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8. COST OF OPERATION: (Continued)

d. Detailed Cost Comparison:

(1) Product:

The Canisteo Mine operated one week over three months during 1934 as compared with 2-1/2 months in 1933. Based on the 1934 accomplishment, there is no question about the capacity output for the mine and washing plant of 800,000 tons of concentrates for the full season.

The character of the ore treated during 1934 was about in line with that for 1933. While the weight recovery improved in 1934, a large amount of very rocky material was put through the mill.

The cost realized in 1934 was $.043 per ton higher than for the previous year. This increase was almost entirely due to the absorption in 1934 of heavier upkeep charges; the inclusion of a heavy structure drilling expense and extraordinary work in connection with the washing plant, such as diking in the tailings basin and water supply expense.

(2) Open Pit Mining:

The cost under this caption was $.010 higher in 1934 than in 1933, due entirely to relatively heavier maintenance expense. The actual cost of operating was approximately $.03 less in 1934 than in 1933, but this was more than off-set by the maintenance of power shovels, locomotives and track work. In 1933 there was no spring repairing, charged to the ore. The equipment was put in shape following the completion of stripping operations and the repair charges went against stripping.

(3) General Pit Expense:

The increase of $.025 under General Pit Expense in 1934, is explained entirely by the fact that the charge for structure drilling alone increased the expense in 1934 by $.028 per ton. Aside from this, there were charges under Stocking Lean Materials and Waste Pile Expense, amounting in the aggregate to $.008 per ton, whereas there was no expense shown under these items for the year 1933. The other charges under General Pit Expense were lower for the year 1934.

(4) Concentrating:

The 1934 increase of $.025 per ton under concentrating is explained by the fact that work on the washing plant dyke cost $.021 per ton in 1934, whereas there was no charge to this account in 1933. Further than this the repair costs against the washing plant in 1934 were somewhat higher than in 1933, as the mill was new and no preliminary repairs were made for the start of the 1933 ore season.

(5) General Mine Expense:

There was an increase of $.016 in the 1934 costs under this caption. This is due to a larger charge per ton for engineering and analysis and grading, as well as a higher expense item for Ishpeming and District Offices. The more extensive charges for engineering

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8. COST OF OPERATION: (Continued)

d. Detailed Cost Comparison:

(5) General Mine Expense: (Continued)

and analysis and grading are due to the fact that very extensive surveys were carried on in 1934 and there was an unusually heavy analysis expense in connection with the structure drilling. Extensive engineering and Geological classification and estimates were made during 1934.

9. EXPLORATIONS AND FUTURE EXPLORATIONS:

An extensive structural drilling program was undertaken during the ore season and extended well in to the fall. This campaign was for the purpose of determining the grade and character of the ore in the Snyder and Hemmens pit bottoms. One drill was started on the high taconite horse at the West end of the Snyder and the second drill on several check holes for tax report purposes, - one on the Bovey, one on the Hemmens and three in the Snyder pit. On the completion of these check holes, the drill was started on the exploration of the Hemmens pit. The drilling was continued throughout the entire ore season and the program was completed the latter part of October. In all, sixty-nine holes, with a total depth of 6,400 feet, were undertaken and completed. Considerable hard ground was encountered and it was necessary to alter our plans from time to time, as the result of encountering a different class of material than anticipated. The cost of the drilling was very satisfactory, averaging $1.90 per foot, which includes all shop work, new pipe and equipment, all hand-washing and analyses charges.

In addition to the sixty-nine holes drilled by our two Armstrong outfits, six holes were put down by Schultze Brothers (contractors) along the South edge of the East Snyder and Hemmens pits. These six holes totaled 1,378 feet.

The Schultze drilling was of great value in that it furnished definite information upon which to base a comprehensive estimate and working plan of the Hemmens and Snyder lands. The results of the drilling were rather disappointing insofar as the Hemmens tonnage and grade of ore was concerned, but it bore out the assumptions which had been made previously in regard to the South Snyder.

The Company drilling was carried forward on three 8-hour shifts, five days per week and the entire cost was charged to ore operations.

During the year 1935 additional structure drilling should be undertaken to prove up the ground along the West side of the North Bovey, as well as the deep ore deposit extending from the Snyder on to the Bovey. Some structure drilling should also be undertaken in the West Snyder area.

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10. TAXES:

The following statement shows the Canisteo Mine taxes and average rates for the years 1933 and 1934:

	1934	1933	Increase	Decrease
Canisteo Mine,	$ 42,779.97	41,637.85	1,142.12	
Washing Plant Lands,	2,591.36	2,573.09	18.27	
Personal Property,	2,308.65	2,540.03		231.38
Total,	$ 47,679.98	46,750.97	929.01	
Village Lots,	189.51	191.30		1.79
GRAND TOTAL,	$ 47,869.49	46,942.27	927.22	
Average Tax Rate,	.764	.761	.003	

The 1934 increase in the Ad Valorem taxes of the Canisteo Mine was due to the fact that two forties in the lease were taken from the inactive and placed in the active class by the Tax Commission.

The washing plant was not considered as completed May 1st, 1933, but subsequent to that date, screens were purchased, conveyor belting installed and the valuation, as of May 1st, 1934 was increased by $1,000.00.

The decrease in the Personal Property taxes was the result of a depreciation taken on the equipment.

11. ACCIDENTS AND PERSONAL INJURY:

There was one lost-time accident at the Canisteo Mine during the year 1934, a description of which follows:

NAME: Rodney Axford DATE: November 15th.

CAUSE: Axford, together with fellow employees was engaged in installing a new 16" discharge line from the pit drainage pumps on the South bank of the Hemmens pit. A blast, made in the pit, approximately 800 feet distant, threw a quantity of rocky material in the vicinity of the bank where the men were working and one of the flying rocks struck Axford on the outer side of his left thigh. The proper general alarm was given and heard distinctly by all of the men working on the pipe line and a sufficient time elapsed for them to get under cover before the shot was fired. The other employees sought shelter under the 16" pipe but Axford was careless and did not take this precaution, with the result noted.

Axford sustained a severe contusion of the left leg, with extensive hematoma.

He was paid in compensation to January 1st, $97.58 and will be released on January 15th, 1935.

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12. NEW CONSTRUCTION AND PROPOSED NEW CONSTRUCTION:

There was no new construction undertaken at the Canisteo Mine during 1934 and none is contemplated for 1935.

13. EQUIPMENT AND PROPOSED EQUIPMENT:

A second Allis-Chalmers vibrating screen was purchased and installed at the Washing Plant during 1934. A "120" Bucyrus electric shovel was transferred from the Holman to the Canisteo Mine in May, 1934 and was used in ore operations at the Canisteo property throughout the season.

One of the 25-ft. logs, with variable speed motor will be transferred from the Holman to the Canisteo washing plant for 1935 operations. This log will replace one of the Dorr washers, which is badly worn and the necessary repairs would be quite costly. A comparison of the operation of a 25-ft. log and bowl classifier, against the Dorr washer will be made during the season of 1935 and should result in determining definitely the efficiency of these two machines, both from the standpoint of ore recovery and costs, including the item of maintenance.

14. MAINTENANCE AND REPAIRS:

Locomotives Nos. 101, 102 and 103 were given a complete overhauling, including the retipping of all flues and the repairs to valve and air equipment.

Locomotives Nos. 104 and 105 had the valve and air equipment repaired and the tires were changed on locomotive No. 146.

Twenty-four - 30-yard cars were put through the shop and completely overhauled. All badly worn wheels were replaced.

The crawling mechanism was overhauled on the No. 35 electric shovel and the driving sprockets and caterpillar pads were built up. The boom was taken down and overhauled. Further repairs will be necessary on this shovel during the winter.

The track shifter and the Industrial crane were taken into the shops. The boiler on the shifter was reflued and enclosed with a jacket and the flues of the crane were rolled. Both machines were carefully checked over.

The gasoline shovel was cleaned and painted and the gas tank repaired. New 17-ft. dipper sticks were made for this machine to increase its loading range.

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14. MAINTENANCE AND REPAIRS:

The two structural drill outfits were generally checked over and repaired, including the replacement of badly worn parts. All of the drill machines will need further overhauling before the start of the 1935 ore season, especially the propelling and crawling mechanism.

The old pumphouse and raft for the 7,000-gallon pump, were dismantled and new structures built for the two 2,000-gallon pumps, which are now being used in connection with the pit drainage.

Washing Plant Repairs:

No repair work was undertaken at the washing plant until April. The new Allis-Chalmers vibrating screen was installed, worn chutes rebuilt and worn pans on the 8-ft. pan conveyor were repaired.

The location of the pumphouse was changed in order to eliminate the long suction, which could not be depended upon to obtain clear water. Two long dykes were built and a ditch dug by the gasoline shovel to carry the tailings around to the North end of the empounding basin and thus prevent their settling in the vicinity of the pump suction.

Electrical Equipment:

The small electrical force overhauled all the motors at the mill, in the pit and at the shops and other electrical equipment was inspected and checked. The electric cables for the shovels and the power drills were brought in and badly bruised spots were repaired and vulcanized. The proper controllers and starters were installed in the rearrangement for pit pumping.

18. NATIONALITY OF EMPLOYEES:

NATIONALITY:	NO. OF MEN
American,	129
Finnish,	17
Austrian,	11
Swedish,	12
Norwegian,	11
Italian,	11
Serbian,	9
Croatian,	6
Slavish,	6
Canadian,	3
Irish,	2
Dane,	1
German,	1
Bulgarian,	2
TOTAL,	221

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19. WASHING PLANT OPERATIONS:

A crew of nine men were put to work on April 23rd, preparing the washing plant for the 1934 ore season. This force was increased to twenty men on the 30th of April and they were engaged in overhauling and repair work until May 14th, when the plant was in shape for operation.

The following work was undertaken by the repair force: The chutes and pockets were lined, a grizzly was taken over from the Holman plant and installed; the new vibrating screen was installed; new blanking plates were placed in the Dorr washers; new rock fingers were furnished at the rock pockets; the chutes from the new vibrating screen to the Dorr washer were rearranged.

A test was made at the washing plant on May 11th and the necessary adjustments were then undertaken.

The washing plant was operated from May 14th to August 22nd, on the basis of three 8-hour shifts, five days per week. Generally speaking, the operation here was satisfactory throughout the season, the only serious question involved being that of our water supply.

The vibrating screens gave us no trouble whatsoever and a very clean product was turned out.

The cone crushers were crowded to capacity the greater part of the time that they operated, but no trouble was experienced and the only delays were the result of necessary cleaning.

Some difficulty was experienced with the feed from the railway receiving bin. At times, when we were handling a fine, sticky ore, the material would arch in the bin and it was necessary to employ several men with iron bars to break the arches and maintain a feed to the 8-ft. pan conveyor. In order to overcome this difficulty, we are revamping the back slope of the pocket and arranging to speed up the 8-ft. pan conveyor, so that a full feed may be maintained to the plant. The reduction in size of the bottom of the pocket will lessen the abrasive action and consequent wear on the 8-ft. pans.

The Dorr washers turned out a very good product, but the wear on this equipment was quite extensive and the repair cost will be high. The Dorr bowl classifiers were only operated intermittently. The average Canisteo ore treated in 1934 contained but a very small percentage of high grade fines and the product from the Bowl classifiers was very low grade.

The water supply from our storage reservoir proved inadequate and we were obliged to pump from the Danube plant on Little O'Reilly Lake for seven and one-half days in June, delivering to our storage basin approximately fifteen million gallons of water. Several heavy rains at the end of the month augmented our water supply, but

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19. WASHING PLANT OPERATIONS:

on the 16th of August it was again necessary to pump from the Danube plant approximately eight million gallons. Provided our washing operation had been carried through September, the question of available water for washing would have been a very serious item.

To insure a supply of water for concentrating purposes, it was decided, in the fall of 1934 to test the ground surrounding the tailings basin, to determine if a sufficient flow could be tapped to give us our requirements. One of the Company's churn drill outfits was moved to the storage basin and the testing job started September 8th. After working for several days it was found that the equipment was inadequate and it was then decided to move one of the Schultze Brothers' drilling outfits on to the job.

The first hole was put down on the East side of the basin to a depth of 110 feet, the last 11 feet being in a decomposed granite. A good water-bearing sand was encountered from 67 to 81 feet, with indications that a satisfactory well could be developed. After some discussion it was decided that it would be better policy to depend on two wells and not draw too extensively from one, which might result in draining the water-bearing strata too rapidly.

A second hole was drilled approximately 100 feet North of the first. This hole reached a total depth of 96 feet, with no water-bearing sand being encountered.

The third hole was put down West of the basin in the vicinity of the stripping dump. A total depth of 133 feet was drilled, all in hardpan and this location was abandoned.

The fourth hole was put down at a point about 500 feet North of the Great Northern washing plant tail track. This hole was bottomed at 105 feet, a good water-bearing sand being encountered from 62 to 89 feet.

A study of the surface contours, together with the data furnished by the drilling, led us to put down a fifth hole, 400 feet West of hole No. 4. This hole encountered good water-bearing sand from 54 to 74 feet and it has been decided to rig up a pumping outfit here and pump approximately 300 gallons per minute until a good head of water is provided over our storage basin area. An 8" casing will be driven and a suitable screen obtained to hold back the gravelly material.

The original schedule of 500,000 tons was reduced, with the result that operations at the washing plant were suspended after August 22nd, with the exception of a two days run in September for the purpose of grading out special cargoes. A total of 430,142 tons of

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19. WASHING PLANT OPERATIONS:

concentrates were produced. On August 1st the Canisteo plant handled 12,985 tons of crude ore, from which was secured 9,047 tons of concentrates. The ore on this day's run was not exceptionally high grade, but of very good structure.

The results of this day's run were as follows:

LEASE	CRUDE ORE TONS	CONCENTRATES TONS	GROSS RECOVERY
Snyder, ----------	7,997	5,320	66.53%
Bovey, ----------	4,988	3,727	74.58%
Total,----------	12,985	9,047	69.67%

The average daily production for the season was 6,058 tons of Concentrates.

