 is a combination of Wade and Helmer.
Beginning with January, 1920, mines were combined and operated as Wade-Helmer Shaft and Wade-Helmer Pit.

WADE-HELMER SHAFT

WADE HELMER PIT.

SEE NOTE ON UNDERGROUND SHEET. Mine leased in 1918.

	1920/	HELMER. 1919.
PRODUCT	116,300	71,831
General Expense	.075	.082
Maintenance	.210	.032
Mining Expense	1.024	.947
Cost of Production	1.309	1.061
Exploratory		.024
DEPRECIATION.		
Original Purchase		.416
Plant	.122	.105
Equipment	.008	.072
Total Depreciation	.130	.593
Taxes	.325	.072
Central Office	.021	.032
Winter Expense		.383
Idle Expense	.223	
Miscellaneous	.005	.160
Cost on Stockpile	2.013	2.005
Loading & Shipping	.040	.091
Total Cost on Cars	2.053	2.096
No.Days Operating	107	216
No.Shifts and Hours	1-10 -38 2-10 -69	2-8 24 2-10
Avg.Daily Product	1087	333
COST OF PRODUCTION.		
Labor	.444	.708
Supplies	.865	.353
Total	1.309	1.061

WADE-HELMER PIT, 1920 SHOWN WITH HELMER MINE 1919
for record only. Figures are not comparative.

COMPARATIVE WAGES AND PRODUCT

	1920	HELMER 1919
PRODUCT	116,300	71,831
No.Shifts & Hours	1-10 2-10	3-8hr 2-10
AVG.NO.MEN WORKING		
Surface	27	7
Underground		23
Total	27	30
AVG. WAGES PER DAY		
Surface	6.38	5.44
Underground		5.81
Total	6.38	5.72
WAGES PER MONTH 25 DAYS		
Surface		136.00
Underground		145.25
Total		143.00
PRODUCT PER MAN PER DAY		
Surface	13.87	29.69
Underground		9.92
Total	13.87	7.43
LABOR COST PER TON		
Surface	.460	.183
Underground		.586
Total	.460	.769
AVG.PRODUCT BRK&G-TRM'G		13.82
" WAGES CONT.MINERS		Co.acct.
" " " TRAMMERS		"
" " " LABOR		"
TOTAL NO. DAYS		
Surface	8,384¾	2,419¾
Underground		7,241¼
Total	8,384¾	9,661
AMOUNT FOR LABOR		
Surface	53494.83	13170.27
Underground		42051.97
Total	53494.83	55222.24

Proportion Surface to Underground Men;
1919 - 1 to 3.67
1918 - 1 to 2.77

Mine leased to C.C.I.CO.Jan.2,1918.
In 1919 Wade & Helmer were operated as separate units. In 1920 the two were combined and operated as Pit and Underground.

WADE-HELMER MINE - OPEN PIT

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE

KIND	QUANTITY	AVERAGE PRICE	AMOUNT 1920	AMOUNT 1919	
30% Powder - - - - - - -	8,850	.1426	1,262.86		
40% " - - - - - - -	2,950	.1704	502.97		
Black " - - - - - - -	23,575	.0857	2,020.75		
Total Powder - -	35,375	.1070	3,786.58		
Fuse - - - - - - - - - -	73,200	9.440	691.50		
Caps - - - - - - - - - -	8,900	13.320	118.58		
Cap Crimpers - - - - - -	5	.35	1.75		
Electric Exploders - - -	2,360	9.842	232.29		
Total Fuse, Etc. -			1,044.12		
Total Explosives -			4,830.70		
Product - - - - - - - -			117,454		
Pounds Powder per ton of Ore			.301		
Cost per ton for Powder			.0322		
" " " " Fuse, Caps, Etc.			.0088		
" " " " All Explosives			.1410		
Avg. Price per Lb. for Powder			.1070		

See Wade-Helmer "Shaft" for 1919 figures.

WADE-HELMER OPEN PIT

ANNUAL REPORT FOR THE YEAR ENDING DECEMBER 31ST, 1920.

Ishpeming, Michigan,

February 16, 1921.

ENGINEERING DEPARTMENT.

Mr.M.M.Duncan, Vice Pres. & Gen.Mgr.,

Building.

Dear Sir:-

The following report of the Engineering Department is herewith handed to you. The photographic maps and views which form part of this report have been bound and the books labeled as follows:

LIST OF ANNUAL REPORT MAP BOOKS FOR 1920.

Cleveland-Cliffs Iron Company,
Ishpeming and North Lake Districts.

Cleveland-Cliffs Iron Company,
Negaunee, Iron River & Republic Districts,
& Hydro Electric System.

Cleveland-Cliffs Iron Company,
Mesabi District.

Cleveland-Cliffs Iron Company,
Gwinn District.

These books contain the maps of the Company's mines; two sets of them have been prepared, one for the Cleveland office, which is handed to you, and the other which is to be kept in the vault in this office.

Special books have been prepared for the other companies which are interested in the Cleveland-Cliffs Iron Company's mines and also books and loose prints have been given to the superintendents of the various districts as follows:

BOOKS - OR LOOSE LEAVES.	DISTRICT.	FOR WHOM.
Loose leaves	Ishpeming	L. Eaton.
Book	North Lake	J. M. Bush.
"	Negaunee	G. R. Jackson.
"	Iron River & Republic	C. J. Stakel.
Loose leaves	Hydro-Electric System	O. D. McClure.
Book	Mesabi	M. H. Barber.
Loose leaves	Wade-Helmer	C. S. Stevenson.
" "	Boeing	C. Brewer.
" "	Hill-Trumbull	H. C. Bolthouse.
Book	Gwinn	W.W.Graff.

BOOKS - OR LOOSE LEAVES.	DISTRICT.	FOR WHOM.
Book	Negaunee	Lackawanna Steel Co.
2 books	Wade, Boeing, Hill-Trumbull	Arthur Iron Mining Co.
5 "	Boeing & Hill-Trumbull	Mesaba-Cliffs Iron Mining Co.
Book	Wade-Helmer	Struthers Furnace Co.

Maps of the Athens Mine have been sent monthly to the Cleveland office.

For the fee owners of the Negaunee Mine, 14 sets of the main levels maps were sent to the Cleveland office in January.

Maps for the Michigan State Tax Commission have been prepared and will be sent out.

Special maps have been furnished for the fee owners of the following properties:

Roman Catholic Cemetery at Maas Mine.
Adams Strip at Maas Mine.
Corbit and Mitchell at Athens Mine.
Virgil and Neely.

Mr. R. J. Chenneour, Assistant Engineer, has written the following pages covering the report on the force employed in the Engineering office.

Following the above, I have added a few remarks on the Abstract Department and various subjects.

Yours truly,

J. E. Jopling

Chief Engineer.

JEJ:LTD.

REPORT OF THE ENGINEERING FORCE EMPLOYED DURING THE YEAR 1920,

AND A BRIEF OUTLINE OF THEIR WORK,

BY REGINALD J. CHENNEOUR, ASSISTANT ENGINEER.

