Following are the charges to E & A No. 381, Opening & Equipping Hill-Trumbull Mine and Washing Plant from September, 1919, to December 31st., 1921. Charges to this E & A have now been completed, with the exception of a small amount for seeding and planting at the location and mine buildings.

SUPERINTENDENT'S DIVISION

	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
GENERAL EXPENSE			
Watchman		82.03	
Engineering		3690.84	
Analysis		42.00	
Mine Office		2297.74	
Central Office		585.05	
District Office		1193.69	
Taxes		144779.99	
Legal		57.50	
Personal Injury		178.80	
Contingent Expense (1)		8.14	
TOTAL	232200.00	152915.78	79284.22
MAINTENANCE			
Tracks and Cars		2335.42	
Locomotives		1066.44	
Steam Shovels		5224.27	
TOTAL	8500.00	8626.13	126.13
PREPARING SITE			
Building Roads		978.32	
Clearing Land		1972.86	
Grading & Ditching		644.03	
TOTAL	11500.00	3595.21	7904.79
TEMPORARY EQUIPMENT			
Miscellaneous		184.20	
Rental of Equipment (Trans. to Stripping)			
Tools in General Use		1534.37	
Locomotive - 2 - 45-Tons		19708.87	
Twelve 12-yd cars		12451.92	
TOTAL	37500.00	33879.36	3620.64
PERMANENT CONSTRUCTION & EQUIPMENT			
Auto Truck		3963.45	
Three 67-70 Locos.		74815.40	
Sixteen 20-yd. cars		59884.05	
One Locomotive Crane		21575.53	
Two 100-Ton Steam Shovels		45403.37	
One Model 36 Shovel From Crosby		8862.76	
Shop Tracks		18354.72	
Flat Car		675.00	
Tracks in Pit		21025.84	
Tracks from pit to dump		33839.00	
Bridge and Culverts		3481.48	
Pit Ditching (Trans.to Stripping)			
Coal Dock Tracks		12328.61	
TOTAL	275075.00	304209.21	29134.21

WATER SUPPLY	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Water Supply, Including Locomotive Stand Pipe		9908.06	
Sewers		1285.19	
TOTAL	8500.00	11193.25	2693.25
OFFICE FURNITURE	750.00	748.49	1.51
EXPLORING		1242.20	1242.20
TOTAL	574025.00	516409.63	57615.37
10% for Contingencies	57402.00		57402.00
GRAND TOTAL EQUIPMENT	631427.00	516409.63	115017.37
WASHING PLANT			
Preliminary Work, Clearing Site, Etc.		2018.85	
Tracks from Dump to Washer		39037.93	
Trestle to Washing Plant		35100.00	
Spur Track from G.N.Main Line		61160.76	
Handling Waste Rock from Washer-Track Work		5295.05	
Diversion Ditch (2)		31597.98	
TOTAL	154600.00	174210.57	19610.57
10% for Contingencies	15460.00		15460.00
GRAND TOTAL WASHING PLANT	170060.00	174210.57	4150.57
TOTAL SUPERINTENDENT'S DIVISION	801487.00	690620.20	110866.80

(1) General Expense for year 1920 transferred to Operating Hill-Trumbull Mine, as per letter of C. D. M. dated 12/17/20.

(2) Diversion Ditch transferred from Deferred Accounts.

MASTER CARPENTER'S DIVISION

	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
TEMPORARY BUILDINGS	2500.00	865.98	1634.02
TEMPORARY COAL DOCK	500.00		500.00
TEMPORARY BOARDING HOUSES			
Buildings		6.65	
Water & Sewer Lines		8.30	
Electric Wiring		142.88	
Furnishings		2053.28	
Rental of Temp. Boarding Hs.		575.00	
TOTAL		2786.11	2786.11
OFFICE & WAREHOUSE BUILDING			
Building		12041.65	
Piping		408.62	
Electric Wiring		114.85	
Water & Sewer Lines		546.40	
TOTAL	8725.00	13111.72	4386.72
SHOP BUILDINGS	43500.00	76218.28	32718.28
LOCO. & STEAM SHOVEL SHOP	15000.00		15000.00

	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
BARN	2000.00	2351.51	351.51
COAL TRESTLE & POCKET	6500.00	7093.51	593.51
HEATING PLANT BUILDING			
Trans. to Acct.35, Shop Bldgs.			
GARAGE - WOOD	2000.00	3879.46	1879.46
STORAGE WAREHOUSE	7000.00	7368.60	368.60
GRAND TOTAL	87725.00	113675.17	25950.17
10% for Contingencies	8772.00		8772.00
TOTAL MASTER CARPENTER'S DIV.	96497.00	113675.17	17178.17

CHIEF MECHANICAL ENGINEER'S DIVISION

WASHING PLANT	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Washer Bldg.Trestle &			
Crusher Building		81482.44	
Probable Extras		13701.76	
Doors,Floors,Windows, Etc.		10920.84	
Foundations		9924.12	
Receiving Bins - 600 Yards		13562.38	
Receiving Bins - Linings, Etc.		1374.38	
TOTAL	90000.00	130965.92	40965.92
MACHINERY IN WASHING PLANT			
Machinery		66579.02	
Freight		1656.79	
Erection		14031.03	
TOTAL	75000.00	82266.84	7266.84
CRUSHING PLANT			
Crushing Machinery		35846.78	
Freight		325.22	
Motors,Including Wiring & Instg.		11410.81	
Belts & Weightometer		4436.89	
TOTAL	45300.00	52019.70	6719.70
WATER TANK			
Water Tank, Erected		5294.35	
Foundation		1040.46	
Pipe In Mill		1576.81	
TOTAL	8900.00	7911.62	988.38
WIRING PLANT IN CONDUIT	500.00	1176.32	676.32
PUMPING PLANT AND PIPE LINE			
Plunger Pump, Freight,			
Foundation & Erecting		13800.64	
Motor		63.38	
Frt.Foundation & Erecting		1194.33	
Station Piping		5169.36	
3000' 20" Pipe,Frt.& Installing		9337.82	
Brick Building		4720.88	
TOTAL	27300.00	34286.41	6986.41
DIVERTING STREAM AND DAM	7200.00	8929.74	1729.74

	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
TELEPEHONE LINE	1000.00	2606.59	1606.59
TRANSMISSION LINE		1831.58	1831.58
TEMPORARY BUILDING	2000.00	856.16	1143.84
HANDLING WASTE ROCK Electric Locos. & 4 Cars	8000.00	5382.97	2617.03
SUB-STATION COMPLETE	7500.00	5692.22	1807.78
TOTAL WASHING PLANT	272700.00	333926.07	61226.07
10% for Contingencies	27270.00		27270.00
GRAND TOTAL WASHING PLANT	299970.00	333926.07	33956.07
SHOP EQUIPMENT	25000.00	37361.33	12361.33
HEATING SYSTEM	5000.00	10074.86	5074.86
FIRE PROTECTION		962.76	962.76
OIL STORAGE TANKS		648.54	648.54
TOTAL EQUIPMENT	30000.00	49047.49	19047.49
10% for Contingencies	3000.00		3000.00
GRAND TOTAL EQUIPMENT	33000.00	49047.49	16047.49
TOTAL CH.MECH.ENGINEER'S DIV.	332970.00	382973.56	50003.56

STRIPPING

GENERAL EXPENSE	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Engineering		330.97	
Mine Office		1686.01	
Central Office		1147.50	
District Office		1049.71	
Personal Injury		120.98	
TOTAL (1)		4335.17	4335.17
Rental of Equipment (2)		6299.00	6299.00
Ditching & Drainage (2)		873.82	873.82
STRIPPING			
Washer Dump to-date 351000 yds.	140400.00	154091.13	
Additional Stripping to-date 350,000 yds.	140000.00	178792.84	
TOTAL	280400.00	332883.97	52483.97
10% for Contingencies	28040.00		28040.00
GRAND TOTAL STRIPPING (3)	308440.00	344391.96	35951.96

1 General Expense for year 1920 transferred to Operating Hill-Trumbull Mine.
2 Transferred from Opening & Equipping Hill-Trumbull, as these were considered proper charges to Stripping.
3 Stripping charges transferred to Deferred Account.

HILL-TRUMBULL MINE.

SUMMARY

PLANT AND EQUIPMENT	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Superintendent's Division	631427.00	516409.63	115017.37
Master Carpenter's "	96497.00	113675.17	17178.17
Ch.Mech.Engineer's "	33000.00	49047.49	16047.49
TOTAL PLANT AND EQUIPMENT	760924.00	679132.29	81791.71
Exploring (1)		278364.14	278364.14
GRAND TOTAL PLANT & EQUIPMENT	760924.00	957496.43	196572.43
WASHING PLANT			
Superintendent's Division	170060.00	174210.57	4150.57
Ch.Mech.Engineer's "	299970.00	333926.07	33956.07
TOTAL WASHING PLANT	470030.00	508136.64	38106.64
Amt.paid Arthur Iron Mining Co.(2)		18824.30	18824.30
GRAND TOTAL WASHING PLANT	470030.00	526960.94	56930.94
GRAND TOTAL	1230954.00	1484457.37	253503.37
Depreciation		25.42	25.42
AMTS.TRANSFERRED FROM DEFERRED ACCT.			
Expenses a/c Bingham Mine		112.16	112.16
Expenses a/c North Star Mine		57.69	57.69
Taxes - North Star Mine		9072.25	9072.25
Taxes - Bingham Mine		11290.58	11290.58
TRANSFERRED FROM CLEVELAND			
Expenses a/c Purchase of Lands,Etc.		107.10	107.10
GRAND TOTAL OPG. & EQUIPPING	1230954.00	1505122.57	274168.57
Unclaimed Wages		169.24	
Sale of Material & Equipment		1071.54	
Reserve for Depreciation		94213.00	
BALANCE		1409668.79	
GRAND TOTAL STRIPPING	308440.00	344391.96	35951.96
GRAND TOTAL STRIPG.& OPG.& EQUIPG.	1539394.00	1849514.53	310120.53

(1) Amount paid Great Northern Ore Properties for explorations, drilling etc.
(2) Amount paid Arthur Iron Mining Co. for taxes in connection with lands for Hill-Trumbull washing plant.

ANALYSIS OF HILL-TRUMBULL E & A NO. 381

"SUPERINTENDENT'S DIVISION"

"GENERAL EXPENSE"

This account shows an unexpended balance of $79,284.22 as of November 31st., 1921. The Hill-Trumbull Mine was put on an operating basis during August, 1920, shipments of direct ore being started on the 11th and the washing plant on the 23rd. There was an overrun of $8,523.04 on September 1st., but some charges were included at that time, which have since been transferred to operating accounts during 1920. This was the result of a ruling by the Cleveland Office and all E & A General Expense charges for that year were placed against operating.

In preparing our estimates, we figured on commencing operations July 1st., 1920, but due to delays in the delivery of washing plant equipment and to the extreme scarcity of labor, we were unable to start our washing plant until the latter part of August. We, of course, were unable to make any extensive shipments of direct ore until our washing plant was in operation, as it was necessary to sweeten this direct ore. There was an unexpended balance of $13,717.92 on July 1st., so that our estimates were quite close. The overrun of $8,523.04 on September 1st. covered charges for two months beyond the time estimated.

The big item under this caption is "Taxes" and the transferring of 1920 taxes to operating, resulted in showing the large unexpended balance on December 31st., 1921.

The result of transferring "General Expense" charges for 1920 to operating has increased the cost of mining, while setting up the large unexpended balance to this account. The transferring of accounts has made an analysis of the cost sheet extremely difficult.

"MAINTENANCE"

Our estimate of $8,500 for this account shows an overrun of $126.13 on December 31st., 1921. This same overrun was shown when we actually went on an operating basis in August, 1920, but on July 1st. there was an overun of $9,601.61. The transferring of maintenance charges to operations in 1920 was responsible for this. The "Maintenance" account should really have shown the

overrun, as of July 1st. The necessary repairs to keep our steam shovels and cars in service was much higher than we anticipated, due to the fact that we were obliged to push our work during the severe winter weather. At the time of making our estimate, we had anticipated conducting stripping operations during the summer and fall of 1919 and closing down in the winter. The second-hand 12-yard air dump cars were much too light for the winter service. The wooden bodies were not strong enough to handle the frozen material and we had a great deal of difficulty with the air dumping device. These cars would have been alright for ordinary service when the ground was not frozen.

"PREPARING SITE"

This account showed an unexpended balance of $10,024.07 on July 1st., 1920, and $7,904.79 on December 31st. 1921.

Our original plans for building roads, clearing land and grading and ditching were changed materially, as the result of obtaining a very favorable site from the Oliver Iron Mining Company. The work on our shop building and office was postponed and we were able to do practically all of the grading with material from the pit. The ditching proved to be considerably less of an item than we had anticipated.

There is still some work to be done in beautifying the grounds around the office. The cost of this work will not be high, but conditions were such last summer that we thought it advisable to postpone it.

"TEMPORARY EQUIPMENT"

An unexpended balance of $3,620.64 is shown against this account on December 31st., 1921. There was a small unexpended balance on July 1st., 1920, but the transferring of rented equipment charges from this account to that of "Stripping" has raised the amount of the unexpended balance by approximately $3,500.

"PERMANENT CONSTRUCTION AND EQUIPMENT"

There was an overrun of $29,134.21 to this account on December 31st. Work under several of the captions was not completed until early this fall and in consequence the situation on July 1st., or September 1st., 1920, need not be discussed.

The expenditures on the items, "Auto Truck", "Three 67-70 Locomotives",

"Sixteen 20-yard cars", "One Locomotive Crane", "Two 100-ton Steam Shovels", "One Model "36" Revolving Shovel from Crosby Mine", "One Flat Car" and "Bridges and Culverts" were either under our estimate, or over very slightly.

Through an oversight, no provision was made for the expense of laying our shop tracks. When we were preparing the original estimates, we had in mind the question of purchasing the old Oliver shops and layout. In case this deal was not put through, we figured on a location for our shops to the north of the present site and east of the coal dock. There have been charges of $18,354.72 to "Shop Tracks" and exclusing this, the total overrun in "Permanent Construction and Equipment" is within $11,000. Our estimate for the permanent tracks in the pit was $15,000, whereas $21,025.84 has been expended and charged. The actual cost of laying the tracks was in excess of our estimate, due in large part to inefficient labor. Further than this, we laid slightly more track than we had anticipated, due to the necessity of beginning our sinking cuts farther up in the approach.

The account "Tracks from Pit to Dump" overran $5,839, our estimate being $28,000 and the charges $33,839. This overrun was due to the cost of laying track and the price paid for ties being in excess of our estimate. We had considerable difficulty in securing efficient men for this work and the progress made was very disappointing. It was necessary to fan to the eastward of the old Oliver dump along the shore line of Mud Lake. This fill kept settling, due to muskeg conditions and we were obliged to reline and raise approximately 1,000' of track several times.

We expended under "Coal Dock Tracks" $12,328.61, as compared to our estimate of $6,000. This overrun is explained by the change in our plans, resulting in a much longer approach to the dock than we had figured on. With our shop site and tracks to the north, the coal dock spur would have been considerably shorter. Further than this, the actual cost per 100' of track was greater than anticipated. We crossed some spongy ground and it was necessary to carry our sub-grade lower, in order to fill with sufficient good material to hold the tracks. The inefficiency of labor and the increased cost of ties, of course, were also a factor here.

"WATER SUPPLY"

The item "Sewers" underran our estimate $2,214.81, but the water supply, including locomotive stand pipe, overran $4,908.06, making an overrun of $2,693.25 to the caption "Water Supply".

At the time of making our estimate, we had figured on utilizing wooden pipe. We had considerable controversy with the Village of Marble with regard to their furnishing water. The Village officials finally consented to furnish us our water supply and on account of the trouble we were then having at the Wade Mine with wooden pipe, it was decided to install cast iron pipe here. The cost of cast iron pipe was, of course, considerably in excess of wooden pipe and it was right at the peak when we purchased it. Although the line was tested, we had some trouble with leaking joints after we had made our back fill and this required additional excavation for repairs. The line was laid during very cold weather and it is our opinion that the leaks developed as a result of the ground heaving.

The reason for the comparatively large unexpended balance to the account "Sewers" is explained by the fact that we had figured on cess pools, but on account of the poor drainage conditions, we decided to use septic tanks and surface drainage.

"WASHING PLANT"

Under the Superintendent's estimate for "Washing Plant", the accounts "Preliminary Work, Clearing Site, Etc.", "Tracks from Dump to Washer", "Trestle to Washing Plant", "Spur Track from Great Northern Main Line" and "Handing Waste Rock from Washer", came within the estimates.

The total charges under Superintendent's estimate for "Washing Plant" overran $19,610.57, and is due to a charge of $31,597.98 for Diversion Ditches around Little Pinacie Lake. Subsequent to the time that the E & A was prepared, objections were raised by the Jones & Laughlin Company in regard to our using the Little Pinacie Lake as a storage basin and pumping the waters therefrom for use in our washing plant. In order to satisfy the Jones & Laughlin Company, a dyke was constructed to hold back our tailings and a ditch was carried around the north and east sides of the lake to divert the waters pumped from the Hill-Annex Mine, and other surface waters, directly into Big Pinacie Lake. The expense of these

jobs has amounted to $31,597.98. The charges under "Diversion Ditch" were transferred from deferred accounts to the E & A by order of the Cleveland Office.

MASTER CARPENTER'S DIVISION

With the exception of "Temporary Buildings" and "Temporary Coal Dock", all of the Master Carpenter's estimates were exceeded.

Exclusive of the 10%, there was an overrun of $25,950.17 in the Master Carpenter's Division as of December 31st., 1921, and with the 10% included, $17,178.17. The largest overrun occurred in"Shop Buildings"and "Locomotive & Steam Shovel Shops" and amounts to $17,718.28. The "Barn" overran $351.51, the "Office & Warehouse" $4,386.72 and the "Storage Warehouse" $368.60. All of these structures were built by Rosenthal-Cornell Company of Chicago on a cost plus 7% basis. The Master Carpenter's estimates were made before securing final prices on materials and as the cost of same advanced materially, there was a decided overrun from his figures. The Contractor had great difficulty in securing and maintaining good men and the unsatisfactory delivery of material was an appreciable item. We were paying the Contractor 7% on his costs and we did everything possible to assist him at all times, both in securing equipment and men.