The amount and analyses of the plant rejects for 1934 were as follows:

LEASE	TONS	IRON	PHOS.	SILICA
Snyder, ----------	14,253	27.39	.022	57.37
Bovey, ----------	18,937	27.29	.097	56.48
Hemmens, ---------	603	28.03	.024	58.91
Total, ---------	33,793	27.35	.064	56.81

The rock removed from the pit and placed on the waste dump was as follows:

LEASE	TONS	IRON
Snyder, ----------	2,790	29.39
Bovey, ----------	5,310	27.47
Total, ---------	8,100	28.13

The waste material, other than taconite, encountered during the season and placed on the dump, was as follows:

LEASE	TONS	IRON
Snyder, ----------	10,350	32.69
Bovey, ----------	29,380	32.21
Hemmens, ---------	1,600	32.15
Total, ---------	41,330	32.33

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19. WASHING PLANT OPERATIONS: (Continued)

The tonnage and iron unit recovery realized in the treatment of Canisteo ore during 1934, was as follows:

LEASE	TONNAGE	IRON UNIT
Snyder, ----------	58.23%	77.22%
Bovey, ----------	63.96%	83.23%
Hemmens, ----------	67.03%	83.56%
Average, ---------	60.49%	78.38%

The analyses of the product from the several machines for the year 1934 was:

SNYDER DRILL MACHINES:

	IRON	PHOS.	SILICA
Dorr Washer Oversize, ----------	56.86	.059	16.50
Dorr Washer Rakes, ----------	57.53	.051	9.78
Dorr Classifiers, ----------	48.80	.047	26.00
Tailings, ----------	22.72		

BOVEY MILL MACHINES:

Dorr Washer Oversize, ----------	56.36	.084	12.36
Dorr Washer Rakes, ----------	57.18	.071	11.46
Dorr Classifiers, ----------	46.74	.064	27.37
Tailings, ----------	22.53		

HEMMENS MILL MACHINES:

Dorr Washer Oversize, ----------	54.02	.059	15.96
Dorr Washer Rakes, ----------	56.47	.048	11.84
Dorr Classifiers, ----------	-	-	-
Tailings, ----------	22.13		

A recap of the data of mill operations follows:

	TONS	PERCENTAGE OF ANALYSIS TOTAL MINED	PERCENTAGE OF ANALYSIS IRON DRIED	CONCENTRATE RECOVERIES MADE FROM TONS	CONCENTRATE RECOVERIES MADE % IRON
Crude Ore and Rock Mined,	753,023	100.00	43.15		
Less Rock Removed in Mining,	8,100	1.08	28.13		
Crude ore Transported to Mill,	744,923	98.92	43.33		
Less Rock Rejects - (Crusher House)	33,793	4.49	27.35		
Crude Ore Entering Mill,	711,130	94.43	44.08	60.49	78.38
Concentrates,	430,142	57.12	57.92		
Tailings (by Deduction)	280,988	37.31	22.89		
Total,	711,130	94.43	44.08		

ORIGINAL

HOLMAN-CLIFFS MINE

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1. GENERAL:

During the period January 1st to April 30th, 1934, six watchmen were employed in policing the mine premises and washing plant. Two of this force were on full time and four on half time. From May 1st to December 15th, four full-time watchmen were engaged and for the last half of December - three full-time and two half-time watchmen.

While there were several brush fires in the vicinity of the washing plant during the summer, they were controlled and no damage resulted. The Taconite Fire Department was called and put out a brush fire near the shop buildings during April.

The 120 Bucyrus electric shovel, which had been stored at the Holman Mine since ore operations were discontinued in 1931, was taken down and shipped to the Canisteo Mine, during the month of April.

The A. Guthrie Company moved their 300-ton steam shovel from the Brown No. 1 pit in August. This machine was used in stripping overburden from the Brown No. 1 and North Star pits, the last work having been done by the contractor in 1931.

A number of pans were removed from the 8-ft. conveyor during the ore season and taken to the Canisteo washing plant for necessary replacements.

In connection with the ore treatment at the Canisteo washer during the season of 1935, one of the 25-ft. logs, with variable speed motor, will be sent from the Holman. This arrangement is for the purpose of accomplishing a minimum of repair expense, as well as to determine the relative merits of ore treatment with logs and bowl classifiers, as compared with the Dorr washers.

The water level in the Holman pit had risen by the fall to about the stage that it was when we started pumping operations at this property in 1929. The rise in the elevation of water in the Holman pit during the past year was approximately 20 feet and it is now considered at its flood stage.

4. ESTIMATE OF ORE RESERVES:

a. Developed Ore:

Assumption: 16 Cubic feet per ton for Wash Ore.

A rock deduction of 10% was made generally and in estimating a part of the deposit the deduction was increased to 20%, due to the exceptionally rocky condition of this ore.

No exploratory work was undertaken at the Holman-Cliffs Group of properties during the past year and there was, therefore, no occasion for making any re-estimates.

The tonnage listed below is on a concentrated basis and is figured on a 60% gross recovery.

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4. ESTIMATE OF ORE RESERVES: (Continued)

a. Developed Ore: (Continued)

Brown No. 1:		
Non-Bess. Concentrates,	1,126,196	tons.
Holman:		
Non-Bessemer Concentrates,	2,798,873	"
Brown #2:		
Non-Bessemer Concentrates,	1,891,533	"
TOTAL HOLMAN-BROWN,	5,816,602	"
North Star:		
Non-Bessemer Direct,	80,103	"
Bessemer Concentrates,	538,083	"
Non-Bessemer Concentrates,	101,891	"
TOTAL NORTH STAR,	720,077	"
Bingham:		
Bessemer Direct,	269,664	"
Non-Bessemer Direct,	329,590	"
Bessemer Concentrates,	1,198,361	"
Non-Bessemer Concentrates,	590,238	"
TOTAL BINGHAM,	2,387,853	"
TOTAL BINGHAM-NORTH STAR,	3,107,930	"
GRAND TOTAL HOLMAN-CLIFFS MINE,	8,924,532	"

b. Prospective Ore:

Additional drilling in the Southerly and Southeasterly portions of the Holman forty is quite likely to result in proving up additional deep ore of treatable character. The possibilities of additional ore in the Brown-North Star or Bingham lands is rather remote, as the ore bodies in these properties have been pretty well outlined.

6. SURFACE:

a. Buildings, Repairs:

The following tabulation shows a list of the house occupants and repairs made during the year 1934. The amount expensed in each instance is also listed:

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6. SURFACE:

a. Buildings, Repairs: (Continued)

Ho.No.	Name of Occupant	Repair work done	Amount Expended
12	Malkolm Olson,	Rep.chimney,plumbing & siding,	$ 20.67
13	Geo. Trombley,	" " siding and painting,	84.92
14	Geo. Dunstan,	" " plumbing & siding,	21.44
15	Thos. Wivell,	" " " and painting,	131.03
16	Hughbert Leitch,	" windows and doors,	4.54
17	C. Winkleblack,	" chimneys,	9.79
37	Geo. Sullivan,	" " siding and painting,	37.26
38	Ernest Lueck,	" " " " "	97.34
39	T. J. O'Brien,	" chimneys,	5.05
40	J. C. Downing,	" roof,	3.35
41	A. L. Sundquist,	" foundation & install new sills,	269.70
42	Mike Shipka,	" siding and painting,	103.57
43	Mrs. G.B. Phillips,	" foundation,	208.16
44	B. P. Axford,	" siding and painting,	112.80
45	Ed. Gustason,	" chimney, siding and painting,	128.53
46	Russell Wivell,	" siding and painting,	88.68
47	Emil Camilli,	" " " "	189.91
48	Wm. Hanson,	" " " chimney,	9.42
49	(Vacant)	" windows and doors,	12.00
50	Dan McKinnon,	" foundation & exterior of building,	296.70
51	J. W. Griffith,	" chimney, siding and painting,	134.44
55	Mrs. H. McNulty,	" " " " "	102.47
56	Grant Hess,	" " " " " (one coat)	69.72
57	August Mergle,	" " "	16.58
58	Russell Barkla,	" chimney,	3.03
59	Geo. Beasley,	" " siding, cellar entrance,	48.51
60	W. F. LeClair,	" " " doors & cellar entry,	73.17
61	Ambrose Hoey,	" siding and cellar entrance,	59.56
62	Jos. Dolezel,	" chimney, plaster and painting,	146.42
63	Pearl Nelson,	" siding, windows and painting,	112.21
64	Herman Mork,	" " porch and painting,	112.70
65	Ed. Johnson,	" " " " "	93.00
66	Mike Doyle,	" windows, doors and interior,	53.28
67	Ed. Doyas,	" chimney, siding and painting,	66.88
68	Geo. Lee,	" siding and painting,	66.57
69	Arnold Lawson,	" chimney,siding & paint for exterior	39,85
73	Roy Elliott,	" siding and chimney,	10.10
74	Clarence Martin,	" windows,	.39
77	Wm. Ryser,	" siding and chimney,	8.28
78	Jas. McNevin,	" " " painting,	107.90
79	Jno. Winkleblack,	" foundation & install new sills,	200.72
80	H. J. Stephens,	" chimney, siding and painting,	89.81
81	Lloyd Wetherell,	" " " " "	96.78
97	William Saw,	" " " " "	141.61
98	Dan Fitzhenry,	" " siding, windows & painting	126,18.
101	Loy Kolar,	" " " porch and painting,	148.87
105	Dan Chamberlain,	" siding, windows and painting,	94.90

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6. SURFACE: (Continued)
a. Buildings, Repairs: (Continued)

Ho.No.	Name of Occupant:	Repair work done:	Amount Expended
106	Myron Youngberg,	Rep.siding, roof and painting,	85.78
116	(Vacant)	" " chimneys and plumbing,	51.52
155	J. F. Carson,	" " and painting,	134.99
156	Lee Farr,	" " " "	147.72
157	J. W. Mattson,	" " " "	121.83
158	W. S. McComber,	" " " "	132.54
	TOTAL, ----------		$ 4,733.17

As a result of negotiations with the Oliver Iron Mining Company in settlement of rentals for the mine buildings and houses in Taconite, it was decided that such rental should be based on the net return to The Mesaba-Cliffs Company after deducting insurance, taxes and upkeep from the revenue secured from house occupants during the years 1933 and 1934. The question of rental was settled for the year 1933, but the amount for 1934 was based on the revenue, minus expense for the two years.

The rent collected during the years 1933 and 1934 amounted to - $9,699.07, divided - $4,283.50 in 1933 and $5,415.57 in 1934.

The following tabulation shows the expense of repairs, taxes, insurance and miscellaneous during the years 1933 and 1934:

Revenue:			
1933 Rent collections,		$ 4,283.50	
1934 " "		5,415.57	
Total rent received 1933 and 1934,			$ 9,699.07
Expense:			
1933			
Repairs to buildings,	$ 104.79		
1932 Taxes paid in 1933,	1,392.69		
Insurance,	353.43		
Miscellaneous,	35.24	1,886.15	
1934:			
Repairs to buildings,	4,733.17		
1933 Taxes paid in 1934,	1,393.64		
Insurance (estimated)	315.00	6,441.81	
Total Expense 1933 and 1934,			$ 8,327.96
Revenue in excess of expenses,			$1,371.11

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6. SURFACE:
(Continued)

a. Buildings, Repairs; (Continued)

The revenue received from house rental during the years 1933 and 1934 amounted to $1,371.11 in excess of the expenses incurred in repairs, taxes and insurance.

The estimate of repairs for the year 1934 and the amount expended follows:

	ESTIMATE	EXPENDED	UNEXPENDED BALANCE
Carpentry work,	$ 1,557.23	1,962.99	405.76
Masonry "	242.80	195.76	47.04
Painting "	3,233.00	2,496.21	736.79
Plumbing repairs,	-	78.21	78.21
Total,	$ 5,033.03	4,733.17	299.86

The following is a list of the houses in Taconite sold and removed by the Oliver Iron Mining Company during the year 1934:

House No.	Date sold:
52	March 19th
54	February 15th
75	October 13th
82-104	April 21st
99	February 27th
103	July 2nd
108	March 15th
109	May 26th
110	February 15th
111	June 21st
112	October 20th
114	September 4th
115	February 15th
Camp #6	July 12th

10. TAXES:

The following statement shows the taxes and average rate for the Holman-Brown, Bingham and North Star Mines, together with the Holman-Cliffs auxiliary lands, Bingham-North Star washing plant lands, Holman-Brown lands, Holman-Cliffs shops and Holman-Cliffs personal property for the years 1933 and 1934:

HOLMAN-CLIFFS MINE
ANNUAL REPORT
YEAR 1934

10. TAXES:
(Continued)

Statement of Taxes:

	1934	1933	Increase	Decrease
Holman-Brown Mine,	$ 34,567.98	49,752.48		15,184.50
Bingham Mine,	13,570.12	13,161.81	408.31	
North Star Mine,	7,238.59	10,256.92		3,018.33
Holman-Cliffs Aux.Lands,	2,625.97	2,149.71	476.26	
Bingham-North Star Washing Plant Lands,	42.47	33.70	8.77	
Holman-Brown Lands,	19.80	15.68	4.12	
Holman-Cliffs Shops,	131.95	279.13		147.18
Holman-Cliffs Personal Property,	2,061.77	2,260.90		199.13
TOTAL,	$ 60,258.65	77,910.33		17,651.68
Rented Buildings,	767.55	1,393.64		626.09
GRAND TOTAL,	$ 61,026.20	79,303.97		18,277.77
Average Tax Rate,	.751	.726	.025	

The decrease in the Holman-Brown and North Star mineral valuations for 1934 was due to the fact that these properties were placed on an inactive basis, whereas they were carried on an active basis in 1933.

The increases noted for the Bingham Mine; the Holman-Cliffs auxiliary lands; the Bingham-North Star washing plant lands and the Holman-Brown lands were a result of an increase in the tax rate.

The decrease in the Holman-Cliffs shops is due to the depreciation taken on the mine buildings and location houses and allowed by the Assessor and Tax Commission.

ORIGINAL

HILL - TRUMBULL MINE

ANNUAL REPORT

YEAR 1934.

HILL-TRUMBULL MINE
ANNUAL REPORT
YEAR 1934

1. GENERAL:

A force of five watchmen were employed, three on full time and two on half time, from the first of the year until the middle of June; from that date until the end of the year, four watchmen have been engaged on full time.

There were several heavy rain storms during the summer and the water rose in the Hill and Trumbull pits. During the fall months the water seeped away and at the end of the year the pit was dry and only about one foot of water covered the bottom of the Trumbull pit. The deep well pump could lower the water in the Trumbull pit within a few shifts, so that ore operations could be advantageously started. The 120 electric shovel, which has stood on one of the lower benches in the Trumbull pit, since ore operations were suspended in 1931, was moved on to higher ground as a safety measure in case of pit flooding.

Several small brush fires were started in the vicinity of the mine buildings and washing plant, but they were controlled by the watchmen and no damage resulted. The watchmen did not report any depredation of any consequence.

The sweet clover growth in the tailings basin proved to be entirely adequate to hold the tailings and even at times of heavy wind storms no dust could be detected in the air. It was not deemed necessary to enter into a contract with the Minnesota Power & Light Company during 1934 and in consequence - the spraying devices were not put in service. This resulted in a considerable saving, as compared with 1933. We now feel positive that the clover growth will afford ample protection against the dust menace, at least until such time as the Hill-Trumbull washing plant resumes operation. The Southerly tailings pond will be used for handling fine rejects from the plant during the first year of operation, so as not to disturb the situation in the larger North basin.