THE FORCE.

There has been a considerable change in the Department during the year. The following men were added to the Department during the year:

Clyde W. Nicolson, engineer, transferred from Geological Department.
Carroll C. Taylor, engineer.
August E. Carlson, draftsman and helper.
J. Donald MacCarthy, engineer and helper.

Additional men for summer field work were:

Charles Feller, axeman.

The following men left the Department during the year:

Alex Ham, draftsman.
John K. Osborne, engineer.
Wm. F. H. Janzen, engineer.
Charles Feller, axeman.

The following table shows the personnel of the Department during the year, arranged in order of entrance:

NAME.	POSITION.	ENTERED.	LEFT.	SUBSEQUENT POSITION.
R.J.Chenneour	Asst. Eng.	Entire year		
H.O.Moulton	Engineer	" "		
J. E. Hayden	"	" "		
J.K.Osborne	"	1 month	Feb.1st	Asst. to R.S.Archinald.
A. Rook	Helper	Entire year		
J. Trosvig	Engineer	" "		
T. A. Miller	"	" "		
S.Malmgren	Helper	" "		
C.W.Nicolson	Engineer	Feb.1st		Transferred from Geological Department.
W.F.H.Janzen	"	1 month	Feb.1st	Beaver Board Granulitic Co.
A. Minnear	Helper	Entire year		
K.C.Pellow	Engineer	" "		
P. Denn	Chauffeur	March 29th		
A. Ham	Draftsman	1 month	Jan.24th	Ill health.
F. Olson	Draftsman & Helper	Entire year		
C.C.Taylor	Engineer	Feb.2nd		
A.E.Carlson	Helper & Draftsman	Feb.9th		
J.D.MacCarthy	Engineer	July 6th		
C. Feller	Axeman	April 12th	Nov.13th	Electrical Department.

All the men in the Department, with the exception of Charles Feller and Sixtus Malmgren, were on a salary basis. Mr. Malmgren was on a salary basis from August 1st to the end of the year.

The following table shows the days worked and days sick, percentage of days worked, etc, for all men on a salary basis. The vacation column shows time granted for regular vacation. All other time lost, other than sickness, is included in absent column. Eight hours constitute a working day. There was no work Saturday afternoons during the year. Where the vacation column shows over fifteen days, it is usually due to the fact that there was little or no vacation taken for the year previous. The total days as shown in this statement are actual days worked and not based on a month of twenty six working days:

NAME.	DAYS WORKED.	DAYS VACATION.	DAYS ABSENT.	DAYS SICK.	TOTAL DAYS.	PERCENTAGE DAYS WORKED.
R.J.Chenneour	241½	21	4	10	276½	87.4
H.O.Moulton	255	18	3½		276½	92.2
J.E.Hayden	249	12½	10½	4½	276½	90.1
J.K.Osborne	23½	-	-	-	23½	100.0
W.F.H.Janzen	23½	-	-	-	23½	100.0
C.W.Nicolson	255	-	-	1	253	100.8
C.C.Taylor	245½	-	6	1½	253	97.0
T.A.Miller	260	16	½	-	276½	94.0
K.C.Pellow	252½	17½	5	1½	276½	91.3
J. Trosvig	249	23	3½	1	276½	90.1
A. Ham	15	-	-	2½	17½	86.0
J.D.MacCarthy	134	1½	1	-	136½	98.2
A. Rock	262	11½	3	-	276½	94.8
A. Mimnear	259½	18	1	-	276½	93.9
S.Malmgren	162	-	-	-	161½	100.3
F. A. Olson	267	7	1	1½	276½	96.6
A.E.Carlson	244½	3	-	-	247½	98.8
P. Denn	197	9	3½	-	209½	94.0

The following table shows the number of working days lost because of sickness or absence and vacation by men in the Department during the last five years:

	1916.		1917.		1918.		1919.		1920.	
	VACATION	SICK.	VACATION	SICK.	VACATION	SICK.	VACATION	SICK.	VACATION	SICK.
R.J.Chenneour	2¼	2	26½	½	12	0	2½	0	25	10
H.O.Moulton	0	1	23½	0	1	1	27	5	21½	0
J.E.Hayden							0	0	23	4½
C.W.Nicolson									0	1
C.C.Taylor									6	1½
T.A.Miller							18½	1½	16½	0
K.C.Pellow					6	4	13	15½	22½	1½
J.Trosvig	0	0	6	0	11	10	6½	1½	26½	1
J.D.MacCarthy									2½	0
A. Rock	12	1	20	6	14	0	4½	2½	14½	0
A.Minnear			1	0	0	4	9	8½	18	1
S.Malmgren									0	0
F.A.Olson							0	0	8	1½
A.E.Carlson									3	0
P. Denn					1	0	6½	2	12½	0

The following table gives the names of men employed in the Department during the last five years, arranged in order of entrance, showing the months worked and the average number employed per month, excluding unskilled men, such as choppers, etc:

	1916.	1917.	1918.	1919.	1920.
C.J.Stakel	4				
C.Brewer	8	12	12	3	
J.F.Hanst	12	3			
R.J.Chenneour	12	12	12	12	12
H.O.Moulton	12	12	12	12	12
J.K.Osborne	12	12	12	12	1
A. Rock	12	12	12	12	12
J.Trosvig	12	12	12	12	12
E.L. Derby	8				
J.E.Hayden	12	4½			12
T.A.Miller	11½	12	2½	11	12
J.J.Heilala	11	12	12	10	
S.Malmgren	8	12	12	12	12
C.W.Nicolson	6	4½			11
C.s.Stevenson		7½			
W.F.H.Janzen		9½	12	12	1
C. Nichols		6	4	3½	
A.Alanen		8	12	8½	
A.Minnear		6½	12	12	12
M.C.Connolly		3½	3½		
K.C.Pellow			12	12	12
P. Denn			9	8	9
F.Christian			3		
Shu Choe			3½		
A. Ham				8	1
F. Olson				2	12
C.C.Taylor					11
A.E.Carlson					11½
J.D.MacCarthy					6
Average number of men	8 5/6	13 5/12	14 1/8	13½	14 1/3

The work performed by each man in the Department is described briefly as follows:

REGINALD J. CHENNEOUR, as Assistant Engineer, has had charge of the office during the year, supervising the office work, field and underground surveys. All sub-level development schemes were checked by him before being submitted to the superintendents and General Superintendent for approval. He made an ownership map of the Mesabi Range showing leases, etc; prepared lists of maps for various mines for estimates for depletion; made a joint estimate of the Holmes-Section 16 mines trespass with Messrs. Wolf and Hulst of the Oliver Iron Mining Company; was underground at the Mackinaw-Gardner, Holmes and Barnes-Hecker mines instructing the men in the operation of the cement gun which is used for fire-proofing pump houses, etc; assisted various men in their underground and surface surveys; planned all surveys in connection with surface work. In the office he prepared the photographic annual report, ordered necessary supplies and set tasks for the engineers, etc.