The housing situation at Marble was very unsatisfactory and in order to take care of the Contractor's and our men, it was found necessary to rent a building and maintain a rooming and boarding house. There was a charge of $2,786.11 to this account. This was charged under the caption "Temporary Boarding House" and placed under the Master Carpenter's Division. He did not, of course, anticipate anything of this sort when he prepared his estimate.

The estimate of $6,500 for "Coal Trestle & Pocket" was exceeded by $593.51. This was due to the necessity of making a more extensive excavation along our approach than we had anticipated.

An estimate of $2,000 was made for our garage and the intention was to build it of wood. The Contractor had a large amount of brick left over and it was decided advisable to use this in the construction of the garage. The result was an overrun of $1,879.46.

CHIEF MECHANICAL ENGINEER'S DIVISION

The Chief Mechanical Engineer's estimate was exceeded by $50,003.56, on his total estimate of $332,970. This overrun is with the 10% for contingencies.

With the exception of "Water Tank", "Temporary Buildings", "Handling Waste Rock" and "Sub-Station", all accounts showed a substantial overrun above the estimated figures.

"WASHING PLANT"

There was an overrun of $40,965.92 to this account. The estimate was $90,000, or in excess of three times the cost of our Crosby mill. The early figures obtained by Mr. McClure were advanced materially before the contracts were let. Further than this, the construction costs of the receiving bins and foundations were higher than anticipated and all of the jobs were forced, so as to get the mill in shape for operation at the earliest possible time, and turn out the maximum tonnage. Our pit was in shape for production early in the summer, whereas the mill was not in shape to turn over until the 23rd of August. There were considerable delays in delivery of a large part of the material going into the mill and it was impossible to keep a full crew of steel workers on the job. The Worden-Allen foreman did everything possible to keep a full crew and push the job, but he admitted himself that it was disheartening. This Company paid the maximum rate, but the men would not come to this out-of-the-way job and many of them that did come, left after a few days.

The only way we could secure a force of carpenters for the mill work was to take over the Rosenthal-Cornell crew. This end of the job went forward in good shape, but, of course, we were obliged to pay Rosenthal-Cornell 7% on the wages of their men, which were Union rates and higher than we would ordinarily have paid.

"MACHINERY IN WASHING PLANT"

The Chief Mechanical Engineer's estimate of $75,000 for the machinery in the washing plant was overrun by $7,266.84, the price of the machinery and the freight checking out and the cost of erection exceeding the estimate by close to $8,000. The Allis-Chalmers Company sent an erection foreman at our expense and our men did the erecting under his supervision. The force of men were old hands, most of them from the Crosby Mine and they worked to good advantage. It

was necessary to make a number of alterations in the piping and stairways and, of course, this added appreciably to the cost of erection. The estimated cost for the erection of the machinery was, however, too low.

The account "Crushing Machinery" shows an overrun of $6,719.70, on an estimate of $45,300. The cost of the crushing machinery checks out very closely. The motors, including the wiring and installation, overran approximately $5,000 and the belts and weightometer $3,000, the difference in the total being caused by the freight running considerably under the estimate.

The price of the motors advanced appreciably from the time prices were secured until the order was finally placed and further than this, the delay on the variable speed motor for the operation of the 8' pan conveyor necessitated our securing one from Ishpeming for temporary service. The cost of shipping and installing this motor was quite an item. The allowance made for wiring and installation was low.

In the case of the belts and weightometer, where the overrun was close to $3,000, the allowance made in the estimate for the belts was too low and the automatic recorder, or weightometer, was not included.

The cost of "Wiring the Plant in Conduit" exceeded the estimate by $676.32. The ordering of the wiring was delayed in hopes that prices would come down. In place of securing a reduction in prices, they advanced. Further than this, the original plans for wiring were found not to be entirely adequate to secure sufficient light for night operations and additions were made.

Expenditures under "Pumping Plant & Pipe Line" overran the $27,300 estimate by $6,986.41. The pumps themselves, including freight and the cost of erection, only overran a small amount, but the expenditures for piping installed, exceeded the estimate appreciably and the brick building to house the pumps was $1,220.88 over the estimate. At the time of making the estimate, we figured on obtaining a rather cheap second-hand pipe. The cost of the pipe that we obtained was in excess of what we anticipated and in order to keep our suction clear, a line had to be run out some distance further from the pump house, than we had figured on.

"DIVERSION DITCH AND DAM"

Our estimate of $7,200 for the diversion ditch and dam was exceeded

by $1,729.74. This work was let on contract, but the best price that we could secure was in excess of our estimate. Further than this, we found it necessary to do considerable excavation for our suction pipe, whereas we had anticipated that the old creek bed would be sufficient.

The overrun of $1,606.59 for "Telephone Line" and $1,831.58 for "Transmission Line" was caused by our taking current from the Great Northern Power Company at one point and transmitting it from the washing plant to the mine shops. In preparing the estimate, we anticipated receiving current at two points. In our estimate we figured on the telephone line running along the County Highway and thence south to our shop buildings and office. When we found that it was advisable to take our current at one point and transmit it, the telephone and transmission lines were combined and carried around the south end of Mud Lake on land that we controlled. This added, of course, considerably to the length of the line and explains the overrun.

There was a very decided overrun in our "Shop Equipment", the Chief Mechanical Engineer's estimate being $25,000 and the expenditures amounted to $37,361.33. This overrun of $12,361.38 is due to the fact that some equipment was added after the estimate was prepared and the cost of the equipment that we figured on was higher than anticipated.

The cost of our "Heating Plant" installed exceeded the estimate $5,074.86. When Mr. McClure made this estimate, he did not take into account the fact that our pipes were to be laid in a clay soil and that it was necessary to put drain tile under them to take care of the water. The cost of the pipe and the labor of ditching was higher than anticipated and the plant layout really called for more extensive lines than we had figured on.

"STRIPPING"

Our estimated costs of stripping 701,000 cubic yards was 40¢ per yard and the cost realized amounted to $.491. The total cost of stripping includes the rental of all equipment and the pit ditching for drainage.

We had anticipated starting the stripping job in the early part of the summer of 1919 at the time the estimate was prepared. The delay in turning over the second half of the Hill Mine and the postponement of stripping operations till late in November, forced us to conduct operations throughout

the winter. Our second-hand equipment would have worked all right for summer stripping, but it certainly was not strong enough to withstand the very severe service to which it was put. In order to uncover ore for 1920 mining, it was necessary for us to attack a high 70' bank and the 100-ton type standard machine could not dig this to advantage with the heavy frost in the ground. The blasting costs were high and numerous delays were occasioned by severe strains to the shovel. The 12-yard air dump cars were too light to handle the big frozen chunks and we also had trouble with the air dumping device freezing. Repairs on the cars kept several men occupied continuously and even then we could not maintain as many in service as we should have. We rented a number of 7-yard cars from the Oliver Company, but this added to our cost, as it was necessary to keep extra men on the dump to handle them.

We were obliged to discontinue stripping in August, 1920, and put all of our equipment onto ore service. We did not complete ore operations until the early part of November and in order to push the stripping for 1921, we were obliged to continue work on the overburden during the winter of 1920-1921. Our equipment did not receive any overhauling and the 85-C Bucyrus was limping badly before it was finally put into the shops.

A serious handicap to our stripping operations during the period in question was the fact that our shops were not in shape to take in equipment until this stripping job was practically completed. The Oliver Iron Mining Company assisted us with repair work in their shops, but naturally their jobs came first and in cases of breakdowns, we often suffered serious delay waiting for repairs. At the time of making our estimate, we had figured on being able to overhaul our equipment in our own shops at least by the early part of the summer of 1920.

We did not purchase a dump plow for the stripping job, as the expense of this machine was quite considerable and we did not desire to purchase an inferior one. We were able to borrow a plow made in the Arcturus shops of the Oliver Company. This did the work after a fashion, but it was necessary to maintain a fair sized crew of men at all times, as we could not depend on securing the plow whenever we wanted it. The Oliver Company were stripping at

the Arcturus during this same period.

COSTS OF MINING ORE

"DIRECT ORE"

At the time of preparing our E & A, we made an estimate on the cost of producing our direct ore at the Hill-Trumbull properties.

Below is a table showing the estimated cost of the direct ore on cars, as compared with the costs secured during the seasons of 1920 and 1921. In working up the cost sheets for direct ore produced during 1920 and 1921, the stripping was charged off on the basis of shipping ore, regardless of whether it was direct or concentrates and also the items Insurance, District Office, Central Office, Mine Superintendence, Special Expenses, Taxes, Winter Expense and Depreciation:

	ESTIMATE	COST FOR SEASON 1920	COST FOR SEASON 1921
Mining Cost----------	$.250	$.650	$.247
Depreciation---------	.265	.200	.200
Stripping----------	.327	.912	.560
Mine Superintendence-	-	.021	.005
Insurance----------	-	.001	.001
District Office------	-	.071	.007
Central Office-------	-	.072	.010
Special Expenses-----	-	.000	.001
Taxes----------	-	.897	.544
Winter Expense-------	-	.000	.295
TOTAL----	$.842	$2.824	$1.870

The estimated mining cost was to have included Mine Supervision, Insurance, District Office, Central Office and Special Expenses. During the season of 1920, we produced 27,582 tons of direct ore and this was scattered over the year. It was necessary to do an excessive amount of track work to secure the tonnage and the operating costs were very high. As shown by the above table, the cost of production for 1920 amounted to $.650, exclusive of the items, Mine Supervision, Insurance, District Office, Central Office and Special Expenses. Including these items, the cost would have been $.815, or $.565 over our estimate.

By a ruling of the Cleveland Office, the entire General Expense and some Maintenance charges for the year 1920 were transferred to ore operations, whereas only a small proportion of these charges should have gone properly

against this account, the balance to the E & A. This affects the cost per ton by $.299, exclusive of the tax consideration. The transferring of all taxes in 1920 from the E & A to operating resulted in further increasing the cost per ton by $.327.

During 1921 the cost of production as shown on the cost sheet was $.247 and including the items of Mine Supervision, Insurance, District Office, Central Office and Special Expenses, it amounted to $.271, or $.021 over our estimate. The production of direct ore during 1921 amounted to 21,945 tons. While there was considerably less track work done in 1921, it was necessary to separate the direct ore from the wash ore in loading and this added, of course, to the cost. At that the 1921 cost came very close to our estimated figure.

The estimated cost of $.25 per ton for the direct ore was an average for the mine. The bulk of our direct ore is located at the east end of the Hill pit and when we get to operating here and load out a substantial tonnage during a year, we should realize costs well within our estimate. In other words, the average cost of the direct ore during the life of the property should be in line with our estimate.

The items of Taxes and Winter Expense were not set up separately in our estimate, but were included under depreciation. Naturally the costs for 1921 would be very high, on account of the small tonnage produced. The total charges for Taxes and Winter Expense for 1921 amounted to $.839 per ton. The Winter Expense for 1921 was very abnormal. The absorbing of this excessive charge and the heavy taxes against the small tonnage is responsible for the decided increase over our estimated figures.

The following table shows the total cost on cars for the concentrated ore as estimated at the time of preparing the E & A and realized for the seasons of 1920 and 1921:

	ESTIMATE	COST FOR SEASON 1920	COST FOR SEASON 1921
Mining Cost--------	$.420	$ .563	$.328
Concentrating------	.200	.387	.201
Depreciation-------	.265	.200	.200
Stripping----------	.505	.912	.560
Mine Supervision---	-	.021	.005
Insurance----------	-	.001	.001
District Office----	-	.071	.007
Central Office-----	-	.072	.010
Special Expenses---	-	-	.001
Taxes--------------	-	.897	.544
Winter Expense-----	-	-	.295
TOTAL-----	$1.390	$3.124	$2.152

The 1920 and 1921 costs were appreciably in excess of our estimate. In the first place our outputs for these years were very much lower than we had figured on and the charge per ton for Taxes and Winter Expense were, therefore, excessive.

Our estimated mining cost included Mine Supervision, Insurance, District Office, Central Office, Special and Winter Expenses. Adding these items to our mining costs, we overran our estimate by $.308 in 1920 and $.227 in 1921. The actual operating costs were high in 1920, due to the excessive amount of track work for the comparatively light tonnage and the fact that our mill was being tuned up and we did not secure a smooth operation.

During 1921 we handled a very large tonnage of taconite in our endeavor to secure the maximum amount of Bessemer ore. Our pit operations were slowed up to a considerable extent as a result of digging in this hard ground and the capacity of our washing plant was reduced by about one-half while we were treating this material.

The ore that we expect to handle for the next several years will be of a much cleaner character and this will certainly be reflected in both our mining and concentrating costs.

In 1921 we were charged with a very heavy Winter Expense, amounting to $.295 per ton. This charge was very extra-ordinary, in that it included a large amount of remodeling and adjusting at our mill. In the future this expense will be very much less and we should never have such an excessive charge for winter repair work. A part of the open pit equipment was second-hand when we purchased it and it was put to very severe service from the fall of 1919 to the winter of 1921. The cost of overhauling and putting this equipment in shape was very excessive and at least twice what it would be under normal conditions.

The tonnage produced during the two years in question was comparatively light. On account of grading, our capacity at the Hill-Trumbull is 350,000 tons per year. We produced in 1920, 171,166 tons and 299,899 tons in 1921. We had figured at the time of preparing our estimate of production on 350,000 tons in 1920 and 655,000 tons in 1921. If these tonnages had been realized, our charges per ton for taxes and winter expense would have been

very much lighter and our costs would probably have been about in line with our estimate. On account of the grading of our ore, we probably will never be able to exceed 550,000 tons in any one season. We are only able to carry a certain quantity of direct ore in our shipments for a season, on account of its high silica content.

HILL-TRUMBULL MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1921.

GRADE	IRON	PHOS.	SILICA
Hill Bessemer Concentrates,	61.61	.044	8.70
Hill Non-Bessemer Concentrates,	61.85	.060	6.25
Hill Bessemer Direct,	58.66	.045	11.74
Hill Direct,	59.10	.055	10.97

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1921.

	Mine			Lake Erie		
GRADE	IRON	PHOS.	SILICA	IRON	PHOS.	MOIST.
Hill Bessemer Concentrates,	61.40	.044	8.64	61.00	.044	5.60
Hill Non-Bessemer Concentrates,	61.46	.059	6.05	60.66		6.77
Hill Bessemer Direct,			(All Mixed)			
Hill Direct,			(All Mixed)			

ORE STATEMENT AND SHIPMENTS - DECEMBER 31ST, 1921.

	HILL CRUDE	HILL BESS. CONCEN-TRATES	HILL CONCEN-TRATES	HILL DIRECT BESS.	HILL DIRECT	TOTAL	TOTAL LAST YEAR
On hand Jan.1,1921,	0	0	0	0	0	0	0
Output for Year,	437,871	85,877	192,077	4,130	17,815	299,899	171,166
Total,	437,871	85,877	192,077	4,130	17,815	299,899	171,166
Shipments,	437,871	85,877	192,077	4,130	17,815	299,899	171,166
Balance on Hand,	0	0	0	0	0	0	0
Percentage of Recovery, 63.5%							
Output Last Year,	191,863	29,084	114,500		27,582	171,166	

1921 -- No Production, Jan. 1st to May 12th, 1921.
1-10 Hour Shift, May 12th to July 11th, 1921.
1-12 Hour Shift, July 11th to July 20th, 1921.
1-14 Hour Shift, July 20th to Aug. 1st, 1921.
1-12 Hour Shift, Aug. 1st to Aug. 7th, 1921.
2-10 Hour Shifts, Aug. 7th to Sept. 24th, 1921.
Mine closed Sept. 24th, 1921.

1920 -- 2-10 Hour Shifts, Aug. 11th to Oct. 28th, 1920.

HILL-TRUMBULL MINE

COMPARATIVE MINING COSTS FOR YEAR

	1921	1920	INCREASE	DECREASE
PRODUCT				
Direct Shipping	21,945	27,582		5,637
Concentrates	277,954	143,584	134,370	
Total Production	299,899	171,166	127,733	
DIRECT SHIPPING ORE				
Labor	.134	.371		.237
Supplies	.115	.279		.164
Total Direct Shipping Ore	.249	.650		.401
CRUDE ORE - CONCENTRATED BASIS				
Labor	.201	.321		.120
Supplies	.128	.242		.114
Total Crude Ore	.329	.563		.234
Total Cost of Production	.323	.577		.254
MISCELLANEOUS GROUP				
Superintendence	.005	.021		.016
Concentrating	.205	.387		.182
Stripping	.560	.912		.352
Insurance	.001	.001		
District Office	.003	.071		.068
Central Office	.014	.072		.058
Special Expenses	.001	-	.001	
Taxes	.487	.897		.410
Winter Expense	.295	-	.295	
Cost Adjustment	.020	-	.020	
Depreciation	.200	.200		
Total Cost on Cars	2.114	3.138		1.024
Miscellaneous Debits & Credits	.004	-		.004
Grand Total Cost	2.110	3.138		1.028
DIRECT SHIPPING				
No. Shifts & Hours	2-10hr-26	2-10hr-62		
Average Daily Product	844	445	399	
CRUDE ORE - CONCENTRATED BASIS				
No. Shifts & Hours	1-10hr-60 2-10hr-48	2-10hr-67		
Average Daily Product	2,573	2,143	430	

HILL-TRUMBULL MINE

COMPARATIVE WAGES AND PRODUCT

	1 9 2 1	1 9 2 0	INCREASE	DECREASE	
PRODUCT No.Shifts and Hours	299,899 1-10; 2-10;	171,166 2-10hr	128,733		
AVERAGE NO.MEN WORKING	148	111	37		
AVERAGE WAGES PER DAY	4.61	6.53		1.92-29.4%	
PRODUCT PER MAN PER DAY	15.37	13.51	1.86		
LABOR COST PER TON	.300	.484		.184	
TOTAL NUMBER OF DAYS	19,510½	12,671¾	6,838¾		
AMOUNT PAID FOR LABOR	89937.57	82784.33	7153.24		

In 1920 Production from Aug.23rd to Nov. 6th, incl.