4. ESTIMATE OF ORE RESERVES:

a. Developed Ore:

Assumption: 13 Cu. Ft. per ton for Direct Ore.
17 Cu. Ft. per ton for Wash Ore.
A rock deduction of 10% was made in the case of the Direct Ore and Wash Ore and 35% for the Rocky Wash.
Concentrates are figured on 65 per cent gross recovery.
No exploratory or development activities were undertaken during the year 1933 and the reserve estimates are the same as reported a year ago:

HILL-TRUMBULL MINE
ANNUAL REPORT
YEAR 1934

4. ESTIMATE OF ORE RESERVES: (Continued)

a. Developed Ore:

Hill Bessemer Direct Shipping,	632,449	tons.
Hill-Non-Bessemer Direct Shipping,	1,132,200	"
Hill Bessemer Concentrates,	291,226	"
Hill Non-Bessemer Concentrates,	389,323	"
TOTAL HILL ORE,	2,445,198	"
Trumbull Bessemer Direct Shipping,	85,000	"
Trumbull Non-Bessemer Direct Shipping,	200,560	"
Trumbull Bessemer Concentrates,	2,255,539	"
Trumbull Non-Bessemer Concentrates,	645,992	"
TOTAL TRUMBULL ORE,	3,187,091	"
GRAND TOTAL HILL AND TRUMBULL ORE,	5,632,289	"

The ore estimate of January 1st, 1935 is the same as that reported a year ago, as no drilling or test-pitting was done during 1934 and there is no reason to make any changes in the tonnage or the grade.

b. Prospective Ore:

The drilling of the land to the North of the Hill pit in the vicinity of the taconite island, will no doubt show up an additional tonnage of concentrating ore. Test-pits put down along the ore limits of the pit in 1925 indicated that the ore makes back beyond the stripping banks and a few old scattered drill holes confirm this. From the standpoint of taxes it has not been advisable to conduct any drilling in this locality, but when ore conditions become normal and the mine resumes operations, it would be advisable to investigate this matter and decide on what drilling should be done.

c. Estimated Analysis:

	Tons	Iron	Phos.	Sil.	Fe.Nat.
Hill Mine:					
Bessemer Direct Shipping,	632,449	58.00	.045	13.00	53.36
Non-Bess.Direct Shipping,	1,132,200	58.00	.055	13.00	53.36
Bessemer Concentrates,	291,226	59.50	.045	8.50	55.04
Non-Bessemer Concentrates,	389,323	60.00	.059	7.50	55.50
TOTAL HILL ORE,	2,445,198	58.57	.052	11.38	54.87
Trumbull Mine:					
Bessemer Direct Shipping,	85,000	56.40	.040	12.79	51.32
Non-Bess. Direct Shipping,	200,560	58.04	.060	9.85	52.82
Bessemer Concentrates,	2,255,539	59.00	.043	9.00	54.57
Non-Bess. Concentrates,	645,992	59.00	.080	9.00	54.57
TOTAL TRUMBULL ORE,	3,187,091	58.88	.054	9.14	54.38
GRAND TOTAL HILL-TRUMBULL,	5,632,289	58.74	.053	10.11	54.59

HILL-TRUMBULL MINE
ANNUAL REPORT
YEAR 1934

6. SURFACE:

a. Buildings, Repairs:

No repair or construction work was undertaken at the Hill-Trumbull Mine during the past year.

9. EXPLORATIONS AND FUTURE EXPLORATIONS:

No exploratory work was undertaken during the year 1934 and none is contemplated for 1935, unless a sizeable ore operation is decided upon for the coming season. In the event that a comprehensive ore program is decided upon for 1935, some structure drilling will be necessary in the bottom of the Trumbull pit during the spring months and this would be augmented by further drilling in the fall to determine the character and grade of ore to be produced in 1936.

10. TAXES:

The following statement shows the taxes and average rate at the Hill-Trumbull Mine for the years 1933 and 1934:

Statement of Taxes:

	1934	1933	Increase	Decrease
Hill Mine,	$36,417.99	34,224.68	2,193.31	
Trumbull Mine,	45,514.88	42,773.61	2,741.27	
Hill-Trumbull Shops,	960.33	902.50	57.83	
Hill-Trumbull W.P.Lands	3,118.80	2,997.79	121.01	
Personal Property,	1,797.78	1,878.81	-	81.03
TOTAL, ----------	87,809.78	82,777.39	5,032.39	
Village Lots,	520.41	538.61		18.20
GRAND TOTAL, --------$	88,330.19	83,316.00	5,014.19	
Average Rate,	.773	.728	.045	

The higher rate prevailing in 1934 was responsible for the increases in the 1934 taxes, as compared with those of 1933.

The increase in the tax rate for 1934 of $.047, or 4.7 mills, was due largely to the placing of the Village of Marble on a cash basis and the necessity of making a State loan, although the tax rate for State and Township purposes was also increased. The increase in the rate for Village purposes amounted to 2.76 mills; for Township 1 mill and State - .89 mills.

D R E W M I N E

ANNUAL REPORT

YEAR 1934.

DREW MINE
ANNUAL REPORT
YEAR 1934

1. GENERAL:

The work of conditioning the Drew pit and washing plant for the 1934 season was started May 7th and ore operations were inaugurated May 28th. Aside from the suspension of ore mining activities from August 3rd to August 13th, while the shaft pocket was being lowered to provide for mining at a reduced elevation in the pit, operations were conducted until all pit ore was exhausted on September 29th.

Generally speaking, the season's work in the pit and at the washing plant was quite satisfactory from the standpoint of costs, as well as grade and tonnage of ore. Whereas the estimated tonnage of open pit ore January 1st, 1934, was placed at 95,040 tons, we actually shipped 103,531 tons.

Upon the completion of mining and washing operations, all of the supplies and equipment were taken to the Hill-Trumbull Mine for storage, excepting the 50-B electric shovel, which was sold to the Evergreen Mining Company and the scrap material sold to a junk dealer.

Some exploratory and stripping work was undertaken prior to the start of ore activities May 7th. The pit equipment was utilized weekends, upon several occasions, cleaning up rock and surface wash.

No difficulty was experienced with flood waters in the pit as the result of heavy rains during the ore season and the stripping banks did not wash or slough to any extent.

The lease on the Drew Mine has been surrendered.

2. PRODUCTION, SHIPMENTS & INVENTORIES:

a. Production by Grades:

Drew Crude Ore, ----------	113,529	tons
Syme Crude Ore, ----------	21,480	"
Total Crude Ore, ----------	135,009	"
Drew Concentrates, ----------	87,522	"
Syme Concentrates, ----------	16,009	"
Total Concentrates, ----------	103,531	"

b. Shipments:

The shipments from the Drew Mine during 1934 were the same tonnages as shown under the production statement, as all ore mined was forwarded to Lower Lake ports.

c. Stockpile Inventories:

No merchantable ore, either concentrates or direct shipping, was stocked at the Drew property during the year 1934.

DREW MINE
ANNUAL REPORT
YEAR 1934

2. PRODUCTION, SHIPMENTS & INVENTORIES: (Continued)

e. Production by Months:

(1) Crude Ore:

MONTH	DREW	SYME	TOTAL
May,	2,557	1,064	3,621
June,	13,275	11,763	25,038
July,	28,737	-	28,737
August,	28,457	2,371	30,828
September,	40,503	6,282	46,785
Total - 1934	113,529	21,480	135,009

(2) Concentrates:

May,	2,112	756	2,868
June,	10,960	8,845	19,805
July,	23,019	-	23,019
August,	20,975	1,620	22,595
September,	30,725	5,023	35,748
October,	269	235	504
Total - 1934	87,522	16,009	10,531

(No direct ore mined during 1934)

f. Ore Statement:

All material considered as ore in mining, was shipped from the property.

3. ANALYSIS:

a. Mine Analysis of Production & Shipments:

	Tons	Iron	Phos.	Sil.	Mang.	Moist.	Alu.	Iron Nat.
Drew Concentrates,	87,522	57.00	.030	11.19	1.99	9.04	1.37	51.85
Syme Concentrates,	16,009	57.06	.042	10.94	1.75	9.12	1.64	51.86
Total 1934, -----	103,531	57.01	.032	11.15	1.95	9.05	1.41	51.85

d. Average Analysis of Crude Ore Produced:

	Tons	Iron
Drew Crude,	113,529	46.36
Syme Crude,	21,480	46.80
Total 1934, -----	135,009	46.43

e. Composite Analysis of Season's Shipments:

	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss
Drew Concts.	56.98	.030	11.25	1.94	1.39	.23	.20	.012	2.50
Syme Concts.	57.21	.039	10.90	1.73	1.44	.22	.18	.011	2.75

DREW MINE
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YEAR 1934

4. ESTIMATE OF ORE RESERVES:

a. Developed Ore:

The following tabulation shows the estimate of Drew and Syme ore as of January 1st, 1934:

	OPEN PIT	UNDERGROUND	TOTAL
Drew, ----------	84,000	4,560	88,560
Syme, ----------	11,040	40,950	51,990
Total, ----------	95,040	45,510	140,550

The actual shipments for 1934 exceeded the estimate of open pit ore by 8,491 tons, the over-run amounting to 3,522 tons in the case of the Drew and 4,969 tons for the Syme. The over-run in shipments, as compared with the estimate was confined to the open pit area, - no underground ore, shown in the estimate of January 1st, 1934, being mined.

b. Prospective Ore:

All of the open pit ore having been exhausted, the leases on the Drew and Syme lands were surrendered. Exploratory work on these properties indicates that no commercial ore bodies remain, or are likely of development. The underground ores could not be mined and treated profitably.

5. LABOR & WAGES:

a. Comments:

(1) Labor:

Labor, both skilled and common, was plentiful for the Drew Mine operation during the year 1934. The Mining Code did not interfere with our operations. Our employees were not satisfied to work under the Code, preferring to put in more time than the 40-hour per week limit specified.

6. SURFACE:

a. Buildings, Repairs:

Only the necessary patch work was undertaken during 1934 to keep the washing plant and frame mine buildings in shape for the season's work. All frame buildings at the Drew Mine were sold during the fall.

7. OPEN PIT:

a. Stripping:

Stripping and clean-up work was started in the pit on May 15th and 11,560 cubic yards of surface material was handled by May 28th, when ore operations were started.

Throughout the ore season, the pit was operated three 8-hour shifts, five days per week, and the washing plant two, 8-hour shifts, - the third, or extra pit shift being devoted to rock and clean-up work.

DREW MINE
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YEAR 1934

7. OPEN PIT:
(Continued)

a. Stripping: (Continued)

Until the pit approach was dug out to allow for mining of the North bank ore during the month of August, all rock and surface slough were removed from the pit and taken to the waste dumps. Rock encountered in mining during the latter part of August and September was cast, or handled and dumped in pit areas where the ore had been exhausted.

A total of 17,080 cubic yards of surface material was removed from the pit during the year 1934.

g. Open Pit Mining & Loading:

Wash Ore:

Open pit mining operations were conducted from May 28th to September 29th. The ore was loaded into 20-cubic yard cars and hauled to the shaft pocket, with the exception of that period in the operations where the 50-B electric shovel was engaged in cutting down around the skip-way and cast the ore directly into the pocket.

To afford the most economic ore operation, it was found advisable to work the pit three 8-hour shifts and the washing plant two, 8-hour shifts. An extra 8-hour shift was required in the pit to handle rock, make the necessary track alterations, move the shovel and thus assure a supply of ore when the washer was operated. To comply with the Mining Code, the pit was operated five days per week, giving the employees a maximum of not to exceed forty hours work each week.

The electric shovel was operated to the North of the shaft during the first six weeks of the season, loading out all ore down to the elevation of the shaft pocket. During July, mining activities were confined to the Southerly part of the pit, where three cuts were taken and the ore body exhausted, with the exception of the area adjacent to the shaft pocket and that along the approach bench.

A resume of the work done during August was as follows: From the first to the fifteenth - the pocket was lowered and the surface material, covering the approach tracks, was loaded and hauled from the pit, or was cast into the South portion of the pit, where the ore had been exhausted. As the result of this work the approach benches were made available for mining and the bottom ore in the pit, both North and South of the shaft pocket, could be mined. Ore operations during the balance of the season consisted in exhausting this ore supply, the shovel being moved back and forth along the West side of the pit and finally digging out the deep pocket of ore in the vicinity of the shaft pocket.

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7. OPEN PIT:
(Continued)

g. Open Pit Mining & Loading:

While operations became somewhat congested during the latter part of the season, the results were quite satisfactory and the delays infrequent. Sufficient coal was placed in the pit, before the track benches had been removed and it was not necessary to use any coal chutes in handling this supply.

Fortunately there were no serious delays from flood waters during 1934, the pumping equipment in the pit proving adequate to handle the seepage from rains, as well as taking care of the normal pit drainage.

8. COST OF OPERATION:

a. Comparative Mining Cost:

(1) Product:

	1934	1933
Concentrates shipped,	103,531	52,047
Average Daily Product,	1,570	1,010
Tons Per Man Per Day,	21.50	15.14
Days Operated,	86	63
Days Idle,	40	64

COST:

Total Cost at Mine:	1934 COST	1933 COST
Production Crude Ore,	$ .224	$ .269
General Pit Expense,	.117	.079
Concentrating,	.162	.238
General Mine Expense,	.112	.125
Totals,	$ .615	$ .711

d. Detailed Cost Comparison:

(1) Product:

The production for the year 1934 was 7,491 tons in excess of the open pit ore estimated as available January 1st, 1934. This increase was the result of less rock being encountered in the process of mining than had been anticipated.

(2) Crude Ore Costs:

The 1934 crude ore production cost was $.045 per ton under that for the previous year and was the result of maintaining a higher output per day and the handling of less rock per ton of ore.

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8. COST OF OPERATION: (Continued)

d. Detailed Cost Comparison:

(3) General Pit Expense:

The 1934 increase of $.038 per ton in this caption is explained by the fact that several substantial items were charged into accounts in 1934 that did not appear in the 1933 statement, such as - removing overburden, $1,781.07; test-pitting $1,642.82 and structural drilling $3,449.04. Previously, the charges of this nature had gone into Plant Account and were either charged to ore under Amortization or Depreciation.

(4) Concentrating:

On account of the higher daily production from the washing plant and less delays, due to the fact that the crude ore supply to the washer was maintained to advantage by operating the pit three shifts, as against two for the plant, the cost per ton for concentrating was reduced $.076 for the year 1934, as compared with 1933.

(5) General Mine Expense:

The decrease of $.003 per ton to this caption was due to lower charges for Mining and Mechanical Engineering during the operating season of 1934.

9. EXPLORATIONS AND FUTURE EXPLORATIONS:

The test-pitting campaign, which had been started in the fall of 1933 was continued for the first six weeks of 1934. Aside from some shallow pits, which were put down for the purpose of sampling to direct our ore grading, no further exploratory work was undertaken during the year.

10. TAXES:

Statement of Taxes:

	1934	1933	Increase	Decrease
Drew Mine,	$ 1,388.48	$ 2,049.30		$660.82
Drew Mine (Syme Lease)	77.29	74.97	2.32	
Personal Property,	178.52	174.28	4.24	
Total,	$ 1,644.29	$ 2,298.55		$654.26
Average Rate,	67.8	59.5	.083	

The decrease in the 1934 mineral valuation was due to the deduction of 1933 shipments and the lower tonnage considered by the Tax Commission, as the result of a petition, advising the Tax Commission that the open pit ore had been exhausted and the total tonnage was

270

DREW MINE
ANNUAL REPORT
YEAR 1934

10. TAXES:
(Continued)

less than shown by the Tax Commission's records. The increase in the surface and Personal Property taxes in 1934 is due to the increase in tax rate prevailing during 1934.

11. ACCIDENTS AND PERSONAL INJURY:

There was one lost-time accident reported at the Drew Mine during 1934, as follows:

NAME: John Heittikka DATE: September 28th.
CAUSE: A plank was placed on dirt floor of washing plant for employees to walk on. The plank was unsteady, due to being laid on uneven ground and when walking on the plank, Heittikka stumbled and fell between two water pipes.
NATURE: Fracture fifth rib. Nipple line.
TIME LOST: Twenty-one days.

12. NEW CONSTRUCTION AND PROPOSED NEW CONSTRUCTION:

No new construction was undertaken during 1934 and the lease on this property has been surrendered.