HENRY O. MOULTON has been in charge of the engineering work at the Negaunee and South Jackson mines all the year. At the Negaunee Mine he made weekly surveys, noting and posting geology; laid out three proposed sub-levels; made East-West cross-sections of area in Nos.1 and 2 shaft pillars; gauged the skip runners; made average cross-section of stockpile to determine the tons of ore per lineal foot of trestle; made Tax Commission estimate and prepared maps and finished the annual report prints. At the South Jackson Mine he surveyed the extensions of the pit and milling drift; he kept an analysis map by which a uniform grade of ore was mined; laid out concrete foundation for a new compressor; made Tax Commission estimate and completed the annual report. At the Athens and Morris mines he assisted in making check plumbings. Of the City of Negaunee he prepared a map of the garden and lot leases for Mr. Jopling.

He assisted in calculating and plotting field notes of Sections 21 and 24, 47-27. In Section 22, 47-27 he did some work in the field. Below is a table showing percentage of his time spent at the Negaunee and South Jackson mines and on other miscellaneous work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Negaunee Mine	30%	5%	41%	76%
South Jackson Mine	3	1	3	7
Miscellaneous	4	2	11	17
Total	37%	8%	55%	100%.

J. ELLZEY HAYDEN did the engineering work at the Maas Mine and for the Dead River Water Power. At the Maas Mine he made weekly trips underground, surveying and noting geology; laid out several sub-level development schemes; planned additional sump capacity for the 3rd level; made tracings of steel plates for lining the 4th level storage pocket at shaft; gauged the skip runners and submitted a report on the results to Mr. Jackson; designed and superintended the installation of a concrete beam to reinforce the present bulk head on the 4th level; made a short-time study of the results obtained with the Armstrong loader; made a study of the tons of ore per man per day stoping in various parts of the mine where tonnage was small; suggested methods to increase the same. In the office, in addition to the regular routine work, he prepared Tax Commission estimate and maps and finished the annual report maps.

For the Dead River Water Power he surveyed a transmission line from the McClure Plant to the Maas Mine, mapped the same and prepared easement maps to cover descriptions not owned by the C.C.I.Company; prepared a map on a scale of 20' to the inch showing spillway section of proposed storage dam; surveyed and prepared a map and profile of proposed tramway from gravel pit to proposed storage dam; surveyed and laid out a spur track from the Hoist branch to the gravel pit to be used for unloading cement, etc; contoured and mapped an area below proposed storage dam showing springs, wet areas, etc; made a map showing land to be deeded to Mr. J. M. Longyear of proposed dam site; made a calculation of the cubic yards of concrete required for dams of various heights; surveyed and mapped drill hole locations at storage dam location; made void tests and concrete blocks from gravel from Hoist gravel pit and submitted a report on the same to Mr. McClure; made maps and estimate for dirt fill for proposed dam; made a drawing showing proposed gravel bins, concrete mixing plan, etc; made a yardage estimate of rock

available for use in concrete. In the office he posted all annual report tracings. Below is a table showing percentage of his time spent at the Maas Mine, Dead River Storage Basin and other miscellaneous work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Maas Mine	35%	1%	27%	63%
Dead River Water Power	0	6	13	19
Miscellaneous	2	6	10	18
Total	37%	13%	50%	100%

JOHN K. OSBORNE had charge of the engineering work at the Cliffs Shaft and Holmes mines for the month of January. The first of February he left this office.

WILLIAM F. H. JANZEN had charge of the engineering work at the Athens Mine for the month of January. The first of February he left this office.

CLYDE W. NICOLSON, beginning with the first of February, had charge of the engineering work at the Athens Mine. He made weekly trips underground, making surveys and taking geology; laid out seven proposed sub-levels; made several check surveys to hole the 6th level drift; made an analysis map of main levels; made an East-West longitudinal cross-section of the Athens ore body; prepared maps of the Corbit Lease; made an ownership map showing houses on Athens Mine surface; laid out and superintended the installation of steel lining plates for the 10th level storage pocket. On the surface he staked out trestle bents. In the office he prepared the annual report maps; made tonnage estimate and maps for the Tax Commission.

At the Morris and Republic mines he assisted in plumbing new levels. For the Dead River Water Power he checked over old field notes of work done in the vicinity of the Hoist dam. In the field he assisted in the surveys of Section 22, 47-27 contours. In the office he plotted and calculated field notes of Sections 15, 21 and 24, 47-27. He also made a map of the lands in the Sidnaw District for Mr. Prickett and prepared a map of the Upper Peninsula for the Cleveland office for the Booklet. Below is a table showing percentage of his time spent on Athens Mine and various other work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Athens Mine Miscellaneous	34.0% 00.5	03.5% 03.0	46% 13	83.5% 16.5
Total	34.5%	06.5%	59%	100.0%

CARROLL C. TAYLOR was employed as an engineer February 1st and did the engineering wprk at the Cliffs Shaft and Incline mines. At the Cliffs Shaft Mine he made monthly surveys, surveyed diamond drill hole locations and made an estimate of broken ore in the stopes. He also took several visitors underground. In the office, in addition to the regular office work, he figured areas, etc, on the estimate maps for the Tax Commission and finished the annual report.

At the Incline Mine he plumbed the shaft and made surveys of the underground workings. On surface he ran surveys from the Cliffs Shaft to the Incline Mine and checked them in order to properly tie the Cliffs Shaft and Incline surveys together. This will enable us to hole from the Cliffs Shaft accurately.

In addition to his mine work, he established permanent concrete survey stations in Section 3, 47-27, ran out surveys and contoured the NE¼ of Section 22, 47-27. In the office he assisted in plotting Sections 15 and 24, 47-27 field notes, made a map of the Cascade Range showing ownerships and ore formation, and prepared a map of Dead River Storage lands. Below is a table showing percentage of his time spent at the Cliffs Shaft and Incline mines and on various other work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Cliffs Shaft and Incline mines Miscellaneous	24.5% 01.0	00.5% 15.0	39% 20	64% 36
Total	25.5%	15.5%	59%	100%

TOM A MILLER did the engineering work at the Angeline, Holmes and Salisbury mines. At the Holmes Mine he made weekly and monthly surveys and noted the geology. On surface he laid out rock and stocking trestles and surveyed cracks due to caving from Section 16 Mine workings.

At the Angeline Mine he made the necessary surveys underground and on surface.

At the Salisbury Mine he made the monthly surveys and surveyed under-

ground drill hole locations. In the office, in addition to the regular office work, he prepared the Tax Commission and annual report maps for the above three mines.