" 1921 " " May 12th to Sept.24th "

HILL-TRUMBULL MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICE.	AMOUNT 1921.	AMOUNT 1920.
60% Powder	1,730	.185	320.05	567.54
40% "	18,590	.1607	2,987.55	907.04
30% "	1,250	.1625	203.12	-
Black "	29,750	.084	2.499.00	1,043.45
Total Powder	51,320	.1171	6,009.72	2.518.03
Electric Exploders	2,616	.095ea	248.52	--
Connecting Wire	20#	.5491b	10.98	1.30
#1 Blasting Machine	1		45.00	--
Fuse	1,030	.76c	27.83	2.50
#6 Blasting Caps	1,578	1.45c	22.60	159.83
Cap Crimpers	6	.54ea	3.22	--
Total Fuse, Etc.			338.15	163.63
Total Explosives			6,347.87	2,681.66

	CRUDE & DIRECT	CONCENTRATES & DIRECT	CRUDE & DIRECT
Product	459,816	299,899	219,445
Pounds Powder per Ton of Ore	.1116	.1711	.0847
Cost per ton for Powder	.0131	.0200	.0114
" " " Fuse, Etc.	.0007	.0011	.0007
" " " All Explosives	.0138	.0211	.0122
Avg. Price per lb. for Powder	.1171	.1171	.1353

Commenced operating May 12,1921, and suspended operations Sept.24,1921.

BOEING MINE

ANNUAL REPORT FOR 1921

Mining operations, which were in the nature of development work during January and February, were put on an operating basis March 1st., and continued as such until the mine was closed down on April 30th. During the four months, 19,938 tons of Merchantable Ore and 657 tons of Lean Ore were produced.

The following table shows the analysis of the output for 1921:

	Tons	Fe.	Phos	Mn.	Sil.	Al.
Merchantable Ore-------	19,938	59.10	.076	1.00	7.20	2.99
No. 2 (Lean Ore)-------	657	54.96	.081	1.15	9.78	3.73

Development work at the west end of the mine has progressed far enough to determine the extent of the deposit, as well as the nature of the particular mining conditions. When we resume underground activities, we will have sufficient working places to enable us to secure an output of 10,000 tons per month. We have always figured the underground ore at the Boeing at 8,000 tons per month, or 100,000 tons per year. Due to the fact that our open pit has been somewhat restricted, thus increasing the tonnage of underground ore, we are able to enlarge the underground operations somewhat.

The expected analysis of our underground ore follows:

Fe.	Phos	Mn.	Sil.	Fe.Nat.
58.00	.080	1.25	7.50	49.00

The highest ore developed is some distance back from the shore line and the bulk of our production for 1921 came from this area. When we resume mining activities, the majority of the contracts will be operating in the vicinity of the shore line, with the result that the iron content of our ore will drop somewhat for a time at least.

Moisture samples taken from various places on the 1370' and 1380' Sub-Levels has averaged 15.33%. It is quite likely that the seepage of surface water into this ore affected the moisture somewhat and the breasts where the samples were taken were quite wet.

The open pit will drain the surface overlying the ore body and we expect that the moisture in the underground ore will decrease somewhat as a

result thereof. From present indications, we will not start up the underground work until next fall and by this time the open pit cuts will have been taken down to the top of the ore adjacent to the westerly underground workings.

We are now positive that our stripping will be far enough advanced by the early part of next summer to insure the production of 200,000 tons of open pit ore. It is quite likely that this output can be increased to 300,000 tons, if desired. The maximum production from the open pit will, of course, be somewhat dependent on the grade of the ore available.

BOEING MINE ORE ESTIMATE OF JANUARY 1ST. 1922

The estimate of ore in sight at the Boeing Mine on January 1st., 1921, the tonnage mined during 1921 and the estimate of January 1st., 1922, are shown below. A reduction of 10% was made for rock in all cases and for the underground ore an additional 10% deduction was made to cover mining loss. A factor of 14 cubic feet per ton was used.

	OPEN PIT ORE	MILLING ORE	UNDERGROUND ORE	TOTAL
Estimate of January 1st.1921-	1,638,000	521,000	577,000	2,736,000
Mined 1921----------	----	----	19,938	19,938
Estimate of January 1st.1922-	1,638,000	521,000	637,000	2,796,000

The development of the 1380' sub-level has shown that the ore extends some distance farther west than we had anticipated. The drill holes were spaced 300' apart and as we used the standard method of estimating, we assumed that the deposit pinched out midway between an ore hole and a blank. The increase of 80,000 tons in our estimate of underground ore for January 1st., 1922, as compared with the previous year, is due to the fact that the ore extends further west than we supposed.

The average analysis of the ore estimated in sight January 1st., 1922, follows:

	Tons	Fe.	Phos	Mn.	Sil.	Mois.	Fe.Nat.
Open Pit Steam Shovel Ore-	1,638,000	57.19	.085	.98	8.28	15.00	48.61
Open Pit Milling Ore------	521,000	58.85	.080	1.24	7.12	15.00	50.02
Underground Ore----------	637,000	58.46	.093	.90	6.64	15.00	49.69
TOTAL AND AVERAGES--------	2,796,000	57.79	.086	1.01	7.69	15.00	49.12

For reporting to the Minnesota Tax Commission, the Boeing tonnage is divided between the two forties as follows:

	Tons
Section 6, 57-20 SE¼ of SW¼ ----------	1,223,500
" " " " SW¼ of SE¼ ----------	1,234,500
TOTAL-------	2,458,000

This tonnage differs somewhat from our estimate, but we have never considered it advisable to report our exact figures to the Tax Commission, on account of assumptions in those estimates.

All underground mining activities will be conducted on the 1380' and 1370' levels when we resume work and as the limits of the ore body here is BOEING MINE.

determined, there is no likelihood of our developing any further ore during the year. We do not contemplate any explorations from either underground or in the open pit.

GENERAL SURFACE

As the mine was closed down on April 30th and the force reduced to a minimum, it was not possible to complete the landscape work laid out by Mr. Manning. This job is pretty well completed, however, and when the mine resumes full operations, the work remaining will be accomplished.

During the month of May, several men were employed in piling the framed mining timber and moving all the lagging, ties and covering boards, which had been placed near the shaft, into the timber yard. This gang also cleaned up the debris around the mine buildings and stored all the underground tools and equipment after cleaning and greasing same.

The timber yard was somewhat of a fire risk, on account of the very dry summer and the fact that our locomotives and steam shovels operating in the open pit, 200 yards distant, were continually throwing sparks. The muskeg between the pit and the stocking ground was drained and the dried out material was ignited from sparks from the open pit equipment and burned off and on throughout the summer. In order to guard against fires, a 4" pipe was laid on surface from the mine fire hydrant to the timber yards. The premises were under surveillance both day and night, especially during the extremely dry period when the muskeg was burning.

The Fee Owners required us to place material running between 40 and 50% iron, encountered in development work, in such manner that it was easily accessible for loading. They objected to our dumping this lean material from the rock trestle, claiming it would mix with the rock and that it might be drawn out with the muskeg, which moved here to a certain extent. Under the circumstances, it was necessary for us to place this low grade product along the end of our ore trestle. Due to a considerable settlement in our stocking ground, it was necessary to make fills and this lean material was used for this purpose. The arrangement was entirely satisfactory to the Fee Owners and with this stockpile covering we were not obliged to use covering boards. If our stockpile fill

had been solid ground and we had used covering boards, as originally planned, the cost of the completed job would have been much less, but under the circumstances it was the only solution. The covering of our stocking ground is now satisfactory and in loading out the piles from year to year, we will not be troubled with ripping up and replacing covering boards.

About 150' of the mine launder to the north of the rock pile was pushed out of place, due to the squeezing of the rock pile. This launder was straightened and calked, after the frost was out of the ground. The drainage ditch around the north and east end of the pit was cleared of all material likely to form dams and in several places it was necessary to drive piling and fill behind same, in order to prevent the water from seeping through and flowing into the pit. We were quite apprehensive that the flow of muskeg would affect our drainage ditch, but fortunately the movement stopped before it had reached the ditch in any point.

The Great Northern Railway Company laid the tracks to the shaft during April and ballasted the coal dock track in October. As we made no shipments, it was not necessary to ballast the shaft track. We now have a direct connection with the Great Northern's Susquehanna spur and can unload timber, coal and other material to advantage. It will require about two weeks' work to ballast the shaft track and get it in shape to handle our ore traffic.

Sixteen cars of timber, shipped from the Meadow Mine, were received and unloaded during the summer. There was also a shipment of small mining supplies from the Meadow Mine, which were stored in the Boeing warehouse.

Before the cold weather set in, all water connections to the various buildings were shut off and the traps drained. Stoves were set up in the office and the shift bosses room in the dry, for the accommodation of the clerk and pumpmen. The cost of running the heating plant was, of course, prohibitive.

"LOCATION"

During November, the carpenters from the Hill-Trumbull Mine spent several days in repairing the roofs of the Boeing location houses. The flashing around the chimneys had become loose and the drip from the snow and rains was damaging the ceilings of the houses.

STOCKING

The ore hoisted during the four months that the mine operated was all placed on stockpile.

Following is the tonnage and analysis of both grades of ore stocked during 1921 and in stock on January 1st., 1922:

	Tons	Fe.	Phos	Mn.	Sil.	Al.
Merchantable Ore Stocked During 1921---	19,938	59.10	.076	1.00	7.20	2.99
Lean Ore Stocked During 1921----------	657	54.96	.081	1.15	9.78	3.73
Merchantable Ore in Stock Jan.1st.1922-	21,927	58.91	.076	1.03	7.34	2.93
Lean Ore In Stock January 1st. 1922----	7,551	52.76	.038	1.09	12.82	2.05

Considerable difficulty was encountered in handling the wet ore on our stocking trestle during the severe weather, and it was necessary to clean the headframe chute daily. The draining of the underground ore by the open pit will make quite a difference in the moisture of the ore when operations are resumed.

By fanning, we could stock approximately 100,000 tons from our present trestle. Normally this trestle could take care of 140,000 tons, but due to the fact that we have a No. 2 pile, which must be kept separate, the capacity is materially reduced.

UNDERGROUND OPERATIONS

Mining activities were conducted during the first four months of the year, all work being suspended on April 30th.

On the main level, the south drift was advanced 98' during January and 86' in February, the contract then being moved into the north workings. There was no possibility of completing the south drift and opening subs, so as to go on an operating basis in March. The restriction of the open pit added to our underground area at the north end of the mine and it was deemed advisable to push operations here. All of the main level work at the north end of the mine was completed in March and Contract No. 2 was brought back into the south heading, and advanced its drift 78' during April.

The ground encountered during January and February was hard taconite and did not require timbering, but the material softened and it was necessary to timber the drift during April. Progress was slow in this heading, due to the

fact that the loader was being used entirely in the north workings to speed up this work. There were narrow soft seams running through the hard taconite and the drills became blocked and had to be taken out and cleaned at frequent intervals. Progress in the south heading would have been much more rapid if the ground had been solid taconite throughout.

The main north drift was completed on January 6th and Contract No. 1 was transferred to No. 5 crosscut. This heading was finished February 19th and the gang was put on raising. No. 2, from the south drift, was brought into the main north drift and advanced this heading 78'. Development work on the sub-levels had, in the meantime, shown an extension of the ore body to the west of the assumed limits and it was advisable to provide additional raises to properly handle the product.

One gang, No. 7, started raising from the north heading in January and was occupied with this work until the mine closed down. When work in the north drift was suspended in January, four additional contracts were put on raising and as the heading was advanced later, additional gangs were added on this work. The raises were spaced 40' apart and were put up to the sand.

Raises Nos. 126, 127, 128, 129, 130, and 135, encountered sand at a lower elevation than had been anticipated and it was necessary to start the 1370' Sub therefrom. We had expected to start our 1380' Sub from these raises. Raises Nos. 120, 121, 122, 123, 124, 131, 136, and 139 struck the sand at a higher elevation and they were cut in and the 1380' Sub started from them.

Contracts Nos. 6, 8 and 10 drifted north toward the Susquehanna boundary from raises Nos. 130, 128 and 126 respectively at an elevation of 1370'. No. 6 advanced 70' before there was sufficient ore in the back to put up a raising set to the 1380' Sub, No. 8, 75' and No. 10, 45'. The gangs drove the remaining distance to the boundary on the 1380' Sub. On account of the necessity of transferring, it was decided to only drift from each alternate raise in this territory and the gangs, therefore, drove crosscuts, paralleling the boundary and one set back therefrom for distances of approximately 70' in the case of Nos. 8 and 10, while No. 6 drove west for 130', where rock was encountered. This gang climbed and followed the rock for an additional 65' and was engaged in stoping

back when the mine was closed. Nos. 8 and 10 had mined out a room approximately 130' long and 28' wide along the boundary when mining was suspended.

No. 16 contract drifted west from No. 130 raise on the 1370' Sub for 45'. There was sufficient back here to raise up to the 1380' Sub and the gang pushed ahead to the west at this elevation for 90' and crosscutted north for 75' to No. 6 boundary drift. The idea was to start climbing the rock and start slicing and stoping back from this crosscut as soon as No. 6's work had progressed to the junction of the drifts. In order to shorten No. 6's tram and also avoid a double transfer, No. 16 drove north from No. 131 raise at an elevation of 1380' and tapped No. 6's boundary drift.

Contracts Nos. 12, 14, 17 and 11 cut out from Nos. 125, 124, 123, 122, 121 and 120 raises at an elevation of 1380'. Drifts were extended to the north boundary and south to the open pit limits. Nos. 14 and 17 started stoping operations along the open pit limits, but on account of the saturated condition of the sand and resulting runs, work was abandoned here and when the mine shut down, all of the gangs were preparing to slice back from the boundary. The open pit will drain this territory and when underground work is resumed, we will be able to start here again without encountering sand runs. As there were no transfers necessary from these workings, drifts were driven north and south from successive raises. The pillars between the drifts are approximately 30' and step slicing will be inaugurated when we resume. The average width of our mining limits, between the north boundary and the open pit, is approximately 140' in this locality.

Contracts Nos. 5, 4, 9, 3, 1 and 13 were employed in cutting out drifts from Nos. 135, 136, 137, 138, and 139 raises at an elevation of 1380'. Contract No. 5 drifted west for 225' from 135 raise and had pushed a crosscut into 131 raise, in order to shorten their tram and aid ventilation.

No. 4 pushed a drift 290' west from 136 raise, where rock was encountered. The gang was engaged in climbing the rock and testing the height of ore in the back when work was discontinued.

No. 9 drifted west 275' from No. 137 raise before the rock cut them out in the bottom. The gang then put up a raise and had continued drifting

west at an elevation of about 1390' for 20' when the mine was shut down. While Nos. 4 and 9 had not reached the westerly limits, we feel that they are very close. These headings are now about under one of the location houses and have progressed approximately 180' farther west than we had supposed the ore extended. It will be necessary to leave some ore here to protect the location, there not being a sufficient tonnage to warrant moving any of the houses. It will probably be a question of paying royalty on a tonnage somewhere between 5,000 and 10,000 tons. A considerable part of the ore is only 5' or 6' in width and, of course, the mining cost would be very high.

Contract No. 3 drifted west from No. 138 raise for 213' before the rock cut them out. The gang was following this rock to the westerly limits when work was suspended.

Contracts Nos. 1, 13 and 15 were engaged in developing the ground to the west and south of No. 139 raise. A solid wall of taconite was encountered 170' west of the raise and No. 15 had started slicing operations here when the mine was closed. Nos. 1 and 13 crosscutted south from No. 15's drift, No. 1 to the west and No. 13 to the east of No. 139 raise. The ore body was found to extend 170' south of the raise. When operations are resumed, one gang will start slicing eastward to the open pit limits and a second gang will step slice behind them. There is a 30' pillar between Nos. 1 and 13 drifts.

The production of Merchantable Ore by months was as follows:

	Tons
January	1,455
February	3,729
March	7,800
April	6,954
TOTAL	19,938

During the first week of May, all contract tools, machine drills and locomotive armatures were taken to surface and stored. Props were placed under caps where there was any likelihood of weight and the breasts were boarded where danger of sand runs was eminent. A weekly inspection of the underground workings was made until October. Owing to the necessity of draining our water pipes, we have been unable to run our compressor and the air is so bad that it is not safe to go into any of the subs without first blowing air.

In July a sand run occurred near No. 121 raise, which filled the 1380' Sub workings in this vicinity and a small amount flowed down the raise to the main level. The sand blocked itself and no further movement was noticed.

The Aldrich plunger pump kept the mine free of water by operating five hours out of twenty-four, until the open pit flow was turned into the mine. Only one pumpman was employed. The flow amounted to approximately 150 gallons per minute, one-third of which came from the north workings and two-thirds from the south drift.

Three 4½" casings were driven from the bottom of the open pit to the main level by October 1st., and the open pit drainage water was turned into them. With the exception of 300 gallons per minute, which was handled by an electric pump of the Winston-Dear Company, all of the surface water was diverted into the casings. This raised our flow to approximately 1,150 gallons per minute and it was necessary to employ three pumpmen, each working eight hours, and to operate the Aldrich plunger pump steadily and the centrifugal about one-third of the time.

We could have, of course, handled the entire flow, but pit operations were such that it was advisable to utilize the small 300-gallon pump of the Winston-Dear Company. We feel that the normal pit drainage will decrease somewhat and that we will have no trouble in handling such normal flow with our present underground equipment when the pit is entirely stripped. From our present information, we do not believe that we will encounter any flow of water in the ore on or above the elevation of the first level.