14. MAINTENANCE AND REPAIRS:

Only the expected maintenance work was done on the equipment and was held to a minimum.

18. NATIONALITY OF EMPLOYEES:

	1934	1933
Americans, ----------	17	29
Scandinavians, ----------	9	10
Italians, ----------	14	17
Austrians, ----------	25	36
Montenegrins, ----------	2	1
Finnish, ----------	7	20
Total, ----------	74	113

DREW MINE
ANNUAL REPORT
YEAR 1934

19, WASHING PLANT OPERATIONS:

The washing plant was operated from May 28th until September 29th. The crews worked two 8-hour shifts, five days per week, being limited by the Mining Code to this procedure.

Generally speaking, the plant gave quite satisfactory results and only very minor repairs were necessary. During the early part of the season the conveyor belt, carrying the concentrates to the railway loading bin, gave us some trouble on account of slippage when the load was heavy. The delays here were not serious.

The weight recovery from the Drew ore was 77.09% and from the Syme 74.53%, which compares with an average of 81.76% for 1933, each year's results being based on a skip tally estimated weight for the crude ore. The iron unit recovery for 1934 amounted to 94.79% in the case of the Drew ore and 90.87% for the Syme. This recovery is also based on estimated weights for the crude ore.

Safety Department

Annual Report

Year 1934.

11. ACCIDENTS AND PERSONAL INJURY.

a. Fatal Accidents.

Our mines sustained three fatalities and the Cliffs Power and Light Company one during 1934. All were classified preventable by the Central Safety Committee.

Description of Fatal Accidents.

Fatal Accident No. 1.

Gust Luoma, a linesman employed by the Cliffs Power and Light Company, was injured at 3:30 P.M. March 16, which caused his death thirty minutes later.

On the day of this fatality there was trouble on the telephone line to the Carp River Plant. Two linesmen, Luoma and Fred Richards, were sent along the transmission line between Negaunee and the Carp River Plant to locate the trouble. At the time of the accident Luoma was seated on two 2" x 6" channels of a steel tower, a distance of 32 feet above the ground. While he was in the act of detaching the ground wire clamp of the telephone line he gave a yell and fell. While being transported in their truck to the Negaunee Hospital Luoma told Richards that he had received a very heavy shock and he complained of severe pain in the abdominal region. The physician at the hospital found his condition serious and a stimulant was given but Luoma died a few minutes later.

It was the opinion of our Investigating Committee that induced electricity in the telephone line from the transmission wires was responsible for the shock which caused Luoma to plunge head first from his seat on the two channels.

Luoma had been employed as a linesman several years and had had sufficient training and experience to classify as a skilled workman. He was twenty-nine years of age, married, with one child fourteen months of age. No inquest by a County Coroner was deemed necessary.

Fatal Accident No. 2.

William Merrilla, a miner, was instantly killed at the Negaunee Mine, on March 20, 1934, by a fall of ground in a sub-level slice.

Safety Department

Annual Report

Year 1934.

11. ACCIDENTS AND PERSONAL INJURY.

a. Fatal Accidents (Continued)

This fatality occurred in No. 10 contract, on the second sub below the 11th level. Merrilla and his partner, Charles Ruhanen, were taking the fourth slice and had advanced about four sets from the raise. On the previous shift they blasted and put in forepoles. The shift boss inspected the place at four o'clock, when they asked for additional poles, which he sent in without delay. As the forepoles did not fully extend to the breast the miners placed six or seven green tamaracks poles from the top of the last set of timber to hitches dug into the breast. They then decided that they had taken every reasonable precaution for their safety.

On reaching the place the following morning, at 8 o'clock, Merrilla walked directly to the breast, which appeared the same as when they left the day before. Ruhanen looked over the puffer at the top of the raise for a few moments and then joined Merrilla. They decided that the place looked satisfactory, there being no evidence of any change during the night. They decided to cut hitches in the breast to which they intended to hang up head blocks for the scraper rope. As Merrilla was picking a hitch on his side of the breast, directly under the back poles, the top of the breast gave way. He was standing on a dirt pile, with his head close to the poles, and as their support in the breast gave way their ends dropped upon his head, giving him no opportunity to jump back to safety. Ruhanen was by his side and escaped injury. Merrilla gave no outcry when the poles fell upon him and it was apparent that he had been killed instantly.

Merrilla was a Finn, single, and 35 years of age. The Coroner's inquest reported as its verdict that "He met his death by an unavoidable accident and no one is to blame."

Fatal Accident No. 3.

An unusual accident occurred at the Cliffs Shaft Mine on June 11, 1934, which resulted in the death of Matt Toppila six days later. Toppila had worked many years mining at the Cliffs Shaft Mine and at the time of the accident was mining in a stope between the 7th and 8th levels, A shaft. During the morning of June 11 and until 3 P.M. he had spent the time trimming the back of the stope, using a long ladder. After completing this job

Safety Department

Annual Report

Year 1934.

11. ACCIDENTS AND PERSONAL INJURY.

a. Fatal Accidents (Continued)

he decided to trim the side of an ore pillar. He placed a short ladder against the pillar and climbed to the 3rd or 4th rung and started to bar. He either slipped or lost balance for he fell off the ladder and landed on the floor of the stope. The distance he fell was about seven feet. The scraper operator, Alfred Hendrickson, heard Toppila talking to himself and approaching found him near the foot of the ladder. Toppila was provoked at himself because he had sustained an injury in such a simple manner. He refused a ride to the shaft station although Hendrickson accompanied him to surface. He walked home, failing to report his injury to a physician.

On the following day he was persuaded by a member of his family to go to the Ishpeming Hospital, where two X-rays were taken, but no serious injury was evident. He was instructed to remain at home for a few days. The next day he reported at the mine with the intention of going to work but was sent home. Later in the day his doctor was consulted and a nurse was sent to his home to take care of him. He contracted pneumonia but lived only three days.

Toppila was a Finn, 62 years old, and is survived by a widow, two sons and a daughter. No inquest was held.

Fatal Accident No. 4.

John Nicholas, Captain at the Tilden Mine since it was opened, was injured about 10:30 A.M. July 24, 1934, and died at 2:15 A.M. the following morning in the Ishpeming Hospital. His death was due to shock sustained by having his right arm torn off at the elbow.

The Captain was in charge of all operations at the mine and when the accident occurred he was concerned with the operation of a new conveying belt in the crusher plant. He was inspecting the place about 10 A.M. and inquired of John Dawe, the engineer, how the belt was working. Informed by the latter that the belt had slipped under a heavy load the Captain replied that there was some good dressing in the warehouse and he left the plant. In a short time he returned and while Dawe was greasing the

SAFETY DEPARTMENT

Annual Report

Year 1934.

11. ACCIDENTS AND PERSONAL INJURY.

a. Fatal Accidents (Continued.)

rollers at the head of the conveying belt he heard the Captain cry out. Turning around he found the Captain falling backward against the pulley block with his arm off. Everything possible was done by first-aid men until he was placed in the care of a physician, who arrived in a short time with an ambulance.

Belt dressing had never before been applied to a conveying belt at this mine. How the Captain exposed himself to the hazard which caused his death is difficult to explain. He had established a fine safety record at the Ogden and Tilden mines and his untimely death was a surprising shock to the men who worked under his supervision and to the officials of the Company.

The Captain was English, a widower, and is survived by two sons and four daughters. The Coroner decided that an inquest was unnecessary.

b. Non-Fatal Accidents.

The mines and plants had 22 lost-time accidents, not including the four fatalities. Six of these accidents occurred on surface and the others underground. None caused a total disability and the only partial disability was the loss of an eye.

Herewith is a brief review of these accidents:

Mine	No. of Accidents	Description.
Athens	1	1. Fall of ground. Fractured foot.
Canisteo	1	1. Struck by flying rock. Contusdd hip.
Cliffs-Shaft	8	1. Carrying scraper shoe. Stumbled and shoe fell on hand. Laceration. 2. Barring chute and ore knocked bar out of hand. Lacerated lip. 3. Guiding drill bucket. Rope broke and he fell with bucket. Fracture of temple bone.

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11. ACCIDENTS AND PERSONAL INJURY.

b. Non-Fatal Accidents (Continued)

Mine	No. of Accidents	Description.
Cliffs Shaft (Cont)		4. Carrying wire rope. Sliver penetrated thro glove into hand. Infection. 5. Carrying drill post and clamp 5 struck his neck. Contusion. 6. Dirt flew in eye while drilling. Was wearing new goggles. Ulcer caused loss of eye. 7.& 8. Double accident. Two men caught under heavy fall of ground. Severe contusions of body.
Drew	1	1. Fell between two piles when walking on a plank. Fractured rib.
Maas	4	1. Lifting heavy timber and felt pain. Hernia. 2. Threw kerosene into fire. Second degree burns. 3. Moving puffer and caught foot. Fractured foot. 4. Jumped off moving locomotive. Hernia.
Negaunee	3	1. Lifting timber and knocked a chunk of ore loose which fell on his back. Contusion. 2. Scraper rope broke and loose end of rope struck face. Fractured nasal bone. 3. Chunk of ore fell on ankle. Sprained ankle.
Tilden	1	1. Working on Cyclone Drill. Jar fell on hand. Compound fracture of little finger.

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11. ACCIDENTS AND PERSONAL INJURY.

b. Non-Fatal Accidents (Continued)

Mine	No. of Accidents	
C.P. & L. Co.	1	1. Was piling brush and twig penetrated ear drum. Ruptured ear drum,
Shops	1	1. Hauling crusher part in truck on icy pavement. Stood by truck and was struck by passing automobile. Torn ligament.
Sample Crusher	1	1. While freeing choked crusher got tips of finger in roller. Crushed and fractured fingers.

c. Accident Statistics.

TABLE I.

Number of days of Labor Performed and Number of Men Killed and Injured at all U.S. Mines and Company's Mines.

Year	Days of Labor		Number Killed		Number Injured.	
	U.S.	Company	U.S.	Company	U.S.	Company
1927	34,160,978	590,753	352	4	25,133	211
1928	32,803,610	535,121	273	4	22,483	123
1929	34,618,120	600,003	350	4	23,092	85
1930	27,869,982	767,945	271	5	15,594	82
1931	18,721,486	495,412	158	3	8,709	27
1932	11,504,791	189,101	107	0	5,014	9
1933		189,398		2		17
1934		321,909		4		22

Note: 1933 and 1934 statistics for U.S. Mines not available.

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11. ACCIDENTS AND PERSONAL INJURY.

c. Accident Statistics. (Continued)

TABLE II

Fatality and Injury Rates per Thousand 300-day Workers, U. S. Mines and Company's Mines.

Year	Fatality Rate		Injury Rate	
	U.S.	Company	U.S.	Company
1927	3.10	2.02	221.54	107.15
1928	2.50	2.24	205.61	58.91
1929	3.03	2.00	200.11	42.50
1930	2.92	1.95	167.86	32.05
1931	2.53	1.82	139.56	14.59
1932	2.78	0.00	130.74	14.27
1933		3.17		27.00
1934		3.60		20.00
Average	2.80	2.15	181.50	45.82

Note: 1933 and 1934 statistics for U. S. Mines not available.

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11. ACCIDENTS AND PERSONAL INJURY.

TABLE III.

Classification of Fatal Accidents 1911 to 1934 inclusive by the Central Safety Committee.

I	Trade Risks		107
II	Negligence of the Company		
	Violation of Rules	4	
	Failure to Provide Safety Devices	5	
	Improper Method of Doing Work	9	
	Failure to Provide Tools or Safe Place to Work	3	
	Failure to Instruct Men	4	25
III	Negligence of Workmen		
A	Injured Men		
	Improper Method of Work	18	
	Violation of Rules	7	
	Failure to Use Tools of Appliances Provided	4	
	Failure to Use Safety Device	1	30
B	Other Workmen:		
	Improper Method of Work	12	
	Violation of Rules	4	
	Failure to Use Tools or Appliances Provided	1	17
	Total		179

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TABLE IV.

Classification of Causes of Fatal Accidents
From December 1st, 1898 to December 31st, 1934.

A	Fall of Ground or Timber	93	
	Run of Mud or Sand	60	
	Fall of Chunk of Ore from Chute	2	
	Stray Chunk or Stick down Raise or Stope	3	158
B	Shaft Accidents.		
	Falling down shaft	14	
	Rock or Timber falling down shaft	2	
	Struck or Caught by Cage, Skip, Bucket or Tool,	8	
	Falling from Cage, Skip or Bucket.	11	
	Falling from Ladder in shaft	5	
	Carried or pushed into shaft by car	3	
	Jumping on or off Cage, Skip or Bucket	3	
	Struck by Crosshead	5	51
C.	Use of Explosives.		
	Explosion of Powder	16	
	Premature Blast	3	
	Fall of Ground or Timber Due to a Blast	4	
	Overcome by Gas	3	
	Miscellaneous Causes	1	27
D	Mine and Railroad Cars.		
	Caught by Haulage Cars	12	
	Riding or attempting to ride cars	6	
	Falling with car from trestle	4	
	Run over by railroad car	6	
	Miscellaneous Causes	1	29
E	Miscellaneous Causes.		
	Falling in Raise or Pocket	7	
	Contact with Electric Wire	8	
	Falling from ladder, stage or trestle	7	
	By Moving Machinery	5	
	Mine Fires	3	
	Stockpile Slide	2	
	Miscellaneous Causes	3	35
	Total		300

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11. ACCIDENTS AND PERSONAL INJURY.

TABLE V.

Classification of All Accidents 1934
By the Central Safety Committee.