He prepared a profile of the finished pipe line at the McClure Plant, assisted with the Section 22, 47-27 survey lines, located diamond drill holes in Section 3, 47-27 and assisted in plotting Section 24, 47-27 field notes. Below is a table showing percentage of his time spent at the Angeline, Holmes and Salisbury mines and on various other work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Angeline Mine	06%	00.5%	12.5%	19.0%
Holmes Mine	22	01.0	28.5	51.5
Salisbury Mine	06	0	12.0	18.0
Miscellaneous	02	03.5	06.0	11.5
Total	36%	05.0%	59.0%	100.0%

KENNETH C. PELLOW did the engineering work at the Lake, Republic and Spies mines. At the Lake Mine he made the monthly surveys underground and on surface made a survey of the caved area.

At the Republic Mine he made the monthly surveys, located diamond drill holes and gave lines for shaft sinking; mapped the stocking grounds and checked over the various fence lines in Section 7 at Republic; prepared a map showing the lot and farm leases after ascertaining in the field the present occupants.

At the Spies Mine he made the necessary surveys underground and made a stockpile estimate on surface.

In addition to the regular office work in the above three mines, he prepared the Tax Commission estimate maps and completed the annual report.

For the Neely Exploration he made the necessary surveys to locate diamond drill holes. He spent some time in the field in connection with Section 15, 47-27 surveys and in the office assisted in the plotting and calculating of old field notes of Section 24, 47-27. Below is a table showing percentage of his time spent at the Lake, Republic and Spies mines and other work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Republic Mine	17%	02.5%	27.5%	47.0%
Lake Mine	09	01.0	15.5	25.5
Spies Mine	02	00.5	13.5	16.0
Miscellaneous	00	01.0	10.5	11.5
Total	28%	05%	67%	100%

JOHN TROSVIG did the engineering work for the North Lake District. At the Barnes-Hecker Mine he gave lines for main levels, he gave lines and supervised the cutting of pump room and sump, gave lines for pump foundations, supervised the construction of concrete dams on the 1st and 2nd levels, surveyed the locations ~~fx~~ of diamond drill holes and plumbed 2nd and 3rd levels from the surface. On surface he surveyed a pole line to furnish electric lights to the location.

At the Lloyd Mine he made monthly surveys and laid out sub-levels for approval. On surface he surveyed caved areas and laid out 1170' of stocking trestle.

At the Morris Mine he made monthly surveys, plumbed the new 7th level from the 6th level, gave lines for pump room and sump and on surface gave lines for new stocking trestle.

For the North Lake District he made surveys and estimate of yardage to be removed for proposed drainage ditch and made a survey and yardage estimate of scheme to lower North Lake by deepening the present outlet; surveyed and reset the South quarter corner of Section 6, 47-27, which is now in the absement of an addition to the school house; he calculated and ran out the boundary lines for the Barnes-Hecker and Moore and Chase leases in order that the men cutting timber on these descriptions may be guided as to ownership. In the office he made Tax Commission estimate and prepared maps and worked on the annual report for the above three mines. Below is a table showing percentage of his time spent on Barnes-Hecker, Lloyd and Morris mines and other work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Barnes-Hecker Mine	38%	02%	09%	49%
Lloyd Mine	11	02	09	22
Morris Mine	14	02	11	27
Miscellaneous	00	02	00	02
Total	63%	08%	29%	100%

J. DONALD MACCARTHY was employed July 1st as an engineer and helper, with his principal work being at the Maas Mine. During the time Mr. Hayden was employed on the Dead River Water Power work, Mr. MacCarthy did the engineering work at the Maas Mine, made weekly and monthly surveys, noted and posted geology, laid out sub-levels for the Superintendent's approval, staked out addition to dry house and laid out sewage disposal system. While not in charge of engineering work, he assisted Mr. Hayden at this mine and did other general work in the office and in the field. Below is a table showing percentage of his time spent at the Maas Mine and on various other work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Maas Mine	41%	01.5%	29.0%	71.5%
Miscellaneous	06	06.0	16.5	28.5
Total	47%	07.5%	45.5%	100%

ARCHIBALD MINNEAR, helper and surveyor, assisted with the surveys and did most of the office work for the North Lake District. Below is a table showing percentage of his time spent at the Barnes-Hecker, Lloyd and Morris mines and other work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Barnes-Hecker Mine	11%	02%	09%	22%
Lloyd Mine	12	01	19	32
Morris Mine	15	02	18	35
Miscellaneous	06	02	03	11
Total	44%	07%	49%	100%

SIXTUS MALMGREN, a helper, assisted with the surveys of all mines and in the office, made blue prints, cleaned tapes and transits, etc. Following is the percentage of his time spent underground, etc:

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
60.5%	08.9%	30.6%	100%

FREDERICK A. OLSON was employed as a helper and draftsman. At the mines he assisted the engineers. In the office he assisted with the calculations, made tracings and assisted in plotting Sections 15 and 24, 47-27 field notes. Following is the percentage of his time spent underground, etc:

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
54.8%	05.4%	39.8%	100%

AUGUST E. CARLSON was employed in February as a helper and draftsman. At the mines he assisted the engineers with their surveys. In the office he made tracings and assisted with the calculations and plotting of field notes. Following is the percentage of his time spent underground, etc:

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
37.4%	16.1%	46.5%	100%

PETER DENN was employed from April 1st to December 31st inclusive as chauffeur for the Department, taking the men ~~and~~ to and from the mines and surface jobs. Part of his time was spent in collecting and assorting core and sludge from diamond drill holes.

ALEX HAM was employed as draftsman for one month.

CHARLES FELLER was employed as chopper from April 12th to November 13th inclusive, chopping lines in Sections 15 and 22, 47-27 and on the Dead River.

The following table shows the percentage of time spent underground, in the field and in the office for engineering work for the mines in this district:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Angeline Mine	35%	1.7%	63.3%	100%
Athens Mine	49.8	3.4	46.8	100
Barnes-Hecker Mine	67.3	4.3	28.4	100
Cliffs Shaft Mine	39.5	4.6	55.9	100
Holmes Mine	50.0	2.8	47.2	100
Lake Mine	39.5	3.0	57.5	100
Lloyd Mine	40.9	6.6	52.5	100
Maas Mine	54.7	2.0	43.3	100
Morris Mine	46.4	5.7	47.9	100
Negaunee Mine	39.7	5.5	54.8	100
Republic Mine	42.1	5.8	52.1	100
Salisbury Mine	38.8	0.0	61.2	100
Spies Mine	20.6	2.0	77.4	100
Average	46.3%	4.0%	49.7%	100%

DISTRIBUTION OF TIME.

The next table shows distribution of time for the various mines, etc, for three years:

ENGINEERING DEPARTMENT.

DISTRIBUTION OF ENGINEERING LABOR FOR YEARS 1919 & 1920.