Several dams have been built along the south drift to prevent any sand that might wash down the casings from going to the sump. It will be necessary to enlarge somewhat the underground drainage ditch along the south drift before mining operations can be resumed.

STRIPPING

The Winston-Dear Company resumed stripping operations on January 10th and continued them throughout the year, closing down on the day shaft of December 31st. The Contractors moved 2,402,278 cubic yards of overburden during 1921 at an average cost of 35¢ per yard.

The following table shows the yardage handled by months, the monthly invoices from the Contractor, the cost per yard and the total cost per yard at the end of each month:

	WINSTON-DEAR BILLS	CUBIC YARDS	---COST PER YARD--- FOR MONTH	FOR YEAR
Previous to Jan.1st.1921-	$ 741,932.31	1,332,657	---	$.557
January----------	37,420.79	67,116	$.557	.557
February----------	51,757.10	87,175	.594	.559
March----------	69,334.58	101,947	.680	.567
April----------	97,898.48	211,655	.462	.554
May----------	72,911.47	252,917	.288	.522
June----------	81,060.72	263,967	.307	.497
July----------	71,790.82	263,651	.272	.474
August----------	68,450.88	202,357	.338	.464
September----------	76,279.83	217,381	.351	.456
October----------	81,447.15	355,952	.228	.432
November----------	74,999.76	257,136	.292	.422
December----------	57,611.62	121,024	.476	.424
TOTAL TO JANUARY 1ST.1922	$1,582,895.51	3,734,935	.---	.424

There are still approximately 1,270,000 yards to be stripped, out of a total of 4,974,500 yards estimated.

The deep channel of muskeg material, which crossed the pit to the southeast of the shaft and had given us so much trouble in the summer operations of 1920, had drained to such an extent that cuts were made across it during last winter, without pulling the loading tracks. There was a considerable settlement of the ground to the east of the rock trestle and for a time we were rather apprehensive that the ground to the drainage ditch might be pulled. Fortunately the movement stopped without affecting the ditch and we do not anticipate any further trouble. The muskeg material was washed from the old main dump, an impounding basin having been built with stripping material to receive the soft running ground.

Repairs on the Model "300" shovel were completed early in January

and operations were started with this machine on the 10th. The first job was in digging out our permanent 4% approach grade. At the mouth of the approach, it was necessary to excavate 16' of muskeg and to fill with gravel for a permanent track grade. The "300" shovel took a slice along the north side of the approach cut and had progressed well into the pit on February 24th, when it was shut down and the Model "92" machine started work on a temporary 2½% grade. The bench with the 2½% grade was provided for handling loads during 1921. All the loads were hauled on this grade during the past year and the empties were brought into the pit on the 4% grade. The bench with the 2½% grade will now be removed and all future operations in the pit will be confined to the outside bench with its 4% grade to the mouth of the pit.

As there was not sufficient trackage in the pit to handle the product from both machines, the Model "300" was idle until the bench for the 2½% grade was completed on March 14th. The "300" machine operated continuously from March 14th until the end of the year, its work being confined to the east end of the pit until the first of August. During August and September, sinking cuts were made at the east end of the pit to get down on the next lift, 35' below the old bottom. The sinking cuts were completed and the machine spent the latter part of September, October, November and the forepart of December in taking two cuts at the new elevation the entire length of the pit. During the latter part of December, the machine was used in cutting down to the ore at the east end.

More or less trouble was experienced in sinking for each lift, on account of the flow of water. In spite of the severe weather, the sinking of the final lift was accomplished in much shorter time and at less expense, due to the fact that the water was syphoned into our first level casing pipes and the pipes were cut off as the shovel dug down around them.

The Winston-Dear Company installed three steam pumps of 600 gallons capacity each and one,of 300 gallon capacity, electric centrifugal pump. The flow in the pit bottom is approximately 1,400 gallons per minute and we are now handling all of this water, with the exception of that at the extreme end of the pit, which is being pumped by the Winston-Dear 300-gallon electric pump.

During September and the forepart of October, three 4½" casings

were driven from the bottom of the pit to the first level by the Carlson Exploration Company. These casings holed along the side of our main level south drift, about 3' outside the timber. The pit water has been handled to good advantage through these casings. The pipe projects from a foot to two feet above the pit bottom and a screen guard is placed to prevent coarse gravel, small boulders and chips from entering the pipe. While the flow from the open pit was close to 1,600 gallons per minute for a time, this volume has decreased somewhat and our Weir measurements now show approximately 1,400 gallons. Our mine pumps at the present time are handling about 1,150 gallons of water and the Winston-Dear pit pump about 250 gallons.

While the water was handled to good advantage in the last sinking cut, the Winston-Dear Company experienced considerable difficulty in dumping the wet material. The weather was quite severe, the average temperature being much below normal for December and reaching 33 degrees below zero on one occasion. The wet material would freeze in the cars by the time it reached the dump and it was necessary to keep a large force of men cleaning the cars. Similar material handled during the summer caused more or less delay in the car service, on account of sticking to the bottom.

The "300" shovel could not clean the ore on account of washing. Inasmuch as the cut must be taken to the extreme east end of the pit, we only endeavored to sink to within 3' to 5' of the ore. When operations are resumed in the spring, the shovel will clean the ore in taking the first cut to the east end of the pit.

The Model "92" shovel after completing the 2½% grade bench in March, operated on the island in the center of the pit and cut down around the west edge of the pit. Successive cuts were taken across the pit, lowering the level of the bottom to within 35' of the ore. This shovel was shut down on December 16th. All of the material had been taken to an elevation 35' above the ore, excepting a narrow 40' island in the center of the pit. It will not be advisable to operate with the "92" machine for more than four additional months at the outside. The "300" machine will be used for all of the clean-up work and the tracks in the present pit bottom can be used for loading. With the

use of the large shovel, it will never be necessary to operate trains down to the ore, on account of its ability to load on the bench above. The cost of pushing against the grades to the ore would be quite an item. As soon as stripping conditions become congested, work with the "92" machine will be suspended.

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

	10-HOUR SHIFTS WORKED.	YARDAGE HANDLED	PERCENTAGE	AVERAGE YARDS PER HOUR
Model "300" Marion----	530	1,441,367	60%	272
Model "92" Marion----	530	960,911	40%	181
TOTAL- - - - - - - - -	1,060	2,402,278	100%	226½

A second 100-ton shovel was used for 18 days in May in taking a cut along the south side of the approach, where the muskeg had sluffed and was blocking the approach track.

A new coal dock of 350 tons capacity was constructed along the approach and was put in service during June. This dock will serve the ore loading, as well as stripping operations and it will last the life of the mine.

The tracks between the pit and the dump have been maintained in very good shape. The agreement with the Rogers-Brown Iron Company, covering the joint use of their track and the Boeing Mine track, did not work out satisfactorily to either company and early in the year permission was obtained from the Oliver Iron Mining Company for a second track for Boeing operations. This track was laid to the west of our original line and was completed in May. We discontinued operating on the Rogers-Brown track February 21st., and our agreement with that company was terminated April 1st. The old Boeing track was used for loads and the new track for empties. As the bridges over the County Highway and the Missabe tracks were for single track only, it was necessary to maintain day and night switch tenders at these points.

The condition on the dumps was quite a little better than during the previous year. We obtained permission from the Oliver Company to start a dump along the Hibbing Village sewer ditch. This dump was started back from the ditch and approximately 10' above the normal ground level, the track being laid on the ditch embankment. In fanning to the northeast from the sewer ditch,

the track was raised and when the muskeg was reached, a height of approximately 25' had been secured. A considerable yardage was disposed of here and the bulk of the material yet to be handled will be placed on this ground.

The muskeg sink hole along the main trestle that had restricted our dumping operations so much during 1920 was filled by fanning from the old dump and we were able to push out the dump to the second sink hole. No attempt was made to fill this hole, other than to slush, by washing soft material along the edge of the main dump.

Fanning operations were started south from the filled part of the old trestle and the ground between the trestle and the sewer ditch was filled.

The muskeg material from the pit was either slushed from the cars into the second muskeg hole, or washed from the old dump, into the storage basin, which was prepared along the sewer ditch and at the west end of our stocking ground. Several hundred thousand yards of this material has been handled by washing and the dumping cost was very low. A 150 gallon centrifugal pump was used in the slushing work.

A second trestle was constructed along the sewer ditch and short lifts were provided further east on the main dump. All of the accessible space was filled by the end of the year. It will be necessary to construct a new trestle across the center of the east dump and fan both ways therefrom. We have ample room for the remaining yardage to be stripped. We will have no more muskeg, but there is some clay above the ore. As far as dumping is concerned, we should handle our remaining yardage to very good advantage.

The following table shows the distribution of the Winston-Dear Company's invoices to the various captions, also the cost per yard against these several accounts:

	TOTAL COST FOR YEAR	COST PER YARD
Dumping	$92,888.38	$.0337
Hauling	89,683.79	.0373
Loading	79,686.49	.0332
Track Maintenance	57,302.94	.0239
Fuel	193,729.98	.0806
Locomotive Repairs	31,650.72	.0132
Shovel Repairs	30,309.74	.0126
Car Repairs	23,972.17	.0100
Clerks and General Expense	12,408.42	.0052
General Supplies	9,474.61	.0039
Ties	10,146.37	.0042
Oil, Waste & Packing	7,504.32	.0031
CARRIED FORWARD	638,757.93	----

	TOTAL COST FOR YEAR	COST PER YARD
Brought Forward----------	638,757.93	$.----
Trucking----------	2,517.64	.0010
Water Supply----------	921.80	.0004
Second Main Track----------	6,435.24	.0027
Coal Dock----------	11,815.54	.0049
Buildings----------	419.31	.0002
Trestles----------	2,127.30	.0009
Bridges----------	219.12	.0001
Pit Pumping----------	17,029.59	.0071
Liability, Insurance, Etc----------	12,608.07	.0052
Plant Rental----------	148,111.66	.0616
GRAND TOTAL- - - - - - - - - - - - - - - -	$840,963.20	$.3500

ACCIDENTS

The following list shows the accidents which occurred at the Boeing Mine during 1921 and were serious enough to be reported:

WM. MAKI

Injured----------January 18th, 1921.
Occupation----------Miner.
Nationality----------Finnish.
Time Lost----------36 Days.
Compensation Paid----------$90.00.

Remarks: Maki was throwing lagging onto a car and hit his hand against the side of the car. He did not report the accident until the next day. Maki sustained a spiral fracture of the 4th meta carpal bone of left hand.

STEVE MILISOJIVICCHI

Injured----------March 29th, 1921.
Occupation----------Timberman.
Nationality----------Austrian.
Time Lost----------34 Weeks.
Compensation Paid----------$510.00.

Remarks: Milisojivicchi was hoisting timber from the main level to the sub above. There was a pile of timber and lagging lying alongside of the drift. He stepped aside to let motor train go by, not noticing that there was insufficient clearance. The motor hit a piece of timber, which struck Milisojivicchi's leg, causing a fracture of right tibia and fibula at junction of lower and middle third.

WAINO MATERI

Injured----------March 31st., 1921.
Occupation----------Miner.
Nationality----------Finnish.
Time Lost----------3 Days.
Compensation Paid----------None.

Remarks: Materi was decending a ladder in raise No. 127 too rapidly. His hands slipped off the rungs and he fell 20'. He suffered a 3" cut on his scalp and an abrasion of the left arm.

CLARENCE HALTER

Injured----------April 1st., 1921.
Occupation----------Surface Laborer.
Nationality----------American.
Time Lost----------13½ Days.
Compensation Paid----------$33.75.

Remarks: Halter was assisting the teamster in loading a wagon with mine timber. He slipped on some ice and a piece of timber rolled against the wagon stake, catching and severely bruising and lacerating the left thumb.

Following is a detailed statement of the Boeing Mine E & A No. 380, covering accounts thereunder from February, 1919, to November 30th, 1921. With the exception of the stripping job and a very small amount of landscape work, the charges under the E & A have been completed.

SUPERINTENDENT'S DIVISION

GENERAL EXPENSE	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE
Insurance		226.44	
Engineering		13031.03	
Analysis		3654.24	
Mine Office		24522.30	
Central Office		14053.08	
District Office		10023.41	
Taxes		59464.28	
Mining Captain		5556.00	
Legal		865.29	
Personal Injury		2627.92	
Special Expenses (1)		100.66	
Contingent Expense		36.16	
Policeman		622.00	
TOTAL	89200.00	134782.81	45582.81
MAINTENANCE			
Tracks & Cars		930.26	
Building		143.33	
Shop Machinery		16.64	
Boilers		52.07	
Hoisting Machinery		313.65	
Compressor & Air Pipes		520.93	
Pumps		1996.35	
Trestles		232.40	
TOTAL	3200.00	4205.63	1005.63
SINKING IN SAND			
Sinking to-date 110'		9597.26	
Timbering		6896.22	
Proportion of Acct.#7		5493.99	
TOTAL	17000.00	21987.47	4987.47
SINKING IN ROCK			
Sinking to-date 127'		13329.64	
Timbering		6275.73	
Proportion of Acct #7		10324.23	
TOTAL	29800.00	29929.60	129.60
DRIFTING TO ORE BODY			
Drifting To-date 4103'		129031.17	
Timbering		43262.92	
Proportion of Acct.#7		61029.24	
TOTAL	79980.00	233323.33	153343.33
PLATS AND POCKETS		3854.89	
Proportion of Acct.#7		1137.06	
TOTAL	5000.00	4991.95	8.05

BOEING MINE.

PREPARING SITE	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Building Roads		3767.43	
Clearing Land		610.27	
Grading & Ditching		32844.58	
TOTAL	20650.00	37222.28	16572.28
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	4500.00	4040.00	460.00
PERMANENT CONSTR.& EQUIPMENT			
Timber Tracks & Cars		1652.21	
Undg. Tracks & Cars		3057.18	
Electric Haulage Tracks		5615.09	
Power Drills		6689.92	
Pump House and Sump		12544.47	
Team & Teaming Equipt.		1000.89	
Underground Loader		2843.60	
Ventilating Equipment		2763.07	
Auto Truck		3992.03	
TOTAL	31400.00	40158.46	8758.46
WATER SUPPLY			
Water Supply		2112.00	
Sewers		1885.50	
TOTAL	6000.00	3997.50	2002.50
OFFICE FURN. & FIXTURES	750.00	730.99	19.01
EXPLORING (2)	21000.00	95155.66	74155.66
TOTAL	308480.00	610525.68	302045.68
10% for Contingencies	30848.00		30848.00
TOTAL SUPERINTENDENT'S DIV.	339328.00	610525.68	271197.68

(1) Proportion of allotment of Lake Superior Industrial Bureau for 1920-1921.
(2) $75503.82 Exploration charges transferred to Opening Mine, as per letter CDM 5/18/20.

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		10409.26	
Lockers & Wash Troughs		1058.43	
Piping		643.93	
Wiring		296.45	
TOTAL	10200.00	12408.07	2208.07
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		9422.83	
Ten Ton Rail		671.51	
Stockpile Plank		199.47	
TOTAL	13400.00	13740.26	340.06
COAL DOCK	4000.00	1906.99	2093.01
PULLEY STANDS	800.00	95.62	704.38
GRAND TOTAL	56950.00	57943.99	993.99
10% for Contingencies	5695.00		5695.00
TOTAL MASTER CARPT. DIVISION	62645.00	57943.99	4701.01

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

	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
SINKING PUMPS			
Pumps		975.00	
Steam & 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		445.79	
Sheaves		432.54	
Wire Rope		263.13	
Erecting		4020.42	
TOTAL	15200.00	17077.47	1877.43
COMPRESSOR PLANT			
Compressor & Motor		8752.31	
Foundations		358.05	
Receivers		1064.03	
Piping		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	
Pockets		3366.54	
Heating & Lighting		601.43	
TOTAL	16100.00	18968.55	2868.55
SHOP EQUIPMENT			
Equipment		6718.08	
Installing		1039.45	
TOTAL	10500.00	7757.53	2742.47
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		3892.99	
Erecting		2589.80	
Rotary Dumps Installed		5014.00	
TOTAL	29400.00	28884.39	515.61
PUMPING PLANT			
Pumps, Motors & Control		10972.07	
Water Column & Station Piping		3042.27	
Electric Lines in Shaft		360.20	
Erecting		3396.32	
TOTAL	15200.00	17770.86	2570.86

SAFETY APPLIANCES	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
TOTAL		900.67	900.67
HEATING SYSTEM			
Boiler		893.99	
Pipe Covering		198.18	
Piping & Radiation		2487.30	
Ditching & Erecting		4013.28	
TOTAL	5000.00	7592.75	2592.75
FIRE PROTECTION	1000.00	901.33	98.67
RECORDING GAUGES	100.00		100.00
TESTING MACHINERY	250.00		250.00
OIL STORAGE TANK	450.00	635.08	185.08
TELEPHONE SYSTEM	500.00	335.10	164.90
SURFACE ELECTRIC LIGHTING	1500.00	1795.32	295.32
COOLING TOWER		649.54	649.54
SUB STATION BLDG. & POLE LINE			
Equipment		4418.25	
Transmission Line		2050.72	
Erecting		1072.13	
TOTAL		7541.10	7541.10
UNDERGROUND LIGHTING		1665.01	1665.01
GRAND TOTAL	117100.00	141740.93	24640.93
10% For Contingencies	11710.00		11710.00
TOTAL CH.MECH.ENGR.DIVISION	128810.00	141740.93	12930.93

STRIPPING

STRIPPING	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Total to-Date 3,613,911 yds.		1460757.03	
Stripping Clerk		3212.00	
Office Expense		1830.80	
TOTAL	1815000.00	1465799.83	349200.17
10% for Contingencies	181500.00		181500.00
GRAND TOTAL STRIPPING	1996500.00	1465799.83	530700.17

BOEING MINE.