I	Trade Risk. (Incidental and Non-Preventable) . .		8
II	Negligence of Company:		
	1. Failure to use Safety Devices Provided	0	
	2. Failure to use Proper Tools or Appliances Provided	0	
	3. Violation of Rules	0	
	4. Improper Act or Selection of Improper Method of Doing Work.(By Foreman) . . .	0	
	5. Failure to Instruct Men as to Method of Doing Work and Hazards Incident Thereto,	1	
	6. Failure to Provide Safety Devices	1	
	7. Failure to Provide Proper Tools, Appliances, or Place of Work	1	3
III A	Negligence of Workmen:		
	1. Failed to use Safety Device Provided . . .	1	
	2. Failed to use Proper Appliances or Tools Provided	0	
	3. Violation of Rules	0	
	4. Improper Act or Selection of Improper Method of Doing Work (by Foreman) . . .	12	13
III B	Other Workmen		
	1. Failed to use Safety Devices Provided . . .	0	
	2. Failed to use Proper Appliances or Tools Provided	0	
	3. Violation of Rules	0	
	4. Improper Act or Selection of Improper Method of Doing Work (By Foreman) , . . .	1	1
	TOTAL		25

TABLE VI. ACCIDENT FREQUENCY

NUMBER OF ACCIDENTS PER 1000 DAYS OF LABOR
FOR YEAR 1934

	Rank	Days of Labor	Num of Accidents 1934	1933	Rate per 1000 Days 1934	1933
Lloyd	1	20380				
Gardner-Mackinaw	2	19172				
Spies Virgil	3	1958		2		.281
Holman-Brown	4	1559				
Hill Trumbull	5	1098				
Canisteo	6	38468	1	3	.026	.119
Athens	7	32089	1	2	.031	.133
Maas	8	53134	4	4	.075	.135
AVERAGE					.081	.095
Negaunee	9	35656	4	2	.112	.116
Drew	10	8736	1	2	.114	.235
General Storehouse	11	7789	1		.128	
C. P. & L. Co.	12	12226	2		.164	
Cliffs Shaft "A"	13	50560	5	2	.178	.093
"B"			4	0		
Tilden	14	6286	2		.318	
Miscellaneous	15	1949	1	1	.513	.756
General Roll		30358				
Various Properties		491				
TOTAL ALL PROPERTIES		321909	26	18		

TABLE VII. ACCIDENT SEVERITY

NUMBER OF WORKING DAYS LOST PER 1000 DAYS OF LABOR

	Rank	Days of Labor	No. of Days Lost 1934	1933	Rate per 1000 Days 1934	1933
Lloyd	1	20380				
Gardner-Mackinaw	2	19172				
Spies Virgil	3	1958		224		31.478
Holman-Brown	4	1559				
Hill Trumbull	5	1098				
Canisteo	6	38468	60	266	1.560	10.978
Miscellaneous	7	1949	$3\frac{1}{2}$	$3\frac{1}{2}$	1.796	2.647
Drew	8	8736	25	63	2.862	7.393
Athens	9	32089	$149\frac{1}{2}$	58	4.659	3.850
Maas	10	53134	$303\frac{1}{2}$	$3641\frac{1}{2}$	5.712	122.949
General Storehouse	11	7789	48		6.162	
AVERAGE					28.784	23.875
Cliffs Shaft "A"	12	50560	2582	123	55.923	5.762
"B"			$245\frac{1}{2}$	0		
Negaunee	13	35656	2065	143	57.914	8.288
C. P. & L. Co.	14	12226	1818		148.670	
Tilden	15	6286	1966		312.758	
General Roll		30358				
Various Properties		491				
TOTAL ALL PROPERTIES		321909	9266	4522		

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11. ACCIDENTS AND PERSONAL INJURY.

c. Safety Inspection.

The mines in Marquette County were inspected monthly by the writer and safety recommendations were adopted without unnecessary delay. Abandoned properties were made in safe condition during the summer months. There were no inspections by safety committees.

Central Safety Committee.

This Committee held three sessions for the classification of accidents and a consideration of safety subjects which came up for discussion.

Safety Inspection Reports.

The various safety reports and the number of same, which were made by mine employees and forwarded to the Safety Department, for checking hazardous operations, were as follows:

TABLE VIII

Hoisting cables	801
Ladderways	270
Skip and Cage Roads	277
Cage Catches	75
Hoists	72
Slack Rope	43
Fire Doors	30
Fire Equipment	25
Electrical Equipment	5
Mine Rescue Equipment	29
	1627

Safety Standards

Standards for the care and treatment of belts were adopted. No changes were made in those adopted in past years.

Safety Conferences.

All employees holding positions of authority or responsibility, such as superintendents, heads of departments, captains, bosses, electricians, and clerks, met at the General Office Club Rooms for two conferences. These conferences were held in the interest of safety and efficiency and were attended by 90 men. The Company provided dinner and the delegates came without remuneration.

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11. ACCIDENTS AND PERSONAL INJURY.

d. First Aid Work.

It was not necessary to train any employees in first aid methods. Sufficient first aid supplies were stored at various places around the mines and plants and only a limited supply of the same had to be purchased.

e. Mine Rescue Work.

The mine rescue stations at the Spies-Virgil and the Gardner-Mackinaw mines were abandoned and the entire equipment was transferred to Ishpeming. Our rescue machines are now obsolete so far as being considered modern equipment, but they will continue to serve our requirement for several more years. While it is impossible to maintain all the oxygen breathing apparatus safe to wear, by replacement we shall be able to keep ten or more machines fit for service. Replacement parts bought during the year amount to only a few dollars.

Rescue training was carried on at the local mines during the year, usually one practice monthly of three men at each underground mine. The value of this training was demonstrated when a fire occurred, between shifts, underground at the Negaunee Mine in December. A crew of five men, wearing apparatus, safely located the fire and extinguished it although it required several hours work.

f. Safety Bulletin.

A two-page safety bulletin is being issued once every two months by this department. It is distributed to all employees.

g. Ventilation.

The problem of improving ventilation was attacked vigorously throughout the year. During the first six months an engineer and helper, under the supervision of the writer, collected air samples at working places within all local mines, and dust counts of the same were calculated. Since this survey was completed our investigation has been confined largely to rock headings. This has required the assistance of one man working two weeks or less each month.

The air samples collected at each mine number as follows:

Cliffs Shaft	247
Maas	57
Negaunee	47
Athens	45
Lloyd	39
Gardner-Mackinaw	19
Total	454

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11. ACCIDENTS AND PERSONAL INJURY.

g. Ventilation (Continued)

The numerous working places and rock headings in the Cliffs Shaft mine account for the high number of samples collected there. With the exception of one operator, we have collected more air analyses than any other company in the Lake Superior District, and that operator has been engaged in this particular work two years and has made only a few more determinations than our company.

Dust preventive measures consist of improving ventilation by supplying an ample supply of fresh air at each heading in a mine; by improving methods of wet drilling in order to lessen the production of dust; by spraying places where dust is produced in order to settle it and also to prevent it being carried beyond the source of its origin; and by equipping workmen with breathing apparatus by which they can work in a dusty atmosphere with safety. All devices which are being installed with these objectives in view have not been perfected at our mines but we have gone a long way in improving mine ventilation, and in a short time the entire field will be under our control.

h. Employees' Representation.

Michigan.

An election of employees' representatives was held in January at the underground mines of the Ishpeming and Negaunee districts for the purpose of completing the quota of representatives which these mines were then entitled to have. An election was held at the Tilden Mine in September. The Cliffs Power & Light Company had one representative, who held over from the 1933 election.

The representatives' organization consisted of 15 members, of whom one repressented open pit mining, 6 surface work, and 9 underground mining. These men held a meeting on February 15th and perfected its organization. John Gray, a watch-man at the Cliffs Shaft mine, was elected Chairman, Henry Houseman, a Maas Mine ~~engineer~~ miner, Vice-Chairman, and W. J. Waters, a top-tram engineer at the Negaunee Mine, Secretary.

The untimely death of Captain John Nicholas, who was a member of the Joint Committee, necessitated the appointment of a Company's representative in his place, and Richard Cattran, underground foreman at the Negaunee Mine, was assigned the position by the Manager. The other Company representatives are Ernest Keast and William Conibear.

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11. ACCIDENTS AND PERSONAL INJURY.

h. Employees' Representation (Continued)

Michigan.

The Annual Conference between all the representatives and the Company's Representatives was held July 28th. Meetings of the General Committee and the Joint Committee were held in compliance with Rules 2 and 3, section VII, of the Representation Plan, and minutes of the same were transmitted to the Company's Manager.

That the relationship between the employer and employee is very friendly and cooperative would be apparent to anybody who might be given an opportunity of attending these meetings. The writer, in the discharge of his duty as the Company's representative, keeps personal contact with the delegates and no effort has been spared to ascertain their attitude toward the Company. If the hot water supply in a change room is not sufficient, or mining clothes do not dry because of lack of heat, there is no reluctance in reporting the same to the mine superintendent. Likewise, with other complaints. The important fact is that our men have no complaint of serious nature other than they feel that two days of work per week is not sufficient employment.

Minnesota.

An election of representatives was held at the Canisteo Mine on August 16th, when the mine was working the season's capacity. There were three voting divisions, and four representatives were elected. After the election a General Committss consisting of Chester Adams of the General Labor division, as Chairman, and J.O. Martin of the Washing Plant division, as Vice-Chairman and Secretary, was effected. The Company's representatives were J. A. Wivell, foreman, M. E. Gaffney, mechanic, and W. A. Sterling, superintendent. There were six meetings held during the active operation of the mine. A few suggestions and complaints, all of minor importance, were adjusted by the Joint Committee.

i. Department Expense.

Salaries	1,888.63
Auto Expense	128.69
Postage	4.31
Stationery & Printing	110.50
Supplies	17.40
Traveling and Entertainment	10.54
Telephone and Telegraph	18.01
Personal Injury Expense	36.42
General - Unclassified	10.61
Total	2,225.11

Respectfully submitted,

William Loubear

Assistant Superintendent.

22. REPORT OF THE GEOLOGIST FOR THE YEAR ENDING DECEMBER 31, 1934

A. STAFF

The staff of the Geological Department continued throughout the year on the same basis as it has been since June 1, 1932, - namely, one man, - Geologist in charge of the Department. Table I, below, gives the personnel and percentage of time actually employed:

TABLE I

NAME	OCCUPATION	DAYS LOST SICKNESS	DAYS LOST ABSENCE	DAYS OVERTIME	NET % DAYS WORKED
E. L. Derby, Jr.	Geologist	7¾	12½	15½	98.1

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

TABLE II

	Total working days	266½ days
	Sundays	52 "
#	Saturdays	34½ "
	Holidays	12 "
	Total	365 days

Worked on Saturday A.M.'s January 1st to September 1st, inclusive. No work on Saturdays after September 1st.

Table III, below, shows the average number of men regularly employed on the staff of the Geological Department during the last five years:

TABLE III

YEAR	AVERAGE NUMBER OF MEN
1930	4.0
1931	3.7
1932	1.5
1933	1.0
1934	1.0

B. GENERAL DESCRIPTION OF THE WORK OF THE DEPARTMENT

The work of the Department was divided between the various mines and miscellaneous items shown in Table IV, below:

TABLE IV

ITEMS	HOURS WORKED	PERCENT
MINES:		
Athens	20¼	1.0
Canisteo	495	25.5
Cliffs Shaft	214¾	11.0
Drew	31½	1.6
Hill Trumbull	61	3.1
Holman Cliffs	118	6.1
Lloyd	14	0.7
Maas	126½	6.5
Mackinaw	31½	1.6
Negaunee	8½	0.4
Ravenna-Prickett Lease	42¾	2.2
Tilden	19	1.0
Virgil	5¼	0.3
TOTAL MINES	1,188	61.0 %
MISCELLANEOUS		
Annual Report	52¾	2.7
Appraisal of Company's Mineral Estate	71	3.7
Depletion Estimates	112½	5.8
Dust Count	2	0.1
General Departmental	203¾	10.5
Gold Leases on Company's Estate	27	1.4
Investigating Explorations on Company's Estate	3	0.2
Investigating Mineral Land Offers	87	4.5
" Outside Explorations	52½	2.7
Michigan Mineral Land Company	2	0.1
Mineral Estate Maps (CompanyLands)	26¼	1.4
Taxes (Michigan Properties)	31¼	1.6
Visit by Bankers	84⅕	4.3
TOTAL MISCELLANEOUS	755½	39.0 %
GRAND TOTAL	1,943½	100.0 %

E. L. Derby, Jr. Approximately ten percent of my time during the year was taken up with the routine work of the office and the numerous miscellaneous duties peculiar to the Geological Department. I was without any regular assistance during the entire year. The largest single increment of my time, - approximately a quarter, - was taken up with activities in connection with the Canisteo Mine. A campaign of structure drilling was carried on there during the operating season. I made frequent trips to the Range to classify the samples from this drilling and to direct the work of making revised estimates of tonnage outlined by the results of this classification, both for operating purposes and for the Congdon interests. I made occasional underground geological surveys in the Cliffs Shaft, Maas, and Negaunee Mines. I also supervised the drilling of a large churn drill hole from the Maas Mine surface, and the wedging of a diamond drill hole from this hole, to determine the thickness of the rock capping over the caved ground above the mine workings in this vicinity.

My activities for the year, in addition to geological surveys which are treated separately later in this report, may be summarized as follows:

In January, I spent nearly half my time working up revised depletion estimates of the Athens and Negaunee ore reserves in accordance with the income tax law of 1932. In this connection, I spent one day at our Cleveland office with Mr. Geffine then he and I spent a day in Washington, going over the Negaunee Mine figures with Mr. W. C. Gordon, engineer in the Metal Section of the Income Tax unit. On our way to Washington, we attended a conference in New York with officials of the Bethlehem Steel Corporation showing to them our proposed depletion set-up on the Negaunee Mine. Messrs. Greene and S. L. Mather also attended this conference.

Classifying drill samples from both current and old structure drilling at the Canisteo Mine took a week of my time on the Mesaba Range.

In February, I spent a third of my time working up new depletion estimates for our other mines having reserves remaining from their March 1st, 1913 valuations. I embodied the results of this study in a special report to Mr. Geffine.

In March, I made a new estimate of the ore reserves in the Ravenna-Prickett lease which was submitted to Mr. Pardee, State Appraiser of Mines, as our Tax Commission estimate in place of the one carried by the Commission for years, that was made up by the Hanna Company after they had drilled and leased the property.

In April, I accompanied Messrs. Elliott, Jackson, Adams and Bubb to a conference at Lansing with Mr. Pardee, State Appraiser of Mines, on our tonnage estimates and valuations for the year 1933. I spent a week on the Mesaba Range supervising a revised ore estimate of the Canisteo Mine to present to the Minnesota State Tax Commission in case of a review of that property, which was anticipated.

In May, I attended the public hearings before the Michigan Tax Commission, both at Ishpeming and at Crystal Falls. While in Crystal Falls, Mr. Adams and I appeared before the Board of Review and argued the assessment placed on several of the Ravenna forties with the result that we were able to get the assessed valuation on these descriptions reduced from $10,500 to $1,000, a reduction of $9,500, or over 90%.

In June, I spent several days at Hibbing going over the completed revised Tax Commission estimate of the Canisteo Mine and supervising a revised Tax Commission estimate of the Drew Mine to include the drilling done in the Fall of 1933. I also layed out a campaign of drilling at the Canisteo Mine to be carried out during the current operating season.

I spent four days with Mr. Elliott conducting Mr. Oscar L. Cox, liquidator of the Union Trust Company of Cleveland, and party, over the Gogebic and Marquette Ranges, and particularly around this Company's properties. Several days previous to this visit were spent in preparing convenient data for Mr. Cox's information and use.

In July, I made two trips to Hibbing and spent considerable time starting the work of preparing a stripping and operating program, with all the necessary estimates and cost data, to cover the next ten years and to include the Canisteo, Hill Trumbull and Holman Cliffs Mines. I also added two contract structure drill outfits to the drilling program at the Canisteo and layed out six holes for them to drill.

Mr. W. G. Swart, consulting engineer, spent a week-end in Ishpeming with me, making an appraisal of the Company's mineral and other estate for Hayden & Stone, New York bankers. I took him underground in the Cliffs Shaft and Negaunee Mines.

In August, I made up several white print maps of the Company's mineral estate on the Marquette and Swanzy Ranges for Hayden & Stone in connection with Mr. Swart's appraisal. I also prepared similar data for a visit to Ishpeming of a bankers committee composed of Messrs. Sullivan, Hanrahan and Creech. This group was accompanied by Messrs. Greene, W. G. Mather and Wade. During their visit and inspection, I gave an informal illustrated talk on the main points of the Geology of the Marquette Range.

I accompanied Messrs. Elliott, McClure, Graff and Wm. McK. Green on a trip to examine the siderite deposit at the Helen Mine, along the Michipicoten branch of the Algoma Central Railway in Ontario, 182 miles north of Sault Ste. Marie, Ontario. Mr. Geo. S. Cowie of the Algoma Steel Corporation, owners of the property, accompanied us.