	1918.			1919.			1920.				
	LABOR.	TIME IN DAYS.	PER CENT.	LABOR.	TIME IN DAYS.	PER CENT.	LABOR.	TIME IN DAYS.	PER CENT.	PERCENT INCREASE.	PERCENT DECREASE.
Angeline	$ 422.79	53	1.30	$ 697.75	84½	2.26	$ 919.39	111½	2.93	.67	
Athens)											
Bunker Hill)	2532.44	336	8.38	3126.57	393⅜	10.53	3235.31	388½	10.20		.33
Barnes-Hecker	755.67	128⅜	3.27	1393.68	216¼	5.78	1887.02	254½	6.68	.90	
Cliffs Shaft	1899.87	273½	6.82	2469.66	342½	9.16	2571.15	338	8.87		.29
Holmes	1504.49	212½	5.30	2183.97	292½	7.82	2119.77	279	7.32		.50
No.3 Incline	0	0	0	0	0	0	102.44	14½	.39	.39	
Lake	998.79	161	4.02	1089.14	129	3.45	1042.97	120	3.30		.15
Lloyd	1080.70	206	5.14	815.49	115⅜	3.09	1331.07	187½	4.92	1.83	
Maas	2662.04	344	8.58	2655.96	343⅜	9.19	3529.42	392½	10.30	1.11	
Morris	828.09	135	3.37	1174.76	167⅜	4.48	1589.73	230	6.03	1.55	
Negaunee	3174.56	393	9.83	3976.41	493⅜	13.20	3438.50	322	8.45		4.75
Republic	1086.74	179	4.46	1638.91	232½	6.21	1530.36	185½	4.87		1.34
Salisbury	796.94	160	4.00	1060.03	179	4.79	680.94	86⅛	2.27		2.52
South Jackson	352.11	34	.85	511.82	57⅜	1.54	467.79	40⅜	1.06		.48
Spies	459.07	219	5.46	240.88	32⅜	.88	563.59	66½	1.74	.86	
Total Ishpeming, Negaunee, Republic, Iron River	$18554.30	2834½	70.78	$23035.03	3080.75	82.38	$25009.45	3023	79.33		3.05
GWINN DISTRICT MINES.											
Austin											
Francis	0	0	0	18.13	2	.05	11.86	1½	.04		.01
Gwinn	0	0	0	21.64	2⅜	.07	16.32	2	.05		.02
Jopling	0	0	0	13.60	1½	.04	0	0	0		.04
Mackinaw-Gardner	0	0	0	18.12	2	.05	89.63	5⅛	.15	.10	
Princeton	0	0	0	22.66	2⅜	.07	19.94	2⅜	.06		.01
Stephenson	0	0	0	0	0	0	14.66	1⅜	.04	.04	
	0	0	0	$94.15	10⅜	.28	$152.41	13	.34	.06	
MESABI DISTRICT MINES.											
Boeing	0	0	0	62.17	6	.16	150.17	17	.44	.28	
Crosby	0	0	0	38.56	4½	.12	103.29	13⅛	.35	.23	
Hill-Trumbull	0	0	0	64.97	17	.46	167.16	20⅜	.54	.08	
Meadow-Fowler	0	0	0	27.18	3½	.09	77.99	10¼	.27	.18	
Wade-Helmer	0	0	0	49.62	6½	.18	146.34	17⅜	.47	.29	
Great Northern Properties	0	0	0	7.91	2	.05	0	0	0		.05
Mesaba Range	48.34	38	.95	124.23	31	.83	0	0	0		.83
	$48.34	38	.95	$374.64	70½	1.89	$644.95	79	2.07	.18	
WATER POWER.											
Au Train	114.90	26	.65	0	0	0	0	0	0		
Carp River	138.32	45⅜	1.14	21.23	5½	.15	68.79	6	0.16	.01	
Dead River Storage Basin	$619.43	864½	21.52	248.74	41	1.10	460.53	43	1.13	.03	
McClure Plant	1058.20	145	3.62	606.07	80½	2.15	61.06	8	.21		1.94
Dead River	0	0	0	59.38	7	.19	0	0	0		.19
Republic Transmission Line	0	0	0	68.46	7	.19	0	0	0		.19
McClure Plant-Maas Mine Transmission Line	0	0	0	0	0	0	562.40	71	1.86	1.86	
Dead River Storage Dam	0	0	0	0	0	0	485.04	46	1.21	1.21	
Total	$5930.85	1081	26.93	$1003.88	141	3.78	$1637.82	174	4.57	.79	
SURVEYS & CONTOURS.											
Sec.3, 47-27 explorations	0	0	0	0	0	0	41.77	5½	.14	.14	
Sec.15, " contours	0	0	0	904.86	190	5.09	867.53	130⅜	3.43		1.66
Sec.21, " "	0	0	0	0	0	0	346.54	45	1.18	1.18	
Sec.22, " "	0	0	0	0	0	0	1090.52	195	5.13	5.13	
Sec.23, " "	8	0	0	0	0	0	38.10	8½	.22	.22	
Sec.24, " "	0	0	0	0	0	0	382.93	47	1.23	1.23	
Neely Lease	0	0	0	0	0	0	42.25	5	.13	.13	
Drill Locations	127.09	23½	.58	232.21	37¼	1.00	0	0	0		1.00
Total	$127.09	23⅜	.58	$1137.07	227¼	6.09	$2809.64	436½	11.46	5.37	
MISCELLANEOUS.											
Boston Mine	124.42	16	.40	0	0	0	0	0	0		
E & A 379 Cliffs Shaft	0	0	0	1254.23	123⅜	3.30	26.31	2	.01		3.29
Sampling Isabella Mine	0	0	0	39.30	6⅜	.17	0	0	0		.17
Abstracts	0	0	0	0	0	0	85.57	21	.56	.56	
Accounts Receivable	0	0	0	0	0	0	132.53	28⅜	.76	.76	
Miscellaneous	81.53	14½	.36	408.47	79	2.11	252.07	33⅜	.90		1.21
Total	$205.95	30⅜	.76	$1702.00	209	5.58	$ 496.48	85	2.23		3.35
Grand Total	$24866.53	4007½	100.00	$27346.77	3739	100.00	$30750.75	3810½	100.00		

RJG:LTD.

ENGINEERING DEPARTMENT.

OFFICE EXPENSES.

Below is a comparative statement of office expenses for three years:

	1918.	1919.	1920.
Traveling expenses and livery	$ 492.61	$ 428.26	$ 558.82
Supplies (see below) - -	3149.34	3364.89	2604.75
Operating automobiles - -	1548.54	1589.65	2009.39
Office expense - - - -	17.76	27.11	230.91
Insurance - - - - -	22.08	22.08	221.25
Taxes - - - - - -	34.29	41.07	45.06
Total	$5264.62	$5473.06	$5670.18
Total salaries, General Office Engineers - -	24866.53	27346.77	30750.75
Total office expense, as above	5264.62	5473.06	5670.18
Total charges to Mining Dept.	$30131.15	$32819.83	$36420.93 #

#(Does not include salary of Chief Engineer and Stenographer).