SUMMARY

	ESTIMATE	TOTAL TO-DATE	UNEXPENDED BALANCE.
Superintendent's Division	339328.00	610525.68	271197.68
Mater Carpenter's "	62645.00	57943.99	4701.01
Ch.Mech.Engineer's "	128810.00	141740.93	12930.93
TOTAL	530783.00	810210.60	279427.60
Stripping	1996500.00	1465799.83	530700.17
Idle Expense		34636.24	34636.24
Tracks - Main Lines to Mine	23000.00		23000.00
Improvement Work		1955.18	1955.18
TOTAL	2550283.00	2312601.85	237681.15
Amt.pd.Arthur Iron Mng.Co.		1784.55	
Dpr. - Supply Inventory		122.17	
Interest on Notes Payable		41271.42	
Depreciation of Supt's Auto		26.87	
TOTAL		43205.01	43205.01
MISCELLANEOUS CHARGES			
Opt. Boeing Rented Buildings		4574.07	
Spec. Expense a/c Curtailment		59.99	
Special War Tax		557.76	
Expense a/c Land Purchased		27.50	
Interest paid on A.I.M.Co.Acct.		54709.38	
Interest Paid on Loans		92123.13	
TOTAL MISCELLANEOUS CHARGES		152051.83	152051.83
GRAND TOTAL	2550283.00	2507858.69	42424.31
Sale of Equipment		25.00	
Ore Produced in Development		72221.10	
MISCELLANEOUS CREDITS			
Shop Earnings		361.36	
Lot Rents		371.75	
Interest Received - Boeing		.20	
Interest Received - Cleveland		5543.12	
Discount on Purchases - Boeing		1469.85	
Discount on Purchases - Cleveland		.70	
Earnings Rented Bldgs.		3855.00	
TOTAL MISC. CREDITS		11601.98	
BALANCE		2424010.61	

ANALYSIS OF BOEING MINE E & A NO. 380

SUPERINTENDENT'S DIVISION

"GENERAL EXPENSE"

In preparing the Estimate and Authorization the "Taxes" were underestimated for the period from August 1st. to April 1st., 1921, when the mine was put on an operating basis. The Tax Commission raised our valuations as the result of our exploratory work and our estimate was based on the old valuations. The estimate of taxes was $48,000, whereas we paid during this period $56,064.28. We paid $3,400 for taxes in April, 1921, when we were on an operating basis. This amount was later transferred to our E & A.

The "Engineering" account overran our estimate by approximately $2,000 as of April 1st., 1921. We went on an operating basis March 1st. and had not planned in our estimate on carrying any engineering charge on the E & A into the operating period. Such was the case, however, and the charges have overrun our estimate by approximately $5,000.

During the months of March and April, the sub-level drifts were extensively sampled. We did not plan on this work in our estimate and the result is that the "Analysis" account overran approximately $2,000.

The estimate for "District Office" just about covered expenses to this account to April 1st. 1921. Charges since then have amounted to about $4,000 and the caption has overrun by approximately this amount. It was expected at the time of making our estimate that charges subsequent to April 1st., 1921, would go against operations.

The estimated amount for "Central Office" was exceeded by approximately $8,000 on April 1st., 1921, and on January 1st., 1922, by $12,000. We did not anticipate such a large charge for Central Office and, of course, this account was carried on through the operating period of March and April. The heavy curtailment made at other properties threw a larger proportion of Central Office charges to the Boeing. The stripping payroll is included in figuring the proportional charge of Central Office.

The "Mine Office" showed an overrun of about $10,000 as of April 1st., 1921, and $12,000 on December 31st., 1921. The increase in wages, the in-

cluding of an assistant clerk and policeman and the extension of time beyond that figured on in our estimate explains this overrun. The heating account was higher than we had figured on.

"MAINTENANCE"

The amount estimated for this account was exceeded by $313.43 on April 1st., 1921. The charges to this account while we were on an operating basis brought the overrun to $1,005.63.

"SINKING SHAFT"

The actual cost of "Sinking Through Rock" was very close to the amount estimated, but the account "Sinking in Sand" was exceeded by approximately $5,000. We encountered quick sand in the shaft and were obliged to discontinue sinking operations for a time in order to jack back the sets and place blocking. These costs as well as the pumping charges were going forward in the meantime and when we resumed sinking, the progress was slow, as extreme care had to be exercized to avoid disturbing the sand and precipitating runs. Heavy plank spiling was driven behind all of the sets from the point where quick sand was encountered to the ledge. All of this work added materially to the cost. Our estimate would have been ample for this account, if we had not struck the quick sand.

"DRIFTING TO ORE BODY"

The account exceeded our estimate by $103,591.51 when we went on an operating basis. Subsequent to this time, additional charges were made, covering the development of our subs and extensions of the main level. The charges to this account during the operating months of March and April increased the overrun materially and at the end of 1921 had reached $153,343.33.

Our estimated cost per foot for drifting and raising was very much too low, considering the nature of the ground encountered. Aside from this, wages were increased beyond our expectations and we were not able to get efficient labor. The cost of coal during 1920 affected our bills for current, resulting in carrying the pumping, hoisting and compressing accounts considerably above that contemplated. The wet material was very difficult to handle on the top landing and in the stocking cars. This account would have been overrun very appreciably in any event, our estimates being based on results obtained in our properties where conditions were more favorable. We only took into account the

advances in wages as affecting labor costs.

As regards the expense of drifting, the cost was raised appreciably, due to our inability to obtain and hold good rock drillmen and to the fact that the seamy ground was very difficult to drill. We would have made better progress if the ground had been solid taconite. The material from the softer seams clogged the drills and the back of the drifts broke down in spite of careful blasting, sometimes winding off from 3' to 6' above the sets, or until a particularly hard seam was reached. This necessitated considerable blocking and added materially to the cost of timbering, as well as increasing the amount of ground to handle. We used an Armstrong Loader in mucking our main level headings. Provided this machine had given good service, our costs would have been better. The loader did not operate a week without some breakdown and in several instances it was laid up for repairs for several days. The men depended on the loader and we did not get the satisfactory results from hand mucking that we would have in case the machine had not been used at all.

The cost and quantity of timber used in our underground development was greater than we had anticipated at the time of making our estimate.

In preparing our Estimate and Authorization, we figured on the following development work:

1,150' of Rock Drifting (Main Level)
2,800' of Ore Drifting (Main Level)
100' of Rock Raising to Subs
433' of Ore Raising to Subs
4,483' TOTAL.

The following amount of work has been accomplished and charged to our E & A. The Sub-Level drifting should have gone against operating expenses under ordinary conditions;

2,883' of Rock Drifting (Main Level)
1,228' of Ore Drifting (Main Level)
304' of Rock Raising to Subs
662' of Ore Raising to Subs
5,077' TOTAL.
3,610' Ore Drifting on Subs
8,687' GRAND TOTAL.

Not alone was the actual cost of drifting and raising figured too low, wages being taken into account, but the quality of labor was not given proper consideration.

From a comparison of the above tables, it is apparent that the total amount of drifting estimated on the main level was exceeded by 161' and whereas we had figured on about 1,150' of rock drifting, we actually accomplished 2,883', a difference of 1,733'. The cost of the rock work was considerably in excess of that for ore and this increased our E & A expense against the caption materially.

Due to an extension of the ore body beyond the easterly limits as indicated by the drill holes, we were obliged to push out this heading 161' further and put up a number of additional raises. Further, our open pit plans had to be altered on account of the Rogers-Brown Company objecting to our carrying the stripping over their line and interfering with their surface arrangement. The result of this was to increase the tonnage of ore to be mined underground and added considerable raising to our original plans. Instead of 100' of rock and 433' of ore raising, we have completed and charged under our E & A, 304' of rock and 662' of ore raising, a difference of 433'. All of the 3,610' of sub-level drifting was done while we were on an operating basis. The account was later transferred to the E & A, affecting the overrun materially.

The following table gives our estimated footages and costs, also the actual footages and costs realized, based on the estimated price per foot in each case:

		ESTIMATED FOOTAGE	ACTUAL FOOTAGE	COST OF ESTIMATED FOOTAGE	COST OF ACTUAL FOOTAGE
Rock Drifting	@ $33.00	1,150	2,883	$37,950	$95,139
Ore "	@ 13.00	2,800	1,228	36,400	15,964
Rock Raising	@ 13.00	100	304	1,300	3,952
Ore "	@ 10.00	433	662	4,330	6,620
GRAND TOTAL		4,483	5,077	$79,980	$121,675

Grand Total Footage----------	$ 121,675
Cost of Estimated Footage----------	79,980
Difference----------	$ 41,695
Estimating 3,610' Sub-Level Drifting @ $8.00 per foot----------	28,880
GRAND TOTAL DIFFERENCE----------	$ 70,575

This table shows that $41,695 was expended on development work on the first level and raises that were not considered in our estimate and $28,880 for sub-level drifts. This total of $70,575 would reduce the overrun appreciably.

BOEING MINE.

"PREPARING SITE"

There was an overrun of $13,505.60 to this account when we went on an operating basis and charges since then have increased this figure to $16,572.25. The items "Building Roads" and "Clearing Land" checked out very closely, the overrun occurring under "Grading & Ditching".

The actual cost of grading for our stockpile ground and timber yard was higher than we had estimated, due in part to a change in plans, requiring a more extensive fill.

We encountered considerable lean material running from 40% to 50% iron. The Fee Owners required that we make a clean separation of this material and also place it in such a manner that it would be easily accessible for loading. Our rock dump was restricted on account of the movement of the muskeg toward the open pit and the Fee Owners' agents objected to our placing material here. It was, therefore, absolutely necessary for us to handle the lean ore from our ore trestle and in order to dispose of it, it was spread over our stocking ground. This was more expensive than covering boards, which we had figured on, but under the circumstances, our best expedient.

Mr. Manning's plans for beautifying the Boeing Mine premises required more grading and filling than we had anticipated and was an appreciable item in the overrun.

The movement of the muskeg around the north and east sides of our pit required us to provide a second ditch, further back from the pit, and also to do considerable plank piling and back filling with clay along the ditch to the east of the shaft. The cost of this work amounted to several thousand dollars.

"PERMANENT CONSTRUCTION AND EQUIPMENT"

The charges to this account had exceeded the estimate by $7,480.14 when the mine was to have been placed on an operating basis, April 1st. 1921. Since that time there have been further expenses and the overrun was $8,756.45 on December 31st., 1921.

The accounts, "Timber Tracks and Cars", "Electric Haulage Tracks", "Team and Teaming Equipment" and "Auto Truck" checked very closely. The estimate for "Underground Tracks and Cars" had been exceeded by over $1,000 on December 31st., 1921, whereas on April first there was an unexpended balance of $221.14.

The present overrun is explained by the fact that all of our sub-level cars, most of them being built subsequent to our going on an operating basis, were charged off after April 1st. If operating accounts had not been charged under our E & A this estimate would have been ample.

The account "Pumphouse & Sump" overran the estimate by $2,544.47. Sometime after we had made our plans for the sump and prepared our E & A Mr. McClure thought it very desirable to increase the capacity, and this was done. Further, we had not anticipated doing any timbering in the pumphouse or sump, as they were located well back in the rock. The ground proved to be very seamy and the back kept slabbing. It was necessary to timber all of the openings and the cost of this work, together with the larger sump excavated, explains the overrun.

During the progress of our main level development work, it was found necessary to install a ventilating system and in order to speed up the drifting an Armstrong Loader was purchased and put in service. While we did not include these items in our estimate, they benefited the work and if we had realized our estimated costs for drifting, they would have been absorbed. The Loader cost $2,843.60 and the Ventilating System installed $2,763.07.

"EXPLORING"

This account shows an overrun of $74,155.66, which is due entirely to a charge of $75,503.82, covering bonus paid the Arthur Iron Mining Company at the time the lease was taken. This bonus included back taxes, royalties, etc., and should have been a separate account in the E & A. Due to a misunderstanding, the charge was not made at the time the E & A was prepared.

An estimate of $21,000 was made to cover exploring and the charges under this caption amounted to $19,651.84, leaving an unexpended balance of $1,348.16.

"MASTER CARPENTER'S DIVISION"

There were small overruns in practically all of the Master Carpenter's estimates, due in part to delays in letting the contracts, labor and materials going up in the meantime, and in part to the fact that adjustments were made with the Contractor, on account of his showing losses on the various jobs.

As of December 31st., 1921, the Master Carpenter's total estimate has been overrun by $993.99. Taking into account the 10% for contingencies, there is an unexpended balance of $4,701.01. The largest overrun is shown against "Change House" and amounts to $2,208.07. Offsetting this, the charges to "Coal Dock" have been $2,093.01 less than the estimate.

"CHIEF MECHANICAL ENGINEER'S DIVISION"

With the exception of "Shop Equipment", "Electric Haulage", "Recording Gauges", "Testing Machinery" and "Telephone Systems", all of the Chief Mechanical Engineer's estimates were exceeded. This was due to a substantial advance in the price of equipment subsequent to the time that the E & A was prepared.

Including the 10% for contingencies, the Chief Mechanical Engineer's estimate overran by $12,930.93. This is a 10% overrun, the total estimate amounting to $128,810.

"STRIPPING"

According to our original plans, 5,506,000 cubic yards of overburden were to be removed from the Boeing property by the Winston-Dear Company and our estimated cost for same, exclusive of the 10% for contingencies, was $.3296 per yard. Including the 10%, the E & A cost per yard was $.3626.

As no suitable arrangements could be effected with the Rogers-Brown Company, we were obliged to restrict our stripping along the north line of the property, which cut down the total stripping to 4,984,500 cubic yards. On this basis, our original estimate of $1,815,000, exclusive of the 10%, would have called for an average cost of $.3641 for moving 4,984,500 yards, and with the 10%, $.4005 per yard.

The overburden handled by the Winston-Dear Company as of December 31st. amounted to 3,734,935 yards, the total expense $1,599,912.14 and the cost per yard $.4284. On January 1st., 1922, there was a balance of 1,249,565 yards to strip and to bring the cost within our original estimate, exclusive of 10%, it would have to be moved for $.1721 per yard, and with the 10% added, for $.3174. The Contractor should certainly secure an average cost of less than $.3174 for the remainder of the stripping and should, therefore, keep within our original estimate, 10% for contingencies being included.

BOEING MINE.

On the basis of $.3296 per yard, our revised stripping, 4,984,500 yards, would call for an outlay of $1,642,891. The average cost for the 3,734,935 yards handled to December 31st., 1921, being $.4284, a price of $.0344 per yard would have to be secured on the remaining 1,249,565 yards to realize our original estimate, exclusive of 10%, and $.1659 per yard with the 10% included. These costs, of course, will not be realized, but with the adjustments made under our agreement with the Contractor, should average close to $.37 per yard for the entire job. While we will not overrun our E & A estimate, we would have by approximately $200,000 in case our estimated cost per yard had been set up against the correct amount of stripping.

The bad muskeg conditions in our pit and on the dump, together with the unsatisfactory arrangements with the Rogers-Brown Company, covering joint use of tracks during the first year of our operation, resulted in raising the Contractor's costs for stripping beyond what they, or we, had expected. Many serious delays were occasioned by the flow of muskeg in our pit, necessitating changes in the operating plans. As regards the dump, the Contractor could not use the high trestle on account of the muskeg wrecking the benches and it was necessary to fill the holes by fanning and raising from the ground level. The dump ground had been sounded and a hard strata encountered at the bottom of the muskeg. This hard strata proved to be only a few feet in thickness and a considerable depth of muskeg was found to exist below it.

At the time of making our E & A, negotiations were going forward with the Rogers-Brown Iron Company for the use of their track in connection with our operations. The Winston-Dear Company and ourselves felt that this could be worked out to advantage, but such did not prove to be the case and after operating under a joint track agreement with the Rogers-Brown Iron Company for a time, it was found necessary for the Contractor to construct a second track between the pit and the dumps for the exclusive use of the Boeing operations.

BOEING MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1921.

GRADE	IRON	PHOS.	SILICA	MANG.
Boeing,	59.06	.076	7.19	1.01
Boeing Lean Ore,	54.96	.082	9.77	1.16

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1921.

GRADE	Mine IRON	PHOS.	SILICA	MANG.
Boeing,	(No Shipments)			
Boeing Lean Ore,	(No Shipments)			

ORE STATEMENT - DECEMBER 31ST, 1921.

	BOEING	BOEING LEAN ORE	TOTAL	TOTAL LAST YEAR
On hand January 1, 1921,	1,989	6,894	8,883	0
Output for Year,	19,938	657	20,595	8,883
Total,	21,927	7,551	29,478	8,883
Shipments,	0	0	0	0
Balance on Hand,	21,927	7,551	29,478	
Increase in Output,			11,712	
Increase in Ore on Hand,			20,595	

1921 -- 2-8 Hour Shifts Jan. 1st to May 1st, 1921.
Mine closed April 30th, 1921.

1920 -- 3-8 Hour Shifts Jan. 1st to July 1st, 1920.
2-8 Hour Shifts July 1st to Dec. 31st, 1920.

WADE AND HELMER MINES

ANNUAL REPORT FOR 1921.

The total production from the Wade and Helmer Mines for the year 1921 amounted to 69,522 tons, all of which came from underground operations. The output from the Helmer was 13,935 tons and from the Wade 55,587 tons. The properties were closed May 28th and no further mining activities were undertaken during the year.

The average analysis of the ore produced from the two properties during 1921 and the stockpiles as of January 1st., 1922, follow:

	Tons	Fe.	Phos	Mn.	Sil.
Wade Ore Produced During 1921--------	55,587	56.77	.064	1.43	7.49
Helmer Ore Produced During 1921------	13,935	56.45	.069	1.27	10.13
TOTAL & AVERAGES----------	69,522	56.71	.065	1.40	8.02
Wade Ore in Stock January 1st., 1922-	77,271	57.22	.064	1.27	7.50
Helmer Ore in Stock January 1st,1922-	20,354	56.48	.066	1.35	10.03
TOTAL & AVERAGES----------	97,625	57.07	.064	1.29	8.03

The labor situation improved to a considerable extent during the winter of 1921 and if operations had continued throughout the year, we would have secured much better results.