In September, I prepared a detailed Geological report of my visit to the Helen Mine. I then spent a week on the Mesaba Range classifying drill samples from the current drilling at the Canisteo Mine, laying out additional holes, and going over the progress being made on the ten year Mesaba Cliffs operating program. I also started

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work on a white print map of the Company's mineral estate on the Marquette and Swanzy Ranges for Mr. Greene's office.

In October, I completed Mr. Greene's map. I went over the geological maps and cross-sections of our operating mines with Mr. Brown and went underground with him at the Cliffs Shaft Mine. I spent ten days on the Mesaba Range classifying the current drilling and aiding in the estimates and other data being prepared for the ten year Mesaba Cliffs operating program.

In November, I spent most of my time on the Mesaba Range. I completed the classification of all current drilling for the year and worked with Messrs. Barber, Sterling and Donovan on the estimates, including all maps, cross-sections, cost and operating data, relative to the Mesaba Cliffs ten year operating program, which, under Mr. Barber's direction, I had been supervising since the work was started in July.

In December, I went back to Hibbing where we completed the work above referred to and also a revised estimate, with map and cross-sections, on the Canisteo Mine for the Congdon interests. Mr. Barber and I then came to Ishpeming where we went over the complete ten year Mesaba Cliffs picture, and the Congdon estimate on the Canisteo, with Mr. Elliott.

I took all this data to our Cleveland office and went over it with Messrs. Brown and Geffine. With Mr. Bubb, I prepared a new operating and cost figures tabulating them on several different premises. Messrs. Elliott and Barber came to Cleveland several days later for a general conference with us on the entire subject. At this time it was decided to work up additional cost data at the Cleveland office and have a conference early in 1935 before presenting the entire picture to the Mesaba-Cliffs partners.

C. SURFACE GEOLOGICAL SURVEYS

There were no detailed surface geological surveys made by the Geological Department during the year. However, in March I examined the surface of the old Standard Mine property in Section 30,47-30, Northwest of Republic, at the request of Mr. Heer, Treasurer. In May and again in October, I accompanied Mr. Brotherton, engineer of the Land Department, on a brief examination of several sections of the Company's estate East of Negaunee in search of an outcrop of talc reported to have been seen many years ago. Our efforts were in vain but another attempt to find it will be made. To find a workable deposit of talc on the Company's lands at this time would be a valuable asset. Also, with Mr. Brotherton in October, I examined the surface of the South portion of the old Webster Mine to determine the feasibility of leasing the area for building lots.

D. UNDERGROUND GEOLOGICAL SURVEYS

Operating schedules at the Company's active mines continued on a curtailed basis throughout the year as follows:

The Athens, Gardner Mackinaw, Lloyd, Maas and Negaunee Mines worked six days per week, single shift from January 1st to September 1st and four days per week, single shift, the balance of the year. In each case half the crew worked alternate weeks.

At the Cliffs Shaft Mine the regular day shift men worked three days per week, - Mondays, Wednesdays and Fridays, - mining, tramming and hoisting ore, - from January 1st to September 1st. The men on rock worked the other three days during the same period. After September 1st, and for the balance of the year, the first crew worked on ore Mondays and Wednesdays and the rock men Tuesdays and Thursdays.

The Tilden Mine worked irregularly during the shipping season but on full time whenever a cargo was being prepared.

D-1. - ATHENS MINE

The geological data at the Athens Mine was mapped periodically by Mr. C. W. Allen, engineer at the property.

The product came about evenly from the blocks between the 4th and 6th Levels, and the 6th and 8th Levels. The development work was confined to the Mitchell area on the South side of the fault dike above the 6th Level, where several minor extensions of known ore areas were outlined under the relatively flat hanging wall. This work was done on the -415', -430', -440' and -450' sub-levels.

The intersection of the horse of jasper, penetrating Block No. 3 from the hanging wall, and the main North dike, was encountered at the Northwest corner of Block 3 on the -515' sub-level. The ore area on the North side of the fault dike, which is contaminated by interbedded slate or dike, has increased in size by developments on the -745' and -760' sub-levels. The effect of this is to still further decrease the estimate of ore reserves. We estimate this condition has reduced the total reserves, to date, by about 150,000 tons.

D-2. CLIFFS SHAFT MINE

I made several underground geological surveys in the Cliffs Shaft Mine during the year but because of the limited time at my disposal, had to confine the work to those areas where the most important development work was going on, - namely, the westerly extension of the 10th Level "B" shaft heading for the Section 9 ore body and several contracts on the Bancroft Lease.

D-2. CLIFFS SHAFT MINE (Cont.)

In "A" shaft, the production continued to come chiefly from the Bancroft Lease on the North; the main deposit, both in the central part and the area adjacent to the old Incline and No. 3 mines on the East; and from the Southeast deposit. Developing continued on the 8th, 10th and the 12th Levels to get under known ore bodies and open up their downward extensions. In a number of places, raises were put up from these development drifts and the ore encountered. Drifting was resumed from the East end of the 15th Level to extend this Level Eastward far enough to encounter a possible downward extension of the ore on the 12th Level and to mine the ore tied up in floors below the 12th. Two raises are being put up, one inclined to the East and the other to the West, from the North-South drift on the 15th Level along the line of drill hole No. 422 on the East side of the Bancroft Lease to develop the main Bancroft ore horizon.

In "B" shaft, the production continued to come almost entirely from floors, raises and stopes in ore areas already developed on the various levels. The drift from the Southwest end of the 10th Level was extended approximately 360' Southwesterly toward the ore body in the West half of Section 9. The drift has followed the diorite footwall contact pretty closely but here and there has encountered narrow lenses of good ore lying on this footwall. No attempt has been made yet to develop these lenses but they may lead to mineable bodies and, at least, are very encouraging. The objective ore body which was discovered by drilling from the surface many years ago, is still some 1700' or 1800' ahead although old surface hole No. 10 had 10' of ore above and about 200' ahead of the present breast of this drift.

D-3. GARDNER MACKINAW MINE

All work at this mine was confined to the Mackinaw lease. Mr. Allen, engineer, has mapped the geology periodically in connection with his regular surveys.

During the year the 8th and 9th Levels were developed from the main Incline shaft. They were driven Northwesterly and Southeasterly in ore along its strike but exposed both foot and hanging contacts with short cross-cuts at irregular intervals. The 8th Level was opened for a distance of 450' Northwest of the shaft with the breast still in ore, and 275' Southeast with the last 145' in mixed ore and jasper. The 9th Level was opened for a distance of 870' to the Northwest of the shaft, with the last 50' driven North along the West boundary of the property and the breast encountering footwall material. To the Southeast the level has been driven 450' from the shaft with the breast in jasper. The 7th Level was extended 100' at its Northwest end and encountered jasper. A cross-cut located about 125' back from this breast was driven 125' Northeast to the footwall contact.

D-3. GARDNER MACKINAW (Cont.)

The production from this mine, except for one stope above the 7th Level near its Northwest end, all came from the main level development cited above and from new raises and stopes opened up between the 7th, 8th and 9th Levels during the year. The ore body is widening to the Northwest with its greatest width, so far exposed (140'), at the Northwest end of the 7th Level. The sulphur content, although still erratic, has lessened with depth below the 7th Level but, unfortunately, the phosphorus content has increased to a marked degree. In fact it begins to look as though the higher sulphur in the upper part of the ore body was a replacement of original phosphorus and that below the 7th Level less sulphur has replaced the original phosphorus content of this ore body.

As a result of the extensive development work during the past year, Mr. Allen has estimated the present ore reserves at approximately 1,000,000 tons with 500,000 tons of this available. The estimate for the Tax Commission a year ago was 164,858 tons, available.

D-4. LLOYD MINE

At the Lloyd Mine the 5th Level plat and pocket were completed and the shaft raise stripped to full shaft size down to the 6th Level and completely equipped. A small cut-out also was made at the 5½ Level elevation, the plat to be completed later. All this work was completed about April 1st, after which mining was resumed. The product all came from the subs above the 4th Level. Very little geological work was necessary as only a small amount of new ground was opened up.

D-5. MAAS MINE

At the Maas Mine, Mr. Moulton, engineer, has kept the geological data up to date and has posted the geological maps and cross-sections.

The principal production continued to come from three localities; namely, above the 3rd Level in the riser of ore from the 4th Level on the Race Course; between the 2nd and 3rd Levels on the footwall side of the main deposit; and above the 4th Level under the hanging wall just South of the Race Course. All the Bessemer production came from this last locality.

The new development work during the year was confined to the 5th Level and the raises put up from it. The Southwest-Northeast drift that connected the South ends of cross-cuts 4 and 5 was extended to connect with cross-cut No. 6 and for a distance of 200' beyond. To the Northeast this drift was extended 100' beyond its connection with cross-cut No. 4. A total of 16 raises were put up from the 5th level and holed into the 4th Level and two others started.

D-6. MORRIS MINE

The Morris Mine continued to be operated under lease by the Inland Steel Company. Mr. Trosvig, formerly engineer at this property with this Company, has continued to serve in the same capacity with the Inland Company. He has made frequent geological surveys and posted this data on his geological maps and cross-sections which I have inspected at infrequent intervals.

The mine operated continuously throughout the year on the basis of about 15 shifts per month, - four days per week some of the time and five days per week at other times. The production continued to come from No. 9 lease and the Cleveland-Cliffs fee land East and South of this lease. Approximately 70% of the product has come from the sub-level stopes and the balance from sub-level slicing and caving. The top most workings were on the 250' sub-level, or about 170' above the 7th Level, and the lowest workings on the 10' sub-level about 80' below the 7th Level and 145' above the 8th Level.

In No. 21 deposit, the most Northeasterly ore body on the 7th Level, developments the past year have shown up considerable additional ore until at present the ore outline on the 170' sub-level covers an area 325' long with an average width of 40'.

The ore limits in the Southwest end of No. 33,or Main, deposit have been materially extended. This is important because at this point much of the deposit extends from No. 9 lease over onto Cleveland Cliffs fee land to the south. The largest development of new ore during the year, however, has been in the "B" or middle deposit,which lies just North and West of the Main, or 33, deposit. Formerly the top of this ore was assumed to be only 40' above the 180' sub-level but it has now been developed as high as the 250' sub-level. At intervals, all the way down to the 7th Level, its horizontal dimensions have been materially expanded. On the 170' sub-level, for example, several hundred feet have been added to its length and at least a hundred feet on the 130' sub-level. In short, the development work at the Morris Mine is confirming our optimism regarding the property.

D-7. NEGAUNEE MINE

At the Negaunee Mine, Mr. Moulton, engineer, has made periodic geological surveys in connection with his engineering work and has posted this data on the geological maps and cross-sections.

The production came, principally, from four localities, namely, from the 3rd sub-level below the 10th Level on the North footwall; from the 2nd sub-level below the 10th on the South footwall; from the 2nd sub-level below the 11th Level along the Maas Mine boundary; and from the 4th sub below the 11th at the Southwest end of the main deposit under the hanging wall.

The only development work consisted of 3 raises put up from the 11th Level in the South footwall area and 2 raises put up from the 12th Level in the main deposit.

D-8. TILDEN MINE

No detailed geological survey or mapping was necessary at this silicious open pit property but I examined two or three unimportant lenses of high grade hard ore that were uncovered by the hydraulic stripping at the East Pit and posted them on the map for future exploring at a lower elevation.

Of the total production of 167,688 tons of silicious ore from the property, 117,421 tons came from the West Pit and 50,267 tons from the East Pit. Several churn drill holes were drilled just East of the West Pit to check the grade of ore indicated by earlier drilling which had showed a sulphur content in the form of pyrite. Some sulphur was found but the areas affected were considered unimportant and plans are going ahead in preparation for extending the pit in this direction.

E. OPTIONS AND LEASES

No new options to explore, nor mining leases, were taken during the year.

Notice of surrender of leases were given to the fee owners of the Drew Mine, Mesaba Range, at the end of the year. These leases are the so-called Drew and Syme-Croxton leases. I understand that Ernest Drew, one of the fee owners of the Drew lease, wants the leases assigned to him and that negotiations to this end are under way at this time.

F. EXPLORATIONS AND COSTS

Drilling explorations were carried on during 1934 in the following districts and mines:

F-1. FROM SURFACE

DISTRICT	RANGE	MINE
Coleraine	Mesaba	Canisteo
Tilden	Marquette	Tilden

Table V, which follows, gives the footage drilled, the ore encountered and the cost per foot of drilling. It will be noted that the average cost of drilling was $1.64 per foot, excluding certain items which were not actual drilling expense but which are charged to the explorations. By including these items, the average cost was $2.01 per foot.

Table VI, also shown below, gives a comparative cost per foot of drilling for the past five years. The 1934 costs were very much lower than the previous years noted, principally because in the previous years, much of the footage drilled was with diamonds. All of the footage in 1934 was churn drilling.

TABLE V

SUMMARY OF DRILLING FOR 1934

PROPERTY	DESCRIPTION SEC.	T.	R.		STAND-PIPING FT.	CHURN DRILLING FT.	DIAMOND DRILLING FT.	TOTAL DRILLING FT.	FIRST CLASS ORE FT.	SECOND CLASS ORE FT.	LEAN ORE FT.	TOTAL COST "A"	COST PER FT. "A"	TOTAL COST "B"	COST PER FT. "B"
						SURFACE DRILLING									
Canisteo Mine	29 & 30	56	24	Minn.	154	7,533	-	7,687	3,645*	-	-	$ 15,431.60	$ 2.01	$ 12,528.07	$ 1.63
Tilden Mine	26	47	27	Mich.	77	466	-	543	-	-	466	1,108.44	2.04	944.82	1.74
TOTAL SURFACE DRILLING					231	7,999	-	8,230	3,645	-	466	$ 16,540.04	$ 2.01	$ 13,472.89	$ 1.64

* This is Wash Ore which may be concentrated to First Class Ore by washing.

Note: Cost "A" includes office expense, engineering, analysis, legal, personal injury, etc.
Cost "B" excludes " " " " " " " " (to compare with contract price)

Of the drilling at the Canisteo Mine, 6 holes aggregating 1,373' were drilled under contract by J. S. Schultze of Grand Rapids, Minn. at a cost of $2.21 per foot.

In addition to the above drilling for exploration, a hole drilled from the Maas Mine surface to test the Jasper capping sunk 29' of standpipe, churn drilled 409' and wedged off a diamond drill hole for 132', - a total of 570', at a cost of $6.56 per foot.

TABLE VI

SUMMARY OF FOOTAGE DRILLED AND COST PER FOOT OF DRILLING FOR THE PAST FIVE YEARS

YEAR	TOTAL FEET DRILLED	COST PER FOOT "A"	COST PER FOOT "B"
1930	14,656	$ 4.15	$ 3.61
1931	8,031	3.59	3.05
1932	63	11.44	3.75
1933	4,939	3.85	3.01
1934	8,230	2.01	1.64

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F-3. DIAMOND DRILL CARBON

We had on hand, January 1, 1934, a total of 368.80 karats of diamond drill carbon which inventoried at $44,799.62. We consumed, in 1934, a total of 0.39 karats in our drilling (all in the wedged hole on the surface at the Maas Mine) at a cost of $51.75. This left on hand, December 31, 1934, a total of 368.41 karats which inventoried at $44,747.87.