The following table shows extraordinary charges in above for year 1920:

Painting building - - - - - -	$187.50
Depreciation Ford cars - - - - -	338.29
Lighting fixtures for draughting room -	100.75
Mounted drawing paper - - - - -	127.75
Imperial tracing cloth - - - - -	219.75
Map negatives, etc - - - - - -	381.47
Repairing transit - - - - - -	73.72
Tires and tubes - - - - - -	136.51
Binders and printing for annual report -	117.00

AUTOMOBILES.

The Ford car and truck were put into operation on March 27th and ran continuously until Decelber 31st. Below is a comparative statement of livery and auto expense for three years:

	1918.	1919.	1920.
Company horses - -	$ 353.72	$ 409.66	$ 426.49
Company automobiles:			
salaries -	453.75	507.57	780.23
expenses -	1094.79	1082.08	1229.16
Livery hire - -	6.00	0	3.33
Auto hire - - -	54.00	0	0
Total	$1962.26	$1999.31	$2439.21

COST OF OPERATING AUTOMOBILES.

	1918.	1919.	1920.
Chauffeur's salary -	$ 453.75	$ 507.57	$ 780.23
Gasoline, oil, etc -	262.53	239.46	280.50
Tires and tools - -	208.72	193.68	255.92
Repairs - - - -	231.86	263.98	181.69
Miscellaneous - -	231.67	40.52	49.40
Insurance - - -	0	123.36	123.36
Depreciation - - -	160.01	221.08	338.29
Total	$1548.54	$1589.65	$2009.39

M I N E S.

ANGELINE MINE.

Monthly surveys were made each month. There was no special work.

ATHENS MINE.

Weekly surveys were made and all geology posted. The new 6th level, which was started from the shaft and back in the mine from raises, was holed perfectly. This work required a number of check surveys as the timber was constantly moving. A number of development schemes for sub-level mining were worked up and properly approved. The storage pocket on the 10th level was measured up and steel plate ordered for lining the same. Analyses maps of main levels were kept up to date. On the surface additional stocking trestle was laid out. In the office a horizontal cross-section of the Athens ore body was made and an abstract of the houses on the Athens surface was prepared.

BARNES-HECKER MINE.

Lines were given for all rock drifting each week. Lines for pump room and sump were also given and the cutting of the sump supervised. Pump foundations were properly lined in. The installation of concrete dams on each level was supervised. All drill holes were surveyed. On the surface a pole line to carry electric light wires was run from the mine to the location. All new railway tracks, coal dock, etc, were surveyed and mapped.

CLIFFS SHAFT MINE.

The monthly surveys were made, lines given and all drill holes locations surveyed. An estimate was made of broken ore in the stopes. Several

trips were made underground with the geologists. On the surface additional stocking trestle was laid out for lump ore.

HOLMES MINE.

Mid-monthly and monthly surveys were made and lines given for raises, crosscuts, etc. On the surface cracks caused by Section 16 workings were surveyed. Additional rock trestle was laid out. A joint estimate of the C.C.I.Company and the Lake Superior Iron Company's trespass was made by the above comapnies engineers.

INCLINE MINE.

Check surveys were run on surface from the Cliffs Shaft Mine to the above mine. The shaft was plumbed and surveys carried to the bottom level.

LAKE MINE.

The usual monthly surveys were made. On the surface the caved area was surveyed to determine the position of ore which was left to keep mud from running into the mine.

MAAS MINE.

Weekly surveys were made and lines given for raises and drifts. All geology in the sub-levels was kept. An addition to the 3rd level sump was laid out and cut. A new motor haulage sub-level was laid out between the 3rd and 4th level to handle ore from the North footwall area. The 4th level storage pocket was measured and steel plates ordered to line the same. Several proposed sub-level development schemes were submitted to the Superintendent for approval. The skip road guides were gauged for clearance and the results of the same submitted to the Superintendent. On the surface additional stocking trestle and an addition to the dry were staked out. A sewage disposal system for the surface buildings was designed and laid out.

MORRIS-LLOYD MINE.

Monthly surveys were made and geology posted on the maps. The new 7th level was plumbed and checked from 6th level surveys. Lines were given for 7th level pump room and sump. Schemes for sub-level development were submitted to the Superintendent for approval. All underground diamond drill

holes were surveyed. On the surface additional stocking trestle was staked out and surface caves surveyed.

NEGAUNEE MINE.

Weekly surveys were made and lines given for all raises and sub-level development. All geology, particularly in the sub-levels, was noted and posted on the maps. Several sub-level development schemes were submitted for approval. Skip runners were gauged to show clearance and the results submitted to the Superintendent. On the surface an average cross-section of ore stockpile was made to determine the tons of ore per lineal foot of trestle.

REPUBLIC MINE.

Monthly surveys were made, diamond drill holes surveyed and lines given for shaft sinking. The winze plumbed and the surveys carried to the 2170' and 2270' levels. On surface additional stocking trestle was staked out. A map was prepared to show lot leases. The occupant of each description was interviewed and record corrected to agree with occupancy.

SALISBURY MINE.

The usual monthly surveys were made. Nothing unusual to report.

SOUTH JACKSON OPEN PIT.

Surveys were made to determine the position of each steam shovel cut and analysis of ore mined was posted daily on a map and in a position to correspond with steam shovel cuts as surveyed. The milling drift was surveyed and lines given as drifting progressed.

SPIES MINE.

Monthly surveys were made and all drill holes located. On surface a stockpile estimate was made.

VIRGIL MINE.

A map was prepared showing the Virgil Mine workings.

MISCELLANEOUS.

CONTOURS.

SECTION 15, 47-27.

Contours were finished and maps made.

CONTOURS (CONTINUED).

SECTION 21, 47-27.

Old field notes were calculated and plotted and maps finished.

SECTION 22, 47-27.

Survey lines and contours for the NE¼ were completed. Field notes will be plotted and maps made.

SECTION 23, 47-27.

A 200' to the inch map was made of all work mapped in this section.

SECTION 24, 47-27.

Old field notes were calculated and plotted and maps completed.

SECTION 26, 47-27.

A 200' to the inch map was made of work formerly done in this section.

DRILL HOLES.

All drill holes locations were surveyed and elevations run to the collar of the hole.

WATER POWER.

TRANSMISSION LINES.

A transmission line was run from the McClure Plant to the Maas Mine and easements prepared for lands not owned by the C.C.I.Company.

DEAD RIVER STORAGE DAM.

Contours were run and a map prepared to show area in the vicinity of proposed dam. All drill holes were located. A map was prepared showing parcel of land to be deeded to Mr. Longyear for dam site. A 20' to the inch map was prepared of the spillway section of proposed dam. Concrete blocks were made from gravel from Hoist pit. Void tests, both wet and dry, were made from above gravel. The results of these tests were embodied in a report to the Mechanical Department.

NORTH LAKE DISTRICT.

A survey was run and an estimate of yardage to be removed made for proposed drainage scheme. A survey and estimate were made to determine whether it was feasible to lower the North Lake outlet by dredging. The lot lines on the Barnes and Hecker and Moore and Chase leases were surveyed and run out in order that contractor cutting timber might be properly guided.