WADE MINE ORE ESTIMATE OF JANUARY 1ST. 1922.

The following is an estimate of the ore in sight at the Wade Mine on January 1st., 1921, the tonnage mined during the year and the estimate of January 1st., 1922.

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

	Tons
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
Ore mined during 1921 (West Deposit)---------------------------	55,587
Ore in Sight Jan. 1st., 1922 (West Deposit)--------------------	1,365,000
Ore in Sight Jan. 1st., 1922 (East Deposit)--------------------	1,515,000
Ore in Sight Jan. 1st., 1922 (Deacon Deposit)------------------	175,000
TOTAL- -	3,055,000

No ore was mined from the East or Deacon Deposits during the year and as no development work was undertaken here or at the West Deposit, the estimates remain the same as on January 1st., 1921, deducting the ore mined from the West Deposit.

The average grade of ore in the several deposits as of January 1st., 1922, follows:

	Tons	Fe.	Phos	Mn.	Sil.	Mois.
West Deposit------	1,365,000	57.90	.074	1.05	6.79	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-----	1,179,000	57.85	.074	1.33	6.40
Below Main Level-----	186,000	58.11	.073	.74	7.03

The tonnage by forty acre tracts on January 1st., 1922, is as follows:

	Tons.	
SE¼ of SW¼ of Section 12, 58-19--------	305,000	Non-Bessemer.
NE¼ of NW¼ of Section 13, 58-19--------	1,305,000	" "
" " " " " " "-------	80,000	Bessemer.
NW¼ of NW¼ of Section 13, 58-19--------	1,365,000	Non-Bessemer.

HELMER MINE ORE ESTIMATE OF JANUARY 1ST., 1922.

Following is an estimate of the ore in sight at the Helmer Mine on January 1st., 1921, the tonnage mined during the year and the amount in sight January 1st., 1922.

A factor of 13 cubic feet per ton was used in the estimate and a 10% deduction made for mining loss in the case of the underground ore, 20% for rock in the open pit and 25% for rock for the scram ore:

	Tons.
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
TOTAL ORE MINED DURING 1921 (Underground)	13,935
Open Pit Ore in Sight January 1st., 1922	15,000
Scram Ore in Sight January 1st., 1922	26,000
Underground Ore in Sight January 1st., 1922	68,000
TOTAL ORE IN SIGHT JANUARY 1ST., 1922	109,000

No development work was undertaken at the Helmer Mine during 1921 and there is no change in the estimate, the 1921 production being subtracted. We do not anticipate developing any further ore in the Helmer, in fact, due to the low grade and restricted mining conditions underground, we will probably be unable to mine a substantial part of this tonnage.

The average analysis of the ore in sight on January 1st., 1922, follows:

Tons.	Fe.	Phos	Mn.	Sil.	Mois.
109,000	56.00	.070	1.35	9.50	12.50

Of the ore remaining in the Wade and Helmer Mines, 576,000 tons will be mined by the open pit method, 26,000 by scram to pit and 2,562,000 tons from underground operations.

GENERAL SURFACE

Stripping operations were conducted to January 19th and 20,232 cubic yards of overburden was handled. The stripping was taken back to the open pit limits on the first bench. It was advisable to do this before the underground caves had progressed too far along the edge of the pit, as this would have drawn material from the open pit area and made an unsafe footing for the operation of our steam shovel.

To complete stripping operations at the Wade Mine, it will be necessary to remove 162,500 yards additional overburden. As we have a substantial tonnage of open pit ore uncovered, it will probably be some time before any further stripping is done.

A small force of men was employed during January, February, March and a part of April in repair work on the four locomotives and two steam shovels. The dump cars were in pretty good shape and practically no repair work was required on them. The equipment is in good shape for a resumption of stripping and ore operations.

It was necessary to extend the stocking trestle 16 bents to accommodate the product from the Wade shaft. An area to the east of the old stocking grounds was cleared, graded and planked.

Some cleaning was done around the mine grounds and location during April and May and a space was brushed to the south of the timber yard, as a safeguard against forest fires. The water tank, which supplies the Wade location, was emptied and thoroughly cleaned. Repairs were made to the water lines in several places.

The fill, carrying the Helmer incline tail track, was widened to the south with material from the old Wade rock pile. It was necessary to do this work on account of the Wade caves pulling the old fill. The old rock pile material at the Wade was used, as we needed all the space possible for ore.

Some repairs were made on the Helmer incline in preparation for shipments from the pit. The guard fences around the pit were also moved back in places and generally repaired.

The mines were closed on May 28th and all small tools and supplies were taken from the underground workings and stored in the warehouse. A dam was built on the Wade main level to the west of the shaft, as a protection against flood waters from the open pit.

The force was gradually reduced during June, as various jobs were completed, and by July 1st., but six men were employed, pumping and policing. This force was maintained throughout the balance of the year.

UNDERGROUND OPERATIONS

Underground operations at the Wade and Helmer Mines were carried forward with a force of 21 contracts from the first of the year until the mines were closed on May 28th.

The production realized from the two properties during this period follows:

	HELMER.	WADE	TOTAL
January----------	2,386	8,608	10,994
February----------	2,504	10,059	12,563
March----------	2,988	11,066	14,054
April----------	2,879	14,326	17,205
May----------	3,178	11,528	14,706
	13,935	55,587	69,522

The labor situation had improved to a considerable extent and we were replacing inferior men with a better class of miners. If operations had continued, we would have been able to secure better results.

The underground conditions at the Wade Mine were satisfactory and when this property is reopened, there should be a decided improvement in the tons per man realized and the cost per ton. The cave has developed generally and a substantial mat has now been established. There should be very little trouble with sand runs in the future.

At the Helmer, we were not able to secure a favorable operation on account of the very restricted workable areas and the presence of considerable weight. It was possible to work only from five to six contracts and a large amount of repair work was necessary to keep the tramways open on the subs. If it were not for the very low overhead against the Helmer operations, the costs here would be prohibitive.

The wash from the open pit has blocked the Helmer portal and when we resume underground work, it will be necessary to do quite a little cleaning with a steam shovel in the open pit, as well as remove such sand and clay as has washed into the main drift.

We feel that the weight at the Helmer Mine will decrease somewhat, now that the cave is fully developed. If this is the case, operations here can

be conducted to much better advantage and we will obtain better results.

We should be able to maintain an output of 15,000 tons per month from the Wade and Helmer underground workings without any difficulty.

WADE UNDERGROUND WORKINGS

"1440 Foot Sub-Level"

Contract No. 14 was engaged here the five months that the mine operated and No. 17 during the months of January, February and March. When the mine was closed, No. 14 was slicing out the small pillar along the taconite capping at the south side of the sub.

The deposit at this elevation was 220' long and averaged 100' in width. The ore was of very fair grade and entirely free from seams of rock. Due to the presence of a dry, but very free running sand, it was necessary to use considerable care in mining and the covering boards were doubled. In spite of the pains taken, several sand runs occurred, which delayed operations and added to the cost. The ore on this sub has now been about exhausted and we do not anticipate trouble with the sand below.

"1420 Foot Sub-Level"

Contract No. 4 was employed at this elevation the first three months of the year and No. 5 the entire five months. These gangs sliced out pillars along the open pit limits, drawing back toward No. 904 raise. On account of safeguarding operations on the 1440' sub, it was necessary to transfer No. 4 and confine No. 5's work to the territory adjacent to the north shore line. When the 1440' sub is exhausted, from two to three contracts will be employed on the 1420'.

The grade of ore mined here is above the average for the mine and with the exception of the material lying along the shore line contact, there are no seams of taconite.

"1410 Foot Sub-Level"

Contract No. 6 spent the month of January in slicing out a pillar at this elevation adjacent to No. 902 raise. This gang was then transferred to the 1400' sub. While some development work has been done at this elevation along the north shore line, it will not be possible to do any slicing operations until work at the 1420' elevation is completed.

"1400 Foot Sub-Level"

Five contracts, Nos. 2, 6, 10, 12 and 15, were engaged here in January. One gang was added in February and when the mine was closed, a force of six contracts was employed. All the pillars were sliced back from the Oliver Iron Mining Company's boundary to the horse of taconite which cuts across the deposit in the vicinity of Nos. 9 and 10 raises. No. 15 was slicing out the last pillar near No. 10 raise and the rest of the force was engaged in slicing and caving between the taconite horse and Nos. 702 and 902 raises.

The previous explorations did not show the presence of this horse of taconite, which averaged from 10' to 25' in width. The ore lying against the taconite was of rather low grade and several seams of rock from 6" to 1' in width were encountered some distance from the horse. Considerable weight developed on this sub and it was necessary to do an appreciable amount of repair work.

With the exception of the shore line workings, where active mining operations cannot be conducted until work on the subs above is completed, the deposit at this elevation is now about exhausted. The so-called shore line area is approximately 200' x 200'. Of course, there is the track pillar to the southeast, which cannot be attacked until our shaft is abandoned and final clean up work started.

"1390 Foot Sub"

Contracts Nos. 7, 8, 9 and 18 were employed here in January, Nos. 3 and 11 being added in February and Nos. 4 and 17 in April. Drifts were extended from Nos. 601, 602, 603, 801, 802 and 803 raises and the deposit blocked out between the track pillar, open pit limits and the Oliver Iron Mining Company's boundary. Slicing and caving operations had been started along the Oliver line and the track pillar when the mine was shut down. In the old workings to the north, Nos. 8, 17 and 18 sliced out pillars and caved back to Nos. 502, 701 and 703 raises. A force of six or seven contracts will be employed at this elevation for several additional months. It will then be necessary to transfer the gangs to the next sub below, as the pillars at this elevation are exhausted.

The 1390' sub workings were much freer from rock than the 1400' and the horse of taconite had about practically disappeared.

As was the case on the 1400' sub, the areas along the north shore line and open pit limits could not be attacked until the deposit is exhausted on the subs above.

"First Level"

Contract No. 1 was employed the first two months of the year in driving ahead toward the east deposit on the first level. Water was encountered in February in this heading in the vicinity of No. 3319 drill hole. It was then necessary to do some ditching and after the completion of this job, the gang was engaged in opening the plat at the shaft, driving a drift for our tail track and installing the rotary dump. This work was all completed in April, but as we did not deem it advisable to take a chance on increasing the flow of water, work in the heading was not resumed and No. 1 was transferred to ore. The breast of the first level is now 450' from the shaft and when underground operations are resumed, we will push ahead here, as it is advisable to develop the east deposit without further delay. The grade of ore in the east deposit is somewhat under that of the west ore body and it is advisable to mine this ore while we still have the high grade material in the open pit. The iron content of the east deposit is about a point under that of the west ore body. The manganese, however, is .72 higher and the silica .70 higher.

HELMER UNDERGROUND WORKINGS

"1443 Foot Sub"

Contract No. 2 was engaged at this elevation during the five months that the mine operated. The gang sliced a block of ground 80' in length and averaging 40' in width back from the open pit face. On account of excessive weight, operations had to be discontinued here and No. 2 started slicing at the west end of the sub. The weight had pretty well subsided in May and the gang had started slicing out the 60' pillar standing between the west workings and their old room. It will require several months' work by one gang to exhaust the ore at this elevation. With the exception of the material along the north shore line, the ore at this elevation averages close to 58%.

"1433 Foot Sub-Level"

Contract No. 6 was employed at this elevation during the entire five month period slicing and caving back toward the open pit face in the vicinity

of Nos. 2 and 3 raises. Contracts Nos. 3 and 5 were added to the force in May and began attacking the pillars just back from the open pit face.

From one to two gangs will be employed here for several months when work is resumed. The ore averages about 57% iron. It was not possible to do much work along the open pit face while the weight was excessive, but we now feel that the general settlement has subsided and that the pillars can be taken with safety.

"1410 Foot Sub"

From two to four contracts have been engaged at this elevation during the first five months of 1921. Contract No. 1 sliced and caved out the deposit between the north shore line and the sand capping in the vicinity of No. 3 raise, No. 7 sliced and caved back along the open pit face at the southeast end of the sub, while Nos. 1 and 3 did some development work from No. 0 raise and slicing operations had been started along the south limits between Nos. 1 and 7 rooms.

ACCIDENTS

The following list shows the accidents which occurred at the Wade-Helmer Mines during 1921 and were serious enough to be reported:

WALTER DOBSON

Injured----------January 27th, 1921.
Occupation----------Miner.
Nationality----------English.
Time Lost----------88½ Days.
Compensation Paid----------$206.25.

Remarks: Dobson and his partner were putting in an open set in No. 6 contract at the Helmer Mine. A large chunk of ore fell from the side, striking Dobson's right foot and ankle. He sustained severe bruises, contusions and legamentous strain of right foot.

ARTHUR MUTTON

Injured----------February 16th, 1921.
Occupation----------Miner.
Nationality----------English.
Time Lost----------15½ Days.
Compensation Paid----------$23.75.

Remarks: At the time of the accident Mutton was engaged in shoveling ore into a wheelbarrow, while his partner was picking a hitch for timber. Mutton stood too close to his partner, who in raising his pick, struck and inflicted a puncture wound on the back of his left hand.

TONY BOMBICH

Injured----------April 11th, 1921.
Occupation----------Miner.
Nationality----------Austrian.
Time Lost----------17 Days.
Compensation Paid----------$27.50.

Remarks: Bombich and his partner were lifting a large chunk of taconite. The chunk slipped from his partner's hands and caught Bombich's thumb, causing a crushing injury to distal phalanx of his right thumb, with the loss of nail.

ELI DELICH

Injured----------April 29th, 1921.
Occupation----------Miner.
Nationality----------Serbian.
Time Lost----------33½ Days.
Compensation Paid----------$68.75.

Remarks: Delich was picking out a hitch for timber. A piece of ore slabbed off the breast of the drift, striking him on the back and causing a contusion of back in right lumbar region.

KNUTE KARLSON

Injured----------May 7th, 1921.
Occupation----------Timberman.
Nationality----------Scandinavian.
Time Lost----------34½ Days.
Compensation Paid----------$71.25.

Remarks: Karlson and several others were hoisting a load of lagging. In trying to guide the load, Karlson caught his thumb between the rope and pulley. He sustained laceration of thumb of his left hand, palmar surface.

JOHN PETOSA

Injured----------May 12th, 1921.
Occupation----------Timberman.
Nationality----------Italian.
Time Lost----------42 Days.
Compensation Paid----------$90.00.

Remarks: Petosa strained his back in lifting a heavy piece of timber.

ANALYSIS OF COST SHEET

For purposes of analysis, the cost sheet covering the underground work at the Wade-Helmer Mines for the first five months of 1921 is compared with the same period of 1920.

The production and costs per ton under the several main captions for the first five months of 1920 and 1921 follow:

	1920	1921
Tonnage----------	54,726	69,522
Underground Costs----------	$2.280	$1.908
Surface Costs----------	.391	.191
General Mine Accounts----------	.230	.181
COST OF PRODUCTION----------	$2.901	$2.280

"UNDERGROUND COSTS"

Under this caption, all items with the exception of "Development in Rock", "Timbering", "Ventilation", "Compressor & Air Pipes", "Compressor & Power Drills" and "Electric Tram Plant" showed a decrease in the cost per ton for 1921, as compared with the previous year.

"Timbering" was $.029 per ton higher in 1921, due to the excessive weight encountered at the Helmer Mine and the necessity of putting in props and repairing, preparatory to closing the properties.

There was no "Ventilation Expense" in 1920, whereas in 1921 this amounted to $.002 per ton. The work was done on the upper Wade subs and the First Level.

The purchase of drills, extending air lines on the first level, overhauling the compressor and making replacements to machines in 1921 resulted in showing an increase of $.053 per ton to these accounts.

"Electric Tram Equipment" was $.011 per ton higher in 1921, due to the charging out of a considerable quantity of rail and equipping the first level for motor haulage.

There was an increase of $.038 per ton in "Development in Rock" for 1921, as compared with 1920. Comparatively little rock work was undertaken during the first five months of 1920, whereas in 1921 the first level was

extended and the plat and tail track room cut, all in taconite.

The decrease of $.30 per ton in the item "Stoping" was the result of a 15% decrease of wages February 1st., 1921, and the fact that contract working conditions were more favorable. More gangs were engaged in slicing operations in 1921.

The hand tramming on the Wade upper subs was discontinued in 1921 and there was less transferring necessary on the Helmer subs, explaining the decrease of $.054 per ton in this account.

The item "Pumping" was $.087 per ton lower in 1921. The 1921 tonnage was larger for the first five months of the year, less water was handled and the steam pump in the open pit sump was replaced by a small electric triplex plunger, effecting a substantial saving.

The larger tonnage handled and lower salaries paid, resulted in a decrease of $.023 to the item "Underground Superintendence".

The larger tonnage handled with less charges for maintenance of "Hand Tramming Equipment" resulted in a decrease of $.012 per ton for this item.

The maintenance charges against "Pumping Equipment" were much less in 1921 and this item showed a decrease of $.03 per ton. The steam pumps were overhauled in 1920.

"SURFACE COSTS"

All accounts under this caption, except "Docks, Trestles & Pockets", showed a decrease in the cost per ton for 1921.

"Docks", Trestles & Pockets" was $.001 per ton higher in 1921, due to the cost of extending the Wade stockpile beyond the old grounds.

The item "Hoisting" was $.01 per ton lower in 1921, due to a decrease in wages and a larger output realized per shift.

There was a decrease of $.051 per ton to the account "Stocking Ore" for 1921. During 1920 the pile was fanned, whereas in 1921 the ore was dumped from a trestle, which had been largely charged out in 1920. The decrease in wages February 1st., 1921, was also an item in the lower cost per ton.

On account of the extremely mild winter of 1921, requiring less coal for heating purposes, and the reduction in wages, the heading "Dry House" was lower by $.005 per ton.