F-4. DRILL SECTIONS

Due to the depletion of the force of the Geological Department, it has been impossible to make cross-section tracings showing in detail the results of the drilling done during the year 1934. Sections of the Canisteo drilling, however, will be prepared at our Hibbing office for use on the Range but these will not be suitable for photographing and including in our Annual Report books.

It has been customary for many years to file photographic white prints of these tracings with the maps and cross-sections in the Annual Report books. This has been impossible for the past two years and is to be seriously regretted. Sometime this information will be wanted on short notice and it will not be available. I trust I shall be allowed to correct this and other similar conditions in the near future, or as soon as the business situation warrants.

G. SURFACE EXPLORATIONS

G-1. CANISTEO MINE, SECTIONS 29 & 30, 56-24, MINNESOTA

A total of 76 structure churn drill holes were drilled in the Canisteo pit during 1934 with a total footage of 7687'. This work is necessary in order to sample the ore layers ahead of the actual mining operations and to determine, more accurately, the limits of future stripping operations, - both rock and surface material.

Drilling started in May, soon after mining operations began, using two of our own rigs. In July, it was found necessary to speed up this work in anticipation of a new reserve ore estimate which was prepared late in the year to aid in determining, with our partners, our future operating plans at this property. Consequently, we engaged the Schultze Brothers, of Grand Rapids, Minnesota, to drill six holes with their two structure churn drill rigs and crew under contract. This work commenced the first of August, and the holes were drilled along the Southeast side of the pit from a berm on the stripping bank. A total of 1373' was drilledin these six holes leaving a balance of 6314' for the 70 holes drilled in the pit bottom with our own rigs and crew.

G-1, CANISTEO MINE, SECTIONS 29 & 30, 56-24, MINNESOTA (Cont.)

The holes drilled were distributed as follows:

1	hole on the	NE Bovey, NE¼-SE¼, Sec. 30.
21	holes "	" Hemmens, SW¼-SW¼, Sec. 29.
45	holes "	" East Snyder, SE¼-SE¼, Sec.30.
9	" "	" Middle " , SW¼-SE¼, Sec. 30.
76	holes.	

All drilling was stopped for the season the last of October.

G-2. TILDEN MINE, SECTION 26,47-27, MICHIGAN

A churn drilling program was started late in October to confirm the higher than average sulphur content of the ore extension not yet-stripped lying just East of the West pit. This area was only partially explored at the time of the original drilling several years ago.

Eight holes were drilled aggregating 543' of which 77' was standpiping through surface material, - an average of approximately 10' of stripping. The work was completed late in November. Of the eight holes drilled, five showed a sulphur average below .030%. The remaining three disclosed higher sulphur in the lower half of each hole. However, the higher sulphur is so distributed within the area and within such limits of analysis that it is believed a suitable mixture can be made if this area is included in the future mining operations.

H. UNDERGROUND EXPLORATIONS

No underground drilling was done during the year 1934.

I. EXPLORATIONS AND NEW DEVELOPMENTS BY OTHER COMPANIES

Due to the continued economic stress throughout 1934, very little exploring and drilling were done by the various iron ore companies in the Lake Superior District. The miscellaneous reports that have come to my attention are as follows:

I-1. MARQUETTE RANGE

The Inland Steel Company, at its Greenwood Mine, continued to develop and mine a moderate tonnage of hard ore on and above the 1100' level. This is the only level connecting with the shaft. The shaft is located about 800' North of the mine workings and is in the hanging wall of the ore body. On May 11, 1934, Mr. Conibear and I went through practically all of the mine workings and examined the maps. I outlined this examination in detail in a special report

I-1. MARQUETTE RANGE (Cont.)

to Mr. Elliott, dated May 14, 1934. At that time about 75 men were employed, including both surface and underground. A diamond drill was operating continuously underground and the ore was being removed about as fast as it was put in sight. The production at that time was about 4,000 tons per month.

Activities in the Gold district just North of Ishpeming increased materially during the year. The old Michigan Gold Mine shaft, located in Section 35,48-28, was reopened by outside capital and a small mill erected. Several thousand dollars in bullion were shipped out but during the latter part of the year operations were suspended temporarily until additional capital could be secured to continue development work.

At the Ropes Gold Mine, in Section 29, 48-27, and on the ten forties adjacent to it, leased to Bjork and Lundin by the Company, exploring was carried on more or less continuously exposing several gold bearing quartz vein systems under shallow overburden at the surface of the ground. These veins were sampled and some of them showed encouraging values. Late in the year the Calumet & Hecla Consolidated Copper Company took over the Ropes Mine from the Ishpeming Gold Mining Company, and also obtained an option on the Company's land leased to Bjork and Lundin as well as an option on four additional adjoining Company forties. An intensive exploring campaign, including the immediate unwatering of the old Ropes Mine workings, is contemplated.

The North Range Mining Company, composed of R. S. Archibald of Negaunee, with Detroit capital, took over the lease on the Blueberry Mine, formerly operated by the Ford Motor Company, and resumed operations, including both production and development work. A new ore body was disclosed just East of the main ore body and it has been followed in exploration work nearly up to the ledge surface.

I-2. MENOMINEE RANGE - IRON RIVER DISTRICT

Jones & Laughlin cancelled its lease on the Forbes Mine in the Mineral Hills District of Iron River. Since then, however, R. S. Archibald and Detroit associates have leased the property and commenced to make repairs to the shaft and equipment, preparatory to resuming mining operations.

Recently, it has been rumored that the large strong ore body at the Bates Mine, operated by M. A. Hanna, has commenced to peter out very rapidly. Effort is being made to discover possible repetition of the ore at other horizons but, so far, without success. The change in the dimensions of the ore body, according to my information, was very sudden.

I-3. MESABA RANGE

The State Mines Experiment Station errected one unit of a combination roasting and magnetic concentrating plant at the Harrison Mine of Butler Brothers near Nashwauk, early in the summer. The plant was operated the balance of the ore season in an experimental way by a crew from the Station, on jig tailings stored nearby which have been rejected the past several years from the Harrison Plant. The work will be continued next season before determining whether the operation is an economic success. If it proves to be so, Butler Brothers will take it over and add additional units to the present plant.

A small washing plant was erected at the St.Paul Mine of Corrigan-McKinney near Keewatin. It wasn't completed until late in the ore season. The chief interest in this plant is in the tratement of the fine ore material usually handled by Dorr bowl-classifiers. At the St.Paul plant this material is treated in a large two-stage improved Hydrotator. Only 800 tons were put through when the plant closed for the winter but I am told the results were very satisfactory. We shall watch near year's operations of this plant with renewed interest.

J. EXAMINATION OF MINERAL LAND OFFERS

Seven mineral land offers were received and recorded during the past year as follows:

NUMBER	DESCRIPTION	REMARKS
1895	Various descriptions in Keweenaw,Marquette and Ontonagon Counties, Mich.	Declined
1897	Various descriptions in Iron County, Mich.	"
1898	1/2 interest in lands in Sections 18 & 20, 47-26, Michigan	"
1901	Fee interest in Perkins Block at Negaunee	"
1902	Gold Lake area near Goldfield & Tonopah, Nev.	"
1904	Helen Mine, Michipicoten District, Ontario	Pending
1908	Minowan Iron Company, in Palmer District	Declined

K. EXPENSE STATEMENTS

Tables VII and VIII, which follow, show a detailed statement of charges to Geological expense for the year 1934 and a comparative statement of these charges for the last three years. They are self-explanatory.

K. EXPENSE STATEMENTS (Cont.)

TABLE VII

STATEMENT OF CHARGES TO GEOLOGICAL EXPENSE FOR THE YEAR 1934

Salaries	$ 4,620.00
Travel & Entertainment	1,234.07
Operating Automobiles	176.30
Supplies & Office Expense	273.34
Personal Injury	88.62
Unclassified	37.49
Total	$ 6,429.82

TABLE VIII

COMPARATIVE STATEMENT OF CHARGES TO GEOLOGICAL DEPARTMENT FOR LAST THREE YEARS

	1934	1933	1932
Salaries	$ 4,620.00	$ 4,544.62	$ 5,469.83
Travel & Entertainment	1,234.07	482.32	633.34
Operating Automobiles	176.30	337.74	560.37
Supplies & Office Expense	273.34	218.02	188.73
Personal Injury	88.62	-	-
Unclassified	37.49	8.35	67.67
	$ 6,429.82	$ 5,591.05	$ 6,919.94

L. RESEARCH DEPARTMENT

No one was employed on research work during the year 1934.

Respectfully submitted,

E. L. Derby, Jr.

ELD:DP

Geologist

21. ANNUAL REPORT OF THE MINING ENGINEERING DEPARTMENT FOR THE YEAR ENDING DECEMBER 31, 1934

Accompanying this report are the usual books of photographic maps, showing the work done at the various mines during 1934. These books are loose-leaf, with paper covers, and contain views, maps or sections of the mines that were operated during the year. The maps show in color the areas mined or development work done during the year. They have been prepared for the different companies interested in the various properties, and are listed below:

Company	Mines
Cleveland-Cliffs Iron Company,	Athens, Canisteo-Cliffs, Cliffs Shaft, Drew, Gardner-Mackinaw, Lloyd, Maas, Negaunee and Tilden.
Bethlehem Mines Corporation,	Negaunee
Hanna Ore Mining Company,	Canisteo-Cliffs
Inland Steel Company,	Canisteo-Cliffs
Jones & Laughlin Steel Corporation,	Canisteo-Cliffs
Otis Steel Corporation,	Canisteo-Cliffs
Pickands, Mather & Company,	Athens
Pittsburgh Steel Company,	Canisteo-Cliffs
Republic Steel Corporation,	Canisteo-Cliffs
Wheeling Steel Corporation,	Canisteo-Cliffs

Two copies of the Cleveland-Cliffs Iron Company book were made, one for the Cleveland office and one for the Ishpeming office. One copy was made of each of the other books.

Besides the above books, others were made for fee owners and Superintendents as follows:

Person	Mines
E. C. Congdon, Fee owner,	Canisteo-Cliffs
M. H. Barber, District Superintendent	Canisteo-Cliffs, Drew,
H. C. Bolthouse, Superintendent	Canistee-Cliffs

B. MAP REPORTS

The following map reports for outside parties were made during 1934:

ATHENS MINE

Blue prints of the mine maps of the Athens Mine were sent each month to the Cleveland office for the Pickands Mather Company. These blue prints showed in red the areas mined during the previous month.

MAAS MINE

Blue prints of the mine workings in the Roman Catholic Cemetery were sent to Mr. R. S. Archibald, Negaunee, Michigan, each month since March, when mining operations were resumed in this lease. These maps showed in red the areas mined during the previous month.

NEGAUNEE MINE

Fourteen sets of the Annual Report maps of the Tenth and Eleventh Levels of the Negaunee Mine were sent, at the end of the year, to the Cleveland office for the fee owners.

At the end of the year, a set of blue prints of the cross-sections of the Negaunee Mine were sent to Mr. W. L. Cummings, Bethlehem, Pa.

MACKINAW MINE

Blue prints of the map of the underground workings on the Mackinaw Lease were sent at the end of each quarter to Mr. G. P. McCallum, Ann Arbor, Michigan.

MICHIGAN STATE TAX COMMISSION

The usual set of maps and estimates of ore reserves of the operating Michigan Mines were prepared and sent to the Michigan State Tax Commission. Complete new estimates of ore reserves of the Athens, Cliffs Shaft, Lloyd, Maas, Mackinaw and Negaunee Mines have been made as of December 31st, 1934.

C. REMARKS ON MISCELLANEOUS DOCUMENTS AND ABSTRACTS.

All documents affecting the Company's lands and holdings pass through the Engineering Department for a matter of record and approval. The documents originate in various departments. The following table shows the number that were entered on the records during 1934. Copies of some of the documents have been placed on file in the Department.

Classification	Number Received	Last File Number
Mining Leases	0	68
Miscellaneous Documents	29	1243
Easements	5	383
Rights-of-way	0	219
Water fights	0	58
Surface leases	226	3944
Applications for Sale	10	139
Sales	27	729
Tax Histories	0	702
Legal Opinions	0	193

The following comments relate to the various papers placed on the records of the Department in 1934:

MINING LEASES

There has not been any change in the status of any of the active mining leases during the year.

MISCELLANEOUS DOCUMENTS

Sixteen of these documents were copies of deeds executed many years ago and constitute part of the chain of title to the lands comprising the Maas and Negaunee Mines and adjacent lands. They were sent to this Department for filing by the Legal Department, which had used them in a lawsuit. Seven others were rights granted to the Company or the Cliffs Power & Light Company, while the remaining six were rights granted by either Company. All of the documents affected either the mineral or water power lands.

EASEMENTS

These five documents were all concerning the Cliffs Power & Light Company. Four documents were transmission line easements, two covering rights-of-way and two crossings of railways. The remaining document was a copy of the Marquette County Board of Supervisors' resolutions permitting erection of the Hoist and McClure Dams. This latter document had never been filed among our records.

SURFACE LEASES

These leases originated in the Land Department and cover all sorts of permits for use of Company lands, farms, garden, residence, camping, etc.

APPLICATIONS FOR SALE

These applications for purchase of Company lands off the mineralized areas, were made through the Land Department, and were submitted for our approval.

SALES

These also came from the Land Department, thirteen were deeds for land, three covered large acreages to the United States for National Forests, eight were sales of Company houses, one timber cutting permit, and two highway rights-of-way.

ABSTRACTS

Early in the year, the Cleveland office requested that the abstracts of the Cliffs Power & Light Company be brought up to date. A good start has been made and most of the outstanding rights have been acquired. Some of the maps and abstracts have been posted to date, but there has been little time to complete them. The Department has been so busy with the regular work in connection with the mines, that the abstract work has been very irregular. There is a lot to be done to bring the records and maps up to date.

TAXES

The usual tax lists for the Mining Department and the Cliffs Power & Light Company lands for payment of 1934 taxes were prepared during October and November.

D. THE FORCE

There has been no change in the staff of engineers in the Department during the year. One helper was added on part time during the last half.

The following table shows the personnel of the Department during the year:

Name	Position	Entered	Left	1934 Employment
R. J. Chenneour	Engineer			12 months
H. O. Moulton	"			12 months
C. W. Allen	"			12 months
T. A. Miller	"	June 1st	June 30th	1 month
E. A. Allen	Helper			12 months
T. W. Hill	"	July 9th		5½ months

The following table shows the length of service in the Department of those employed at the end of the year:

Name	Date Entered	Years
R. J. Chenneour	Jan. 1903	32
H. O. Moulton	Apr. 1910	23¾
C. W. Allen	June 1925	8
E. A. Allen	Sept. 1931	1-7/8
T. W. Hill	July 1934	1/2

The following table shows the total working days, days worked, days of sickness and vacation, for all men in the Department during the year. Sundays and Holidays are not included.

Name	Working Days	Days Worked	Days Overtime	Days Sick	Days Absent
C. Brewer	265½	253	½	2½	10½
R. J. Chenneour	265½	257½	1½		9½
H. O. Moulton	265½	260			5½
C. W. Allen	265½	264	3	2	2½
T. A. Miller	22½	22½			
E. A. Allen	265½	259½			6
T. W. Hill (1)	56	56			

(1) T. W. Hill is regularly employed in the Safety Department and works in the Engineering Department when not otherwise occupied.