BOOKLET FOR CLEVELAND OFFICE.

A map was prepared of the Upper Peninsula and another which was sent from Cleveland was finished. Several photographs and prints were taken for the Booklet.

CASCADE RANGE.

A map was made showing geology and ownership.

GARDEN LOTS - ISHPEMING & NEGAUNEE.

Maps were prepared showing lots leased from the Mining Department for both cities.

ESTIMATE FOR DEPLETION.

Maps were prepared for estimate for depletion purposes to be sent to the Federal Government.

TAX COMMISSION MAPS.

Blue prints and estimates were made for the State Tax Commission. The estimates were checked by the superintendents. This year all maps for the Tax Commission were furnished on a scale of 200' to the inch. This made it necessary to photograph the Negaunee Mine cross-sections and some special Gwinn District tracings. The regular annual report prints were used for mines in the Ishpeming and Negaunee districts.

ANNUAL REPORT.

The months of January, February and part of March were spent in preparing annual report. The annual report and the Tax Commission Maps required 580 new negatives and views, and about 4400 sheets of special blue print paper.

REPORT ON THE ABSTRACT DEPARTMENT FOR THE YEAR 1920.

Since the departure of Mr. C. H. Echler in September 1919 no regular work has been done in the Abstract Department in this building. Documents which have been received have been copied when necessary and recorded. There still remains to be abstracted some of the water power lands in the Dead River District and also in that of the Au Train. Abstract maps but no abstracts have been made of the lands acquired on the Mesabi Range during the past two years.

OPTIONS FOR MINING LEASES.

No options for mining leases have been acquired during the year.

MINING LEASES.

There were surrendered during 1920 the following leases:

No.1, covering Lots 2 and 3 of Section 21, 45-25 at Gwinn, which had been leased from the C. & N. W. Railway Company was surrendered on January 1st.

No.7, covering the NW¼ of the NE¼ of Section 28, 45-25 at Gwinn, leased from Mr. Alfred Kidder was surrendered May 16th.

One lease was taken out during the year:

No.51, Virgil Mine, Iron River, dated August 9, 1920, for 45 years.

DOCUMENTS RECORDED.

The following list of documents is a summary of those placed on the records in the files during 1920:

	No. Received.	Last File No.
Land offers	50	1265
Authorizations	1	116
Deeds	17	683
Easements	5	134
Rights of Way	1	172
Water Rights	3	15
Surface Leases	288	1831
Applications for Sale	8	42
Sales	53	201
Tax Histories	0	506
Legal Opinions	2	136

LAND OFFERS.

Most of the lands offered were in Marquette County. They included, however, scattered holdings in Minnesota and two in Canada. A large number of the offers consisted of houses and lots at Negaunee. Reports were written from this office on nearly all these offers. The lands of only a few were examined, the reports on the rest being made up from information on hand.

AUTHORIZATIONS.

An authorization was obtained for renewed explorations on the Neely.

DEEDS AND MISCELLANEOUS DOCUMENTS.

These included deeds from other parties to the C.C.I.Company; also a few other documents have been entered in this book for which there is no other place provided.

EASEMENTS.

Four of the above noted were regular transmission line easements. The fifth was a license to cross the C. & N. W. Railway near the Barnes-Hecker location.

RIGHTS OF WAY.

A right of way over the Company's lands was granted the County of Marquette for the Baraga Trunk Highway.

WATER RIGHTS.

The water rights obtained were along the stream into which the Spies Mine water is discharged, where damages had been claimed.

SURFACE LEASES.

These were leases granted by this Company on farms and lots.

APPLICATIONS FOR SALE.

Applications for sale, which were sent to this office by the Land Department for approval, were entered.

SALES .

The sales entered consisted of miscellaneous parcels conveyed by this Company to various parties; also a number of sales were entered, consisting of lands owned by Mr. W. G. Mather at Michigamme to various parties.

LEGAL OPINIONS.

The legal opinions entered were relative to special descriptions of land.

LAND OFFER PLAT BOOK.

To this book has been added a series of county maps upon which are shown the areas of iron formation and the areas of geologic surveys recorded in this office. In it are recorded the land offers and also the outside explorations noted in office records.

ABSTRACTS.

No new abstracts of Company lands have been completed during the year. Abstract maps were made to cover the recent acquisitions in Minnesota.

HYDRO ELECTRIC ABSTRACTS.

Maps have been made to cover the lands held under lease for water power and also those lands across which transmission lines have been built.

SUNDRY ITEMS BY J. E. JOPLING.

PYRITES.

The following offers of pyrites were received during the year:

No.155, K. P. Ketchum & Company, 138 N. La Salle St., Chicago. The only information is contained in a letter from Mr. S. L. Mather dated March 8th, which indicates that the property is near Atlanta, Ga.

No.156, Frank G. Stevens, 36 Oakmount Road, Toronto, Can. The offer consisted of the Delyea Mine at Queensboro, Ontario, which was examined by Professor H. L. Smyth and J. E. Jopling a few years ago but was declined.

No.157, Robert H. Taylor, Sault Ste. Marie, Michigan, offered this Company the Holdsworth property in the Michipicoten District of Ontario. This was examined by Mr. E. L. Derby and J. E. Jopling and a complete report was made dated September 24, 1920. This property was declined.

No.158, Rand Consolidated Mines, at Goudreau, in the Michipicoten District. This property was offered to Mr. Mather in October. Under date of September 25th, Mr. E. L. Derby and J. E. Jopling made a report on this property, which was visited at the same time as that of the Holdsworth.

WATER POWER.

Further surveys were made in connection with the proposed dam at the Hoist on Dead River and standpipes were put down to ledge. Further agreements were made with Mr. Longyear relative to leasing additional lands in the proposed basin.

The falls on Dead River owned by the Lake Superior Powder Company were examined July 26th and reported upon.

TRANSMISSION LINES.

A new transmission line from the Mc Clure Plant to the Maas Mine was surveyed. Easements were acquired covering the necessary lands and the line was constructed in 1920.

MICHIGAN STATE TAX COMMISSION.

The estimates of ore in the Company's mines were completed and forwarded to the Michigan State Tax Commission together with the usual maps. Mr. L. P. Barrett, Appraiser of Mines, arrived January 14th and inspected the mines and went over the maps and estimates with the superintendents.

FEDERAL TAX.

Brief histories were prepared for the Cleveland office to accompany the report on federal tax valuations.

MICHIGAN MINERAL LAND COMPANY.

Upon the request of Mr. W. S. Prickett, I went to Sidnaw on August 13th and later prepared several maps showing lands of the Michigan Mineral Land Company to show lands for sale.

HEIDELBACH LANDS.

An examination was made on October 21-26 of the Heidelbach lands on the Cascade Range which were offered by Mr. J. H. Quinn.

ASHLAND MINE.

On October 22nd I accompanied Mr. J. M. Bush to the Ashland Mine where we investigated new discoveries of ore in connection with the agreement made at the time of the surrender of the mine by this Company.