The "General Surface Expense" was $.077 per ton lower in 1921, due

to there being less men employed and the reduction in wages February 1st.

The maintenance charges to "Hoisting Equipment", "Shaft", "Top Tram Equipment" and "Mine Buildings", was cut down decidedly in 1921, the larger part of the repair work having been undertaken during the latter part of 1920, and the cost per ton for these items showed a decrease of $.058 per ton.

"GENERAL MINE ACCOUNTS"

Excepting for "Personal Injury Expense", all items under this caption were lower for 1921.

"Personal Injury Expense" was $.011 per ton higher for 1921, due to the settlement of several cases, that of Pete Schemich alone amounting to $780.00, and the legal expense resulting therefrom.

The item "Insurance" was $.002 per ton less, due to the larger tonnage handled in 1921.

While there was somewhat less engineering work required during 1921, the principal reason for the $.012 reduction in the cost per ton for 1921 was the lower salaries paid.

There was a decrease of $.003 per ton for "Analysis" in 1921. The number of determinations was less and the price per determination lower.

Due to a reduction in salaries and the larger tonnage handled, there was a decrease of $.042 per ton in the 1921 accounts "Mine and District Office".

HELMER-WADE MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1921.

GRADE	IRON	PHOS.	SILICA	MANG.
Helmer,	56.45	.069	10.12	1.27
Wade,	56.77	.064	7.51	1.43

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1921.

GRADE	Mine IRON	PHOS.	SILICA	MANG.
Helmer,	(No Shipments)			
Wade,	(No Shipments)			

ORE STATEMENT - DECEMBER 31ST, 1921.

	HELMER	WADE	TOTAL	TOTAL LAST YEAR
On hand January 1, 1921,	6,419	21,684	28,103	31,208
Output for Year,	13,935	55,587	69,522	240,143
Total,	20,354	77,271	97,625	271,351
Shipments,	0	0	0	243,248
Balance On Hand,	20,354	77,271	97,625	28,103
Decrease in Output,	28,787	141,834	170,621	
Increase in Ore on Hand,	13,935	55,587	69,522	

1921 -- 2-8 Hour Shifts Jan. 1st to May 28th, 1921.
Mine closed May 27th, 1921.

1920 -- 2-8 Hour Shifts Jan. 1st to May 21st, 1921 (Helmer).
1-8 Hour Shift May 21st to Dec. 31st, 1921(Helmer).

2-8 Hour Shifts for Year (Wade Underground).
2-10 Hour Shifts May 1st to Nov. 23rd, 1920 (Wade Pit).

HELMER-WADE MINE

SHIPMENTS FOR YEAR 1921.

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Helmer,	0	0	0	42,407
Wade,	0	0	0	200,841
Total,	0	0	0	243,248
Total Last Year,			243,248	
Decrease,			243,248	

WADE-HELMER MINE (SHAFT)

COMPARATIVE MINING COST FOR YEAR

	1921	1920	INCREASE	DECREASE
Product	69,522	123,843		54,321
Underground Costs	1.908	2.280		.372
Surface Costs	.191	.336		.145
General Mine Accounts	.182	.216		.034
Cost of Production	2.281	2.832		.551
Plant Account	.120	.160		.040
Equipment	.003	.007		.004
Taxes	.216	.325		.109
Central Office	.068	.095		.027
Contingent Expense	.008		.008	
Idle Expense	.779		.779	
Cost Adjustment	.211	.002	.209	
Cost on Stockpile	3.686	3.421	.265	
Loading & Shipping		.105		.105
Miscellaneous Debits & Credits	.038	.061		.023
Total Cost on Cars	3.724	3.587	.137	
No. Days Operating	125	309		184
No. Shifts & Hours	2-8hr	2-8hr		
Average Daily Product	556	401	155	
COST OF PRODUCTION				
Labor	1.492	1.938		.446
Supplies	.789	.894		.105
Total	2.281	2.832		.551

Mine closed May 28, 1921.

WADE-HELMER UNDERGROUND

COMPARATIVE WAGES AND PRODUCT

	1921	1920	INCREASE	DECREASE
PRODUCT	69,522	123,843		54,321
No.Hours and Shifts	2-8hr	2-8hr		
AVERAGE NO.MEN WORKING				
Surface	13	31		18
Underground	51	88		37
Total	64	119		55
AVERAGE WAGES PER DAY				
Surface	5.62	6.19		.57-9.20%
Underground	5.43	6.56		1.13-17.22
Total	5.47	6.47		1.00-15.45
WAGES PER MONTH OF 25 DAYS				
Surface	140.50	152.50		12.00
Underground	135.75	164.00		28.25
Total	136.75	161.75		25.00
PRODUCT PER MAN PER DAY				
Surface	17.88	12.70	5.18	
Underground	4.48	4.50		.02
Total	3.58	3.33	.25	
LABOR COST PER TON				
Surface	.314	.487		.173
Underground	1.212	1.457		.245
Total	1.526	1.944		.418
AVG. PRODUCT BRK'G & TRM'G	6.25	6.55		.30
" WAGES CONTRACT MINERS	5.67	7.03		1.36
" " " TRAMMERS				
" " " LABOR	5.67	7.03		1.36
TOTAL NUMBER OF DAYS				
Surface	3,889	9,753¼		5,864¼
Underground	15,506	27,496½		11,990½
Total	19,395	37,249¼		17,854¼
AMOUNT FOR LABOR				
Surface	21837.15	60365.55		38528.40
Underground	84239.98	180462.58		96222.60
Total	106077.13	240828.13		134751.00

Proportion Surface to Underground Men:

1921 - 1 to 3.92
1920 - 1 to 2.84
1919 - 1 to 3.14
1918 - 1 to 3.59

Mine closed May 28, 1921.

WADE-HELMER PIT

COMPARATIVE WAGES AND PRODUCT

	1921	1920		
PRODUCT		116,300 1-10 2-10		
AVERAGE NO.MEN WORKING				
Surface		27		
Underground				
Total		27		
AVERAGE WAGES PER DAY				
Surface		6.38		
Underground				
Total		6.38		
WAGES PER MONTH 25 DAYS				
Surface				
Underground				
Total				
PRODUCT PER MAN PER DAY				
Surface		13.87		
Underground				
Total		13.87		
LABOR COST PER TON				
Surface		.460		
Underground				
Total		.460		
AVG.PRODUCT BRK'G & TRM'G				
" WAGES CONT.MINERS				
" " " TRAMMERS				
" " " LABOR				
TOTAL NO.DAYS				
Surface		8,384¾		
Underground				
Total		8,384¾		
AMOUNT FOR LABOR				
Surface		53494.83		
Underground				
Total		53494.83		

Proportion Surface to Underground Men:

1919 - 1 to 3.67
1918 - 1 to 2.77

Mine leased to C.C.I.C. Jan.2,1918. In 1919 Wade & Helmer were operated as separate units. In 1920 the two were combined and operated as Pit and Underground. No men employed at Pit during 1921.

WADE-HELMER MINE.

TIMBER STATEMENT FOR THE YEAR ENDING DECEMBER 31, 1921.

KIND	LINEAL FEET	AVG. PRICE PER FOOT	AMOUNT 1921	AMOUNT 1920
8" to 10" Timber	33,600		2,978.88	4,099.10
10 to 12 "	71,016		6,391.44	12,297.30
Total	104,616	.0896	9,370.32	16,396.40
	LINEAL FEET	PER 100'		
6' Lagging	265,000	.806	2,177.50	4,661.00
Poles	17,500	2.44 Bd.Meas.	427.50	1,818.00
Covering Boards	211,336	2.586	5,464.58	
Total			8,069.58	6,479.00
Product			69,522	122,689
Ft.Timber per ton of ore			1.49	1.548
" Lagging "			3.88	4.4
" " per ft. of timber			2.58	2.84
Cost per ton for timber			.1348	.1336
" " lagging			.0313	.0380
" " poles			.0062	.014
" " covering boards			.0787	
" " all			.2510	.1864
Equivalent stull timber to bd.measure			187,842	350,958
Feet Bd.measure per ton of ore			2.702	2.861
Total cost for timber, etc., 1921				17439.90
" " 1920				22875.40

Mine closed May 28, 1921.

WADE-HEIMER MINE

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

KIND	QUANTITY	AVERAGE PRICES	AMOUNT 1921	AMOUNT 1920
30% Powder - - - - - - - - -	36,550	.1682	6,150.84	9,964.41
40% " - - - - - - - - -	1,050	.1737	182.43	723.47
60% " - - - - - - - - -	100	.2225	22.25	28.84
Total Powder - -	37,700	.1685	6,355.52	10,716.72
Fuse - - - - - - - - - - - -	82,000	8.70	713.40	1,261.73
Caps - - - - - - - - - - - -	26,400	14.60	385.44	570.35
Cap Crimpers - - - - - - - -	24	.479	11.50	5.25
Total Fuse, Etc. -			1,110.34	1,837.33
Total All Explosives -			7,465.86	12,554.05
Product - - - - - - - - -			69,522	122,689
Pounds Powder per ton of Ore			.5424	.5530
Cost per ton for Powder -			.0914	.0873
" " " " Fuse, Caps, Etc.			.0160	.0150
" " " " All Explosives			.1074	.1023
Avg. Price per Lb. for Powder			.1685	.1580

For operating conditions see "Comparative Wages & Product".

ANNUAL REPORT FOR THE YEAR ENDING DECEMBER 31st, 1921.

Ishpeming, Michigan,

January 10, 1922.

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 1921.

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	Boeing	C. Brewer
" "	Hill-Trumbull	H. C. Bolthouse
Book	Gwinn	W. W. Graff
"	Negaunee	Lackawanna Steel Co.
2 books	Wade,Boeing,Hill-Trumbull	Arthur Iron Mining Co.
5 "	Boeing and 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.

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 1921,

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 due to the depressed condition of the iron ore market. There were no additional men employed during the year. The following men were laid off: C. C. Taylor, engineer, J. D. MacCarthy, engineer, A. Minnear, draftsman and engineer's helper, S. Malmgren, engineer's helper, F. A. Olson, draftsman and engineer's helper, A. E. Carlson, draftsman and engineer's helper, and P. Denn, chauffeur.

The following table shows the personnel of the Departmenr 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	"	" "		
A. Rock	Helper	" "		
J. Trosvig	Engineer	" "		
T.A.Miller	"	" "		
S.Malmgren	Helper	Six months	June 6th	Marquette County Road Com.
C.W.Nicolson	Engineer	Entire year		
A. Minnear	Helper	Six months	June 6th	Marquette County Road Com.
K. C. Pellow	Engineer	Entire year		
P. Denn	Chauffeur	Six months	June 6th	Marquette County Road Com.
F. A. Olson	Draftsman & Helper	" "	" "	" " " "
C.C.Taylor	Engineer	" "	" "	" " " "
A.E.Carlson	Draftsman & Helerp	" "	" "	" " " "
J.D.MacCarthy	Engineer	" "	" "	" " " "

The following table shows the days worked, days sick, percentage of days worked, etc, for all men in the Department. The vacation column shows time granted for regular vacations. All other time lost, other than sickness, is included in the absent column. Eight hours constitute a working day. There was no work Saturday afternoons during the year. When 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 absent column includes days at home because of sickness, death, etc, in the family. The total days as shown in this table are actual days worked and not based on twelve months of

26 working days each:

NAME.	DAYS WORNED.	DAYS VACATION.	DAYS ABSENT.	DAYS SICK.	TOTAL DAYS.	PERCENTAGE DAYS WORKED.
R.J.Chenneour	256½	17		3	276½	93%
H.O.Moulton	272	4½			276½	98%
J. E. Hayden	257½	19			276½	93%
C.W.Nicolson	252½	24			276½	91%
C. C. Taylor	97½	22½		4	124	79%
T. A. Miller	273	3½			276½	99%
K. C. Pellow #	216	13½		49½	276½	78%
J. Trosvig	257	11½		8	276½	93%
J.D.MacCarthy	115½			3	118½	97%
A. Rock	270	4½		2	276½	98%
A. Minnear	118½				118½	100%
S. Malmgren	114		4½		118½	96%
F. A. Olson	117		½	1	118½	99%
A. E. Carlson	118			½	118½	100%
P. Denn	97½	8		1	106½	92%

K. C. Pellow was home with a broken ankle.

The following table shows the number of working days lost because of sickness and vacation by men in the Department for the last five years. The vacation column includes days for regular vacation and days absent:

	1917.		1918.		1919.		1920.		1921.	
	VACATION.	SICK.	VACATION.	SICK.	VACATION.	SICK.	VACATION.	SICK.	VACATION.	SICK.
R.J.Chenneour	26½	½	12	0	2½	0	25	10	17	3
H.O.Moulton	23½	0	1	1	27	5	21½	0	4½	0
J. E. Hayden					0	0	23	4½	19	0
C.W.Nicolson							0	1	24	0
T. A. Miller					18½	1½	16½	0	3½	0
K. C. Pellow			6	4	13	15½	22½	1½	13½	49½
J. Trosvig	6	0	11	10	6½	1½	26½	1	11½	8
A. Rock	20	6	14	0	4½	2½	14½	0	4½	2

The following table gives the names of the men employed in the Department during the last five years, arranged in order of entrance, showing the months worked and the number employed during the month:

	1917.	1918.	1919.	1920.	1921.
C. Brewer	12	12	3		
J. F. Hanst	3				
R.J.Chenneour	12	12	12	12	12
H.O.Moulton	12	12	12	12	12
J.K.Osborne	12	12	12	1	
A. Rock	12	12	12	12	12
J. Trosvig	12	12	12	12	12
J. E. Hayden	4½			12	12
T. A. Miller	12	2½	11	12	12
J.J.Heilala	12	12	10		
S.Malmgren	12	12	12	12	6
C.W.Nicolson	4½			11	12
C.S.Stevenson	7½				
W.F.H.Janzen	9½	12	12	1	
C. Nicholls	6	4	3½		
A. Alanen	8	12	8½		
A.Minnear	6½	12	12	12	6
M.C.Connolly	3½	3½			
K. C. Pellow		12	12	12	12
P. Denn		9	8	9	5
F. Christian		3			
Shu Choe		3½			
A. Ham			8	1	
F. A. Olson			2	12	6
C. C. Taylor				11	6
A. E. Carlson				11½	6
J.D.MacCarthy				6	6
Average number of men	13 5/12	14 1/8	13½	14 1/3	11 5/12

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 assisted the engineers in their underground and surface surveys, planned all surveys in connection with surface work, made the monthly surveys at the Republic Mine for November and December and prepared the annual report maps of the same. Jointly with Mr. J. L. Hyde of the Mine Timber Department he prepared a report on the preservative treatment of mine timbers. In the office he prepared the photographic annual report, ordered the 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 for the entire year. At the Negaunee Mine he made the weekly and monthly surveys, noting and posting geology, supervised the construction of concrete abutments for a dam on the 12th level and gauged the skip runners in the shaft for clearance. In the office he

made the Tax Commission estimate, prepared the maps for the same and finished the annual report tracings and prints.

At the South Jackson Mine he surveyed the extensions after the steal shovel had loaded a small tonnage. He prepared the annual report tracings and prints and also made Tax Commission estimate for the Cliffs Shaft Mine. He assisted in the field and office work in connection with Sections 11, 14 and 22, 47-27 contours.

At the Carp River power house he ran a profile of the bottom of the river from the power house to Lake Superior. At various times he helped the other engineers with their mine and surface surveys.

Below is a table showing the percentage of his time spent at the Negaunee Mine and other miscellaneous work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Negaunee Mine	21%	8%	23%	52%
Miscellaneous	4%	10%	34%	48%
Total	25%	18%	57%	100%

J. ELLZEY HAYDEN did the engineering work at the Maas Mine. At this mine he made weekly trips underground surveying and noting geology, laid out three sub-level development schemes, made cross-sections of the ore body under the Roman Catholic Cemetery, made a composite map of sub-levels above the 3rd level, submitted drawings of a plan to concrete the present shaft, replacing wooden sets with steel, together with a statement showing the estimated cost, submitted a report to the Superintendent on the mining of the Maas ore body Westward to the West limit of the Race Track, together with a surface map of this territory showing all lots with assessed valuation. In the office he prepared the annual report maps and prints and made the Tax Commission estimate and prints to accompany the same.

He did considerable work in connection with Sections 11 and 14, 47-27 contours, both in the field and office, and office work in connection with Section 22, 47-27.

At the Hoist plant on the Dead River he surveyed the pipe line, surge tank, power house, etc.

At the Algoma Steel Company's plant at the Canadian Soo he made a joint estimate with their engineers of the Spies, Stephenson and Negaunee ores in stock.

In the office he posted the City of Ishpeming plat book and made an abstract of the old City of Ishpeming Cemetery. He made a tracing to show the proposed change in Partridge Brook at Negaunee. He helped the engineers with their surveys at various times.

Below is a table showing the percentage of his time spent at the Maas Mine and other miscellaneous work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Maas Mine	27%	2%	43%	72%
Miscellaneous	3%	8%	17%	28%
Total	30%	10%	60%	100%

CLYDE W. NICHOLSON had charge of the engineering work at the Athens Mine. He made weekly trips underground, making the surveys and noting geology, gauged the skip runners to show clearance, made air tests and superintended the erection of a fan, etc, for ventilating system. On surface he made drawings for and superintended the erection of the old Lake crusher at this mine.

In the office he prepared the annual report tracings and prints, made the Tax Commission estimate and prepared maps of the same.

He helped the other engineers with their underground and surface surveys.

In addition to the Athens work, he worked in the field and office on the contours of Sections 11 and 14, 47-27, prepared maps for a special report of the Gardner-Mackinaw Mine, made a special map for Mr. W. S. Prickett, prepared an abstract and made maps of the Sterling Addition at Negaunee and worked on the abstract of the Dead River storage basin lands.

Below is a table showing the percentage of his time spent on the Athens Mine and various other work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Athens Mine	15%	15%.	31%	61%
Miscellaneous	3%	8%	28%	39%
Total	18%	23%	59%	100%

CARROLL C. TAYLOR had charge of the engineering work at the Cliffs Shaft Mine until May 31st when it was closed. At the Cliffs Shaft Mine he made the monthly surveys and ran check surveys on all levels.

He did considerable work making abstract maps for the Dead River water power lease.

In the field he worked on the contour of Sections 11 and 14, 47-27. On June 13th he was laid off because of the depressed conditions.

Below is a table showing the percentage of his time spent at the Cliffs Shaft Mine and various other work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Cliffs Shaft Mine	22%	0%	39%	61%
Miscellaneous	0%	18%	21%	39%
Total	22%	18%	60%	100%

TOM A MILLER did the engineering work at the Angeline, Holmes and Salisbury Mines.

At the Holmes Mine he made the monthly surveys and located diamond drill holes. The area along Section 16 Mine boundaries required constant attention.

On the surface he gave lines and heights for bents for additional stocking room, made a survey for proposed new location of main line railway tracks and estimated the coal on hand. In the office he prepared the Tax Commission maps and the annual report tracings and prints.

At the Angeline Mine he made the surveys until May 31st when this mine was abandoned, made a map of drainage pipe lines, located the old road bed of the Marquette & Bay de Noquet Railroad and estimated the coal on hand. In the office he prepared the Tax Commission maps and annual report.

At the Salisbury Mine he made the monthly surveys until March 5th when this mine was closed. He also estimated the tonnage in the coal pile. In the office he prepared the annual report and Tax Commission maps.

In the field and office he worked on Sections 11 and 14, 47-27 contours, located diamond drill holes in Section 3, 47-27 and helped the engineers with their surveys.

Below is a table showing the percentage of his time spent on the Ange-

line, Holmes and Salisbury Mines and other work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Angeline Mine	4%	0%	7%	11%
Holmes Mine	18%	4%	41%	63%
Salisbury Mine	1%	0%	5%	6%
Miscellaneous	2%	6%	12%	20%
Total	25%	10%	65%	100%

K. C. PELLOW did the engineering work at the Lake, Republic and Spies Mines.

At the Lake Mine he made the monthly surveys until May 31st when the mine was abandoned. He also prepared the annual report for this mine.

At the Republic Mine he made the monthly surveys, located all diamond drill holes and ran special surveys for holing raises. He spent considerable time in the office and field in connection with boundary lines for the division of Smith's Bay. In the office he prepared the Tax Commission and annual report tracings and prints.

At the Spies Mine he made the monthly surveys until May 31st when the mine was closed, located diamond drill holes and in the office prepared the annual report and Tax Commission maps. In connection with the Spies Mine he made cross-sections of the Virgil Mine and also prepared maps for the fee owners.

At the Neely exploration he located all diamond drill holes.

Below is a table showing the percentage of his time spent on the Lake, Republic and Spies Mines and other work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Lake Mine	6%	0%	13%	19%
Republic	13%	2%	32%	47%
Spies	4%	1%	14%	19%
Miscellaneous	3%	1%	11%	15%
Total	26%	4%	70%	100%

JOHN TROSVIG did the engineering work for the North Lake District.

At the Barnes-Hecker Mine he surveyed and gave lines for drifting until March 17th when the mine was closed.

At the Lloyd Mine he made the monthly surveys and estimated the tonnage in the coal pile.

At the Morris Mine he made the surveys, located diamond drill holes and made trips underground with the geologist.

In the office he posted the East-West vertical projection of the North Lake ore body and prepared the annual report maps and made the Tax Commission estimate, prepared maps of the same for the North Lake District.

In addition to the regular mine work, he surveyed and mapped the water lines at the North Lake location, gave lines and grades for digging the Barnes-Hecker conversion ditch and made an estimate of the yardage removed from the same.

Below is a table showing the percentage of his time spent on Barnes-Hecker, Lloyd and Morris Mines and other work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Barnes-Hecker	1%	23%	6%	30%
Lloyd Mine	7%	2%	10%	19%
Morris Mine	20%	3%	27%	50%
Miscellaneous	0%	1%	0%	1%
Total	28%	28%	44%	100%

J. DONALD MAC CARTHY assisted the engineers in the Negaunee District with their surveys and office work. He also assisted with the Sections 11 and 14, 47-27 contours, both in the field and office. On June 6th he was laid off.

Below is a table showing the percentage of his time spent underground, in the field and in the office:

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
41%	13%	46%	100%

ARCHIBALD MINNEAR, a helper and surveyor, assisted with the surveys and did most of the office work for the North Lake District until June 6th when he was laid off.

Below is a table showing the percentage of his time spent at the Barnes-Hecker, Lloyd and Morris Mines and other work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Barnes-Hecker Mine	1%	26%	3%	30%
Lloyd Mine	12%	1%	14%	27%
Morris Mine	18%	1%	21%	40%
Miscellaneous	1%	2%	0%	3%
Total	32%	30%	38%	100%

ALBERT ROCK, a helper, assisted with the surveys at the mines and on surface. After the regular chauffeur was laid off, he drove the Ford truck, collecting the core from the diamond drill holes and taking the engineers to and from the mines.

In the office he made blue prints and all the annual report prints.

Below is a table showing the percentage of his time spent underground, in the field and in the office:

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
13%	50%	37%	100%

SEXTUS MALMGREN, a helper, assisted the engineers, principally with their underground surveys.

In the office he repaired tapes and did other miscellaneous work. On June 6th he was laid off.

Below is a table showing the percentage of his time spent undergroud, in the field and in the office:

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
41%	33%	26%	100%

FREDERICK A. OLSON, helper and draftsman, assisted the engineers with their underground and surface surveys.

In the office he assisted with the plotting and making of the maps for Sections 11, 14 and 22, 47-27 contours. On June 6th he was laid off.

Below is a table showing the percentage of his time spent underground, in the field and in the office:

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
28%	17%	55%	100%

AUGUST E. CARLSON, helper and draftsman, assisted the engineers with their underground and surface surveys.

In the office he assisted with the plotting and making of the maps for Sections11, 14 and 22, 47-27 contours. On June 6th he was laid off.

Below is a table showing the percentage of his time spent underground, in the field and in the office:

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
27%	21%	52%	100%

PETER DEEN was employed as chauffeur, collecting and assorting the core from the diamond drill holes and taking the engineers to and from the mines. On June 6th he was laid off.

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

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL
Angeline Mine,	34%	6%	60%	100%
Athens Mine,	28	24	48	100
Barnes-Hecker Mine,	2	82	16	100
Cliffs Shaft Mine,	47	1	52	100
Holmes Mine,	34	13	53	100
Lake Mine,	43	0	57	100
Lloyd Mine,	37	13	50	100
Maas Mine,	38	8	54	100
Morris Mine,	44	9	47	100
Negaunee Mine,	37	18	45	100
Republic Mine,	30	5	65	100
Salisbury Mine,	19	0	81	100
Spies Mine,	21	9	70	100
Average,	32%	15%	53%	100%

DISTRIBUTION OF TIME.

The next table shows the distribution of time for the various mines and other work for the last three years:

ENGINEERING DEPARTMENT.

DISTRIBUTION OF ENGINEERING LABOR FOR YEARS 1919, 1920 and 1921.

	1919.			1920.			1921.				
	LABOR.	TIME IN DAYS.	PER CENT.	LABOR.	TIME IN DAYS.	PER CENT.	LABOR.	TIME IN DAYS.	PER CENT.	PERCENT INCREASE.	PERCENT DECREASE.
Angeline	$ 697.75	84½	2.26	$ 919.39	111½	2.93	$ 408.28	58½	2.06		0.87
Athens)							2291.62	273½	9.76		0.44
Bunker Hill)	3126.57	393¾	10.53	3235.31	388½	10.20					
Barnes-Hecker	1393.68	216¼	5.78	1887.02	254½	6.68	138.07	17	0.60		6.08
Cliffs Shaft	2469.66	342¾	9.16	2571.15	338	8.87	1245.63	171½	6.06		2.81
Holmes	2183.97	292½	7.82	2119.77	279	7.32	1900.09	265	9.48	2.16	
No.3 Incline	0	0	0	102.44	14½	.39	1.81	½	0		0.39
Lake	1089.14	129	3.45	1042.97	120	3.30	528.22	77	2.73		0.57
Lloyd	815.49	115¾	3.09	1331.07	187½	4.92	977.71	132½	4.69		0.23
Maas	2655.96	343¾	9.19	3529.42	392½	10.30	3191.92	348½	12.45	2.15	
Morris	1174.76	167¾	4.48	1589.73	230	6.03	1886.87	266	9.50	3.47	
Negaunee	3976.41	493½	13.20	3438.50	322	8.45	2233.63	232½	8.24		0.21
Republic	1638.91	232¼	6.21	1530.36	185½	4.87	1422.41	183	6.50	1.63	
Salisbury	1060.03	179	4.79	680.94	86½	2.27	190.77	28	1.00		1.27
South Jackson	511.82	57½	1.54	467.79	40½	1.06	18.69	2½	0.07		0.99
Spies	240.88	32¾	.88	563.59	66½	1.74	469.89	61	2.16	0.42	
Virgil							27.11	3½	0.10	0.10	
Total Ishpeming, Negaunee, Republic & Iron River	$23035.03	3080.75	82.38	$25009.45	3023	79.33	$16932.72	2120½	75.40		3.93
GWINN DISTRICT MINES.											
Austin										0	0
Francis	18.13	2	.05	11.86	1½	.04	27.66	3	0.10	0.06	
Gwinn	21.64	2½	.07	16.32	2	.05	42.93	6	0.20	0.15	
Jopling	13.60	1½	.04	0	0	0					
Mackinaw-Gardner	18.12	2	.05	89.63	5½	.15	69.67	9	0.30	0.15	
Princeton	22.66	2½	.07	19.94	2½	.06	45.12	5½	0.20	0.14	
Stephenson	0	0	0	14.66	1½	.04	47.47	5	0.20	0.16	
Total Gwinn District	$94.15	10½	.28	$152.41	13	.34	$232.85	28½	1.00	0.66	
MESABI DISTRICT MINES.											
Boeing	62.17	6	.16	150.17	17	.44	29.75	3¾	0.10		0.34
Crosby	38.56	4½	.12	103.29	13½	.35	36.17	5	0.20		0.15
Hill-Trumbull	64.97	17	.46	167.16	20½	.54	44.56	6	0.22		0.32
Meadow-Fowler	27.18	3½	.09	77.99	10½	.27	24.89	3½	0.12		0.15
Wade-Helmer	49.62	6½	.18	146.34	17¾	.47	41.67	5¾	0.21		0.26
Great Northern properties	7.91	2	.05	0	0	0	0	0			
Mesabi Range	124.23	31	.83	0	0	0	0	0			
Total Mesabi District	$374.64	70½	1.89	$644.95	79	2.07	$177.04	24	0.85		1.22
WATER POWER											
Dead River	59.38	7	.19	0	0	0					
AU Train	0	0	0	0	0	0	0	0	0		
Carp River	21.23	5½	.15	68.79	6	0.16	97.33	11	0.39	0.23	
Dead River Storage Basin	248.74	41	1.10	460.53	43	1.13	0	0	0		1.13
McClure Plant	606.07	80½	2.15	61.06	8	.21	0	0	0		0.21
Republic Transmission Line	68.46	7	.19	0	0	0	0	0	0		
McClure Plant-Maas Mine Transmission Line	0	0	0	562.40	71	1.86	11.57	1	0		1.86
Dead River Storage Dam	0	0	0	485.04	46	1.21	293.01	34½	1.21		
Total	$1003.88	141	3.78	$1637.82	174	4.57	$401.91	46½	1.60		2.97
SURVEYS & CONTOURS.											
Section 3, 47-27 Expl.	0	0	0	41.77	5½	.14	16.99	2½	0.08		0.06
" 1, " Contours							23.35	4	0.15	0.15	
" 2, "							9.66	2½	0.08	0.08	
" 3, "							29.05	5	0.20	0.20	
" 4, "							4.39	1	0.03	0.03	
" 6, "							6.07	1½	0.04	0.04	
" 11, "							1369.80	164½	5.80	5.80	
" 12, "							54.93	7½	0.27	0.27	
" 13, "							5.54	1½	0.04	0.04	
" 14, "							975.64	136	4.83	4.83	
" 15, "	904.86	190	5.09	867.53	130½	3.43	27.80	7	0.25		3.18
" 21, "			0	346.54	45	1.18	15.41	4	0.18		1.00
" 22, "			0	1090.52	195	5.13	199.83	23½	0.82		4.31
" 23, "			0	38.10	8½	.22	18.83	5	0.20		0.02
" 24, "			0	382.93	47	1.23	0	0	0		1.23
" 26, "							19.33	6	0.22	0.22	
" 27, "							4.84	1½	0.03	0.03	
Neely Exploration			0	42.25	5	.13	13.22	1½	0.03		0.10
Drill Locations	232.21	37½	1.00	0	0	0	0	0	0		
Total	$1137.07	227¼	6.09	$2809.64	436½	11.46	$2794.68	374½	13.25	1.79	
MISCELLANEOUS											
American-Boston	0	0	0	0	0	0	28.93	2½	0.08	0.08	
E & A 379 Cliffs Shaft	1254.23	123½	3.30	26.31	2	.01	0	0	0		0.01
Heating Plant							22.72	3½	0.10	0.10	
Sampling Isabella Mine	39.30	6½	.17	0	0	0	0	0	0		
Abstracts			0	85.57	21	.56	297.88	39½	1.40	0.84	
New Hard Ore Warehouse							6.79	1	0.03	0.03	
Division of Smith's Bay							105.27	15½	0.53	0.53	
Accounts Receivable			0	132.53	28½	.76	0	0	0		0.76
Diversion Ditch, Barnes-Hecker							920.25	136	4.87	4.87	
Miscellaneous	408.47	79	2.11	252.07	33½	.90	157.08	25	0.89		0.01
Total	$1702.00	209	5.58	$496.48	85	2.23	$1538.92	223	7.90	5.67	
Grand Total	$27346.77	3739	100.00	$30750.75	3810½	100.00	$22078.12	2817	100.00		

OFFICE EXPENSE.

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

	1919.	1920.	1921.
Traveling expenses and livery,	$ 428.26	$ 558.82	$ 252.88
Supplies (see below), - -	3364.89	2604.75	2910.19
Operating automobiles, - -	1589.65	2009.39	1877.24
Office expense, - - - -	27.11	230.91	107.93
Insurance, - - - -	22.08	221.25	221.25
Taxes, - - - - -	41.07	45.06	43.63
Total	$5473.06	$5670.18	$5413.12
Total salaries, General Office Engineers, -	27346.77	30750.75	22078.12#
Total office expense, as above,	5473.06	5670.18	5413.12
Total charges to Mining Dept.	$32819.83	$36420.93	$27491.24

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

The following table shows extraordinary charges in the above for the year 1921:

Eugene Dietzgen Company (supplies) -	$ 40.40
Magazines, - - - - - - -	22.00
U.S.Blue Print Paper Co.(supplies) -	68.29
Stenglein Bindery, - " - -	57.73
Eugene Dietzgen Company (supplies) -	40.13
Childs Art Gallery (map negatives) -	638.03
Gutta Percha Rubber Mfg. Co.(rubber mats)	44.65
Keuffel & Esser (tracing cloth) - -	124.18
George A. Newett (printing) - - -	38.16
Eugene Dietzgen Company (supplies) -	51.73
L. E. Paddock (supplies) - - - -	36.66
Stenglein Bindery (printing) - - -	57.17
Eugene Dietzgen Company (printing) -	32.76
C. L. Berger (transit) - - - -	548.20
Childs Art Gallery (annual report) -	340.83
Depr. auto for Engr. & Geol. Depts. -	135.54
Dept. auto truck " " " -	202.75

AUTOMOBILES.

The Ford truck and touring car operated from January 1st to December 15th. Below is a comparative statement of auto and labor expense for three years:

	1919.	1920.	1921.
Company horses,	$ 409.66	$ 426.49	$ 251.18
Company automobiles:			
Salaries, - -	507.57	780.23	601.31
Expenses, - -	1082.08	1229.16	1275.93
Livery hire, - -	0	3.33	0
Traveling expense,	0	0	1.70
Total	$1999.31	$2439.21	$2130.12

COST OF OPERATING AUTOMOBILES.

	1919.	1920.	1921.
Chauffeur's salary, -	$ 507.57	$ 780.23	$ 601.31
Gasoline, oil, etc, -	239.46	280.50	246.39
Tires and tools, - -	193.68	255.92	207.84
Repairs, - - - -	263.98	191.69	292.75
Miscellaneous, - -	40.52	49.40	77.58
Insurance, - - - -	123.36	123.36	113.08
Depreciation, - - -	221.08	338.29	338.29
Total	$1589.65	$2009.39	$1877.24

M I N E S.

ANGELINE MINE.

Monthly surveys were made each month until May 31st when the mine was abandoned.

ATHENS MINE.

Weekly surveys were made and all geology posted. On the 10th level a fan was placed which sucks air from the cage compartment on the 10th level and exhausts into the skip compartment on the 4th level. The air is shunted through the workings by doors placed on the various levels. Before this fan was installed tests showed the air to contain 17.5% oxygen and 2.5% carbon dioxide. Since the installation tests show 20% oxygen and 0.5% carbon dioxide. On the surface the Lake Mine crushing plant was installed at the shaft to crush all ores shipped direct and not stocked.

BARNES-HECKER MINE.

Surveys were made for this mine until it was closed March 17th. The bulk of the work was in connection with new construction on surface, such as stocking trestle, stocking grounds, tail track, coal dock, etc.

CLIFFS SHAFT MINE.

Monthly surveys were made and checked surveys run on all levels. This mine was closed on May 31st.

HOLMES MINE.

Monthly surveys were made. All workings along Section 16 Mine boundaries were surveyed frequently for possible trespasses. On the surface additional stocking ground was laid out and lines and elevations given for a new stock-