DIAMOND DRILLING.

No carbon was purchased in 1920.

THE CLEVELAND CLIFFS IRON COMPANY.

REPORT OF THE GEOLOGIST FOR THE YEAR ENDING DECEMBER 31, 1920.

STAFF.

The staff of the Geological Department for 1920 is given in Table I below. Mr. Nicolson was transferred to the Engineering Department February 1st and was assigned the engineering work at the Athens Mine. Mr. A. W. Pinger was engaged by the Department as assistant geologist following his graduation from Harvard University in June. He began work June 21st. During the first three months of the year, Mr. Denn spent all his time collecting, labeling and filing diamond drill samples, etc. The remaining nine months he accomplished this in connection with his work of chauffeur for the Engineering Department and was allowed one quarter time by the Geological Department.

TABLE I.

STAFF OF GEOLOGICAL DEPARTMENT IN 1920.

NAME.	OCCUPATION.	DURATION OF EMPLOYMENT IN 1920.	DAYS LOST. SICKNESS.	VACATIONS.	% OF WORKING DAYS WORKED.
E.L.Derby,Jr.	Geologist in charge of Department.	Entire year.	7½	2½	96.4
C.W.Nicolson	Assistant Geologist.	1 month.	0	0	100.0
A.W.Pinger	Assistant Geologist.	6 1/3 months.	0	1	99.3
E.A.Allen	Assisting Geologists, testing diamond drill holes & visiting outside explorations.	Entire year.	1	0	99.6
Gustaf Afuhs	Draftsman.	Entire year.	0	1½	99.5
P. N. Denn	Collecting core, etc.	Full time for 3 months; ¼ time for 9 months.	1	2	95.5

The year was divided into the factors shown in Table II below:

TABLE II.

Total days of eight hours worked - - - -	276½ days.
Sundays - - - - - - - - - - -	52 "
Days resulting from Saturday afternoons - -	26 "
Holidays - - - - - - - - - - -	11½ "
Total	366 days.

The following table , No.III, shows the average number of men regularly employed on the staff of the Geological Department during the last five years:

TABLE III.

YEAR.	AVERAGE NUMBER OF MEN.
1916	3.17
1917	3.35
1918	4.85
1919	5.44
1920	4.06

DIVISION OF WORK AMONG THE MEMBERS OF THE DEPARTMENT.

H. L. SMYTH. The work of the Geological Department continued under the direction of Mr. H. L. Smyth as Consulting Geologist.

E. L. DERBY, JR. The greater portion of my time during the past year was taken up with general oversight and supervision of the work of the Department. This included, besides the usual office routine work, surface drilling explorations in the Ishpeming, Dead River, Crystal Falls and Gwinn districts; underground drilling in the Barnes-Hecker, Cliffs Shaft, Francis, Jopling, Mackinaw, Morris-Lloyd, Negaunee, Republic, Salisbury and Spies mines; underground geological surveys in the Angeline, Athens, Barnes-Hecker, Cliffs Shaft, Francis, Gwinn, Jopling, Maas, Mackinaw-Gardner, Morris-Lloyd, Negaunee, Princeton, Republic, Salisbury, Spies and Stephenson mines; and in visiting and reporting on the explorations of other companies on the Michigan and Wisconsin iron ranges. I have accompanied frequently the men making the underground surveys and constantly have kept in touch with and supervised their detailed studies of the results of these surveys.

The time not taken up with these duties was spent chiefly as follows:

In January, I checked over special estimates of the Mackinaw-Gardner property and assisted in preparing the cost and profit and loss statements accompanying the E and A for opening the Hill-Trumbull properties on the Mesabi Range.

In April, I assisted in preparing an E and A for the opening of the Neely property. I also spent one day at Escanaba examining the reports and core of the drilling being conducted at that time by the Escanaba Iron Range Exploration Company, about four miles West of Escanaba. This property was offered to us at the time.

In May, I spent practically all of the time preparing estimates of ore in all the Company's mines to be submitted to the Federal Government for depletion purposes.

In June, I completed the estimates for depletion purposes commenced in May.

In September, I spent five days in company with Mr. Jopling on a trip to the Michipicoten District in Ontario on the Algoma Central Railway, North of the Canadian Soo. We examined the Holdsworth pyrite property, two miles from Hawk Lake Junction, which was offered to this Company. We also visited the Rand Consolidated Company's pyrite property at Goudreau, 13 miles North of Hawk Lake Junction.

In October, in conjunction with Mr. Jopling, I made a field examination of the Heidelbach lands on the Cascade Range, which were offered to this Company.

C. W. NICOLSON. Mr. Nicolson continued as an assistant geologist only during the month of January. On February 1st he was transferred to the Engineering Department, becoming mining engineer for the Athens Mine. During January he made underground geological surveys and posted the geological maps and cross-sections of the Athens, Cliffs Shaft, Francis, Holmes, Jopling and Mackinaw-Gardner mines. He also assisted Mr. Moulton of the Engineering Department in making the annual estimate of ore in the Maas and Negaunee mines.

A. W. PINGER. Mr. Pinger, at the suggestion of Mr. Smyth, was engaged as an assistant geologist. He began work on June 21st, immediately following his graduation from Harvard University. After familiarizing himself with the geology of the district, he assumed the work of making underground

geological surveys at all the Company's operating mines in Michigan. Most of these were made regularly at monthly intervals but some, of necessity, were made at irregular and at longer intervals. He also assisted in taking water samples for the determination of the sulphur content of the ore when these tests were made at the Section 3 exploration at Ishpeming and in connection with the last drilling from the 4th level of the Mackinaw Mine. He spent the remainder of his time on the routine work of the office.

E. A. ALLEN. Mr. Allen continued as a valued assistant in the Department throughout the year. The majority part of the time he spent as regular geologist's assistant, assisting on nearly all of the underground geological surveys. He made all the surveys of drill holes that were made with the Maas Compass and assisted in wedging off both holes in Section 3 where this method was used. He acted as field geologist with the engineering party that mapped the outcrops in the S½ of Section 15, 47-27 Salisbury Mine. He assisted in taking all water samples for sulphur tests in the drill holes sampled in this way. He made occasional visits to all the outside explorations being conducted, on the Michigan and Wisconsin iron ranges and submitted the results of these observations in special reports. He culled out all superfluous core in the core room to make available added filing space. He also made the regular monthly carbon reports and the annual inventory of diamond drill equipment. He spent the rest of his time in routine office work.

GUSTAV AFUHS. Mr. Afuhs continued as draftsman throughout the year. His work consisted chiefly in preparing cross-sections of drilling, monthly drill reports and geological maps and cross-sections. He colored all annual report sheets of the Company's drilling. He also prepared a complete set of index maps covering all geological surveys and explorations conducted by the Company in years past. He also made copies for our files of all geological information received by this office in the form of land offers. He spent the rest of the time on routine office work.