The next table shows the distribution of time spent underground, in the field or office during the year:

Name	Underground	Field	Office	Total
C. Brewer	29	33	191	253
R. J. Chenneour	76	35	146½	257½
H. O. Moulton	96½	28½	135	260
C. W. Allen	87	30	147	264
T. A. Miller	0	9½	13	22½
E. A. Allen	78	32	149½	259½
T. W. Hill	36½	13	27	76½
Total	403	181	809	1393
%	28.9	13.0	58.1	100.0%

The following is a brief summary of the work done by each member of the force, that is not mentioned elsewhere in this report:

CARL BREWER, Chief Mining Engineer, had charge of the office and exercised general supervision over all work in the Department. He entered on the records all documentsreceived in the office and reported on them as necessary. He compiled the Annual Report books and ore estimates and maps for the Michigan State Tax Commission. He looked after all the Engineering work at the Lloyd Mine during the year, making the monthly surveys, map reports and the ore estimate, as well as the weekly mine inspections. Some time was spent on making a general study of the Lloyd Mine East ore body and correlating the mine maps and sections. He did the work on the abstracts and maps of the Cliffs Power & Light Company and spent several days in the field in connection with the work. He ran the survey for the

new transmission line from the McClure Plant to the Pioneer Furnace.

The following table shows the distribution of his time for the year:

Property	Underground	Field	Office	Total	%
Athens Mine	1	2	6½	9½	3.7
Cliffs Shaft Mine	½		½	1	.4
Lloyd Mine	26½	7	47½	81	32.0
Maas Mine		1	2	3	1.2
Gardner Mackinaw Mine		1		1	.4
Negaunee Mine		½	2	2½	1.0
Spies Virgil Mine	1		6	7	2.8
Cliffs Power & Light Co.		8	12½	20½	8.1
Miscellaneous		13½	114	127½	50.4
Total	29	33	191	253	100.0
%	11.5	13.0	75.5	100.0	

REGINALD J. CHENNEOUR, has been regularly engaged throughout the year in the engineering work at the Cliffs Shaft Mine. He has run surveys on many of the levels and working places. He made the monthly surveys, map reports, estimates, etc. of this property and also done some of the geology. During March he made a study for Mr. Stakel, of the location of the various contracts with respect to each other and to the different haulage levels, with the possible aim of more concentration of working places. He has also made a study of available ore in floors. During December he spent a few days running time tests on drilling in the underground workings. During April and May he supervised the construction and installation of the underground pocket on the 5th Level Lloyd Mine.

The following table shows the distribution of his time for the year:

Property	Underground	Field	Office	Total	%
Athens Mine		1	½	1½	.6
Cliffs Shaft Mine	59½	27	136	222½	86.4
Lloyd Mine	16½	2½	7	26	10.1
Maas Mine		1		1	.4
Cliffs Power & Light Co.		3½	½	4	1.5
Miscellaneous			2½	2½	1.0
TOTAL	76	35	146½	257½	100.0
%	29.5	13.6	56.9	100.0	

HENRY O. MOULTON, has looked after the engineering work at the Maas and Negaunee Mines throughout the year, making the monthly surveys, maps reports, ore estimates, etc. In June he spent two weeks in Cleveland, Ohio, making surveys and estimates of ore in stock at the Otis Steel Company's plant. He made the stockpile surveys at the Maas, Negaunee and Lloyd Mines, and assisted on the surveys at other mines.

The following table shows the distribution of his time for the year:

Property	Underground	Field	Office	Total	%
Athens Mine			1	1	.4
Cliffs Shaft Mine			½	½	.2
Lloyd Mine	3½	4	3½	11	4.2
Maas Mine	46½	3	60	109½	42.3
Gardner Mackinaw Mine	1		1½	2½	1.0
Negaunee Mine	45½	1½	68½	115½	44.3
Cliffs Power & Light Co.		3½		3½	1.3
Miscellaneous		16½		16½	6.3
Total	96½	28½	135	260	100.0
%	37.1	11.1	51.9	100.0	

CHARLES W. ALLEN, did the engineering work at the Athens and Gardner Mackinaw Mines throughout the year, and at the Tilden Mine during its operation. He made the monthly surveys, map reports, ore estimates, etc., and weekly inspections at the underground mines. He supervised the drilling and blasting at the Tilden and made such estimates, etc., as were necessary. He made the stockpile surveys at the Athens and Mackinaw-Gardner Mines and assisted on other surveys.

The following table shows the distribution of his time during the year:

Property	Underground	Field	Office	Total	%
Athens Mine	47	3	54½	104½	39.6
Cliffs Shaft Mine			3½	3½	1.3
Lloyd Mine			½	½	.2
Maas Mine			2½	2½	.9
Gardner Mackinaw Mine	37	1	45	83	31.4
Negaunee Mine	3		2½	5½	2.1
Spies Virgil Mine			½	½	.2
Tilden Mine		19½	26	45½	17.2
Cliffs Power & Light Co.		4½	½	5	2.0
Miscellaneous		2	11½	13½	5.1
Total	87	30	147	264	100.0
%	33.0	11.3	55.7	100.0	

TOM A MILLER, entered the Department early in June from the Safety Department, where he had been engaged in the dust count research. As the preliminary work in this study has been completed, only a small proportion of his time would be necessary to carry on. He was therefore transferred to the Department with the understanding that only his available time would be with the engineers. He left the employ of the Company at the end of the month. During June he resumed his engineering work at the Cliffs Shaft Mine and was engaged in making a survey of the stockpile for factor purposes.

The following table shows the distribution of his time for the month he was employed.

Property	Underground	Field	Office	Total	%
Cliffs Shaft Mine		9½	11½	21	93.3
Miscellaneous			1½	1½	.7
Total		9½	13	22½	100.0
%		42.2	57.8	100.0	

ERNEST A. ALLEN, was employed throughout the year as engineer's helper. He assisted in underground and surface surveys and in the office did all the blue printing. He looked after the cars of the Department, and spent a few days work making thin sections for the Geological Department.

The following table shows the distribution of his time for the year:

Property	Underground	Field	Office	Total	%
Athens Mine	5½	2½	½	8½	3.3
Cliffs Shaft	40	13	1	54	20.8
Lloyd	11	1½		12½	4.8
Maas	5½	2		7½	2.9
Gardner Mackinaw	11	1		12	4.6
Negaunee	5	1		6	2.3
Tilden		6		6	2.3
Cliffs Power & Light		2½		2½	1.0
Miscellaneous		2½	148	150½	58.0
Total	98	32	149½	259½	100.0
%	30.1	12.3	57.6	100.0	

THOMAS W. HILL, who helped Mr. Miller in the Dust Count Research of the Safety Department, has in his spare time also helped in the Engineering Department since July 20th.

He has assisted in underground ans surface surveys and while in the office has been draftsman, making new maps, etc.

The following table shows the distribution of his time while in the Department:

Property	Underground	Field	Office	Total	%
Athens Mine	5	½		5½	7.2
Cliffs Shaft	9½	3½	5½	18½	24.2
Lloyd Mine	5	2		7	9.1
Maas	2½	2½		5	6.5
Gardner Mackinaw	12	1		13	17.0
Negaunee	1½	½		2	2.6
Spies Virgil	1			1	1.4
Tilden		3		3	3.9
Miscellaneous			21½	21½	28.1
Total	36½	13	27	76½	100.0
%	47.7	17.0	35.3	100.0	

E. DISTRIBUTION OF TIME.

There was comparatively little work done in the Department, outside of that directly connected with the mines. The time connected with blueprinting, both monthly and annual reports, drafting, etc., has been included under "Miscellaneous", this year because of the difficulty of accurate separation between properties.

The following table shows the distribution of time spent underground, in the field or office for the various properties, of the entire force:

Property	Underground	Field	Office	Total	%
Athens Mine	58½	9	63	130½	9.4
Cliffs Shaft Mine	109½	53	158	321	23.1
Lloyd Mine	62½	17	58½	138	9.9
Maas Mine	54½	9½	64½	128½	9.2
Gardner Mackinaw Mine	61	4	46½	111½	8.0
Negaunee Mine	55	3½	73	131½	9.4
Spies Virgil Mine	2		6½	8½	.6
Tilden Mine		28½	26	54½	3.9
Cliffs Power & Light Co.		22	13½	35½	2.5
Miscellaneous		34½	299	333½	24.0
Total	403	181	809	1393	100.0
%	28.9	13.0	58.1	100.0	

F. COSTS.

The following table shows the comparison of costs of the Engineering Department for the last three years:

	1932	1933	1934
Salaries	$ 7,841.96	$ 3,279.59	$ 9,668.78
Auto Expense	439.77	348.16	280.68
Heat, Light & Power	14.98	28.25	53.83
Insurance	288.40	206.09	194.06
Postage	12.18	13.63	14.93
Repairs	5.07		117.99
Stationery & Printing	59.87	8.55	35.40
Supplies	82.00	157.35	365.07
Taxes	43.97	40.75	41.46
Personal Injury Expense			192.27
Telephone & Telegraph	102.73	45.60	68.69
Papers & Publications	1.67		6.00
General-Unclassified	195.39	18.11	25.71
Janitor & Cleaning			7.04
TOTAL	$ 9,027.99	$ 4,146.08	$ 11,071.91

H. AUTOMOBILES.

The Ford Sedan and Ford Station Wagon, owned by the Department, continued to be in service all the year. The following table shows the mileage covered by these cars for the year, total miles, and the date received by the Department:

CAR	MILES		DATE RECEIVED
	1934	Total	
Sedan	4,436	30,866	July 9,1930
Station Wagon	2,595	19,792	Nov.10,1930

I. MINES.

The following is a brief description of the special work done at the various properties during the year:

GENERAL.

Weekly inspection trips were made to each working place in the soft ore mines by the engineer in charge. Monthly map reports were made to the General Superintendent and Mine Superintendents showing the areas mined, and a written monthly report for the Mine Superintendent on the underground mining for all the mines except Lloyd and Cliffs Shaft Mines.

ATHENS MINE.

A map of the ledge contours in the vicinity of the Athens Mine was made by Mr. Brewer. The data was taken mostly from drill hole records. Levels were run across the Athens property to determine evidence of settlement. No change was noted, except an enlargement of the cave.

CLIFFS SHAFT MINE.

Many underground surveys were run on the various levels to check up on the extensions made during the last two years. These surveys were far behind as the engineering staff has been unable to keep up with this work. The underground maps of the mine are very old and dilapidated. A complete new set is necessary. This has been started but very little accomplished so far.

LLOYD MINE.

During the first four months of the year, the stripping of the shaft was completed and the cutting and installation of pocket on the 3rd Level finished. Mr. Chenneour had charge of the construction of the pocket. When the mining operations began, Mr. Brewer became engineer and has done the engineering work. The shaft was plumbed from the 4th to 5th Levels in December. During the year surveys were run to various sub-levels, and development work planned. During the fall, levels were taken on surface to record the settlement of ground in the vicinity of Section 6 Shaft.

A joint survey with Mr. Trosvig of the Inland Steel Company, operators of the Morris Mine, was made in August and witness posts placed on the boundary line between the Lloyd and Morris Mines.

MAAS MINE.

Surveys were run by Mr. Moulton to the various new sub-levels and lines, etc., given for the main level development. A mine map of ledge contours was made by Mr. Brewer of the Maas-Negaunee Mines.

GARDNER MACKINAW MINE.

The development of the 8th and 9th Levels was watched closely by Mr. Allen, and surveys frequently made, both for development on the levels and for stoping.

TILDEN MINE.

The location of drill holes and supervision of blasting for the various cuts at the East Pit were done by Mr. Allen.

CLIFFS POWER & LIGHT COMPANY.

Two and a half miles of survey were run east from the McClure Plant for a new transmission line to the Pioneer Furnace. Mr. Brewer ran the survey and made the maps and profiles for the line.

Mr. Moulton ran levels on Lake Michigamme to check the elevations along the D.S.S.& A.Railroad between Champion and Michigamme and at the Dam. The water level was taken for turning point and referred to two U. S. Coast & Geodetic Survey monuments as datum. A survey was run at the Escanaba River Water Power in connection with the sale of land and at the Hoist Plant for drainage purposes.

J. MISCELLANEOUS.

SHAFT GAUGING.

The runners in the shafts of the operating mines were gauged as follows:

Lloyd Mine	April 2nd
Mackinaw Mine	Oct. 19th
Athens Mine	Nov. 2nd
Negaunee Mine	Nov. 16th
Maas Mine	Nov. 30th
Spies Mine	Dec. 20th

STOCKPILE SURVEYS.

The stockpiles were surveyed during the summer and the report of the engineers estimate of ore in stock was made as of October 15th.

ALGOMA STEEL CORPORATION.

Messrs. Brewer and Moulton spent five days in May making an estimate of ore in stock at the plant of the Algoma Steel Corporation at Sault Ste. Marie, Ontario, Canada.

OFFICE HOURS.

The office hours during the year were as follows:

	A.M.	P.M.	Saturday
January 1st to Sept. 8th	8:30 - 12:00	1:00 - 4:45	8:30 - 12:15
September 8th to Oct.1st	8:30 - 12:00	1:00 - 4:45	None
October 1st to Dec. 31st	8:00 - 12:00	1:00 - 5:00	None

HOLIDAYS.

The following were holidays during the year:

January 1st	-	New Years Day
February 22nd	-	Washington's Birthday
March 30th	-	Good Friday
April 2nd	-	Election Day
May 30th	-	Memorial Day
September 3rd	-	Labor Day
September 11th	-	Primary Election Day
November 6th	-	National Election Day
November 11th	-	Armistice Day
December 24th	-	1/2 day
December 25th,26th	-	Christmas
December 31st	-	1/2 day.

Carl Brewer

Chief Mining Engineer

CB:DP

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CLIFFS SHAFT MINE:

A new 5' x 13' Link Belt Company picking belt was installed in the crushing plant. This belt was installed so that the ore is dumped direct from the car onto the belt, which enables the men to pick out the rock before it enters the crusher. In order to dispose of this rock it was necessary to change several chutes and also install a rock tram plant. We had a 6' sheave tram plant at the Republic Mine and this was installed to take care of the rock. The above equipment was put in operation on April the 16th and it is operating very nicely.

Some changes were also made to the tram plant which handles the ore from the shaft houses to the crushing plant. The cars on this tram are operated in balance. As there is a difference of 52 feet in the distance traveled by the two cars, it was necessary to make two spots to load one car and unload the other, which slowed up the operation to some extent. In order to rectify this condition a second drum was installed and provision made to take up the 52 feet so that one car is now being loaded at the shaft house while the other is being dumped at the crushing plant. This change saves considerable time each trip and was put in operation in July.

A new steel bent was put in the steel trestle at "B" Shaft to replace a wood bent that was in very poor condition.

The new combination aluminum-steel skip and cage was put in service on November the 30th. It is operating very satisfactorily. The weight of the old skip was 13,230 lbs., while the new combined skip and cage weighs only 10,000 lbs., a difference of 3,200 lbs. With the old arrangement it was necessary to change the skip and cage twice each day, which took up considerable time. With the new skip and cage they can start to hoist ore as soon as the men are in the mine. Another advantage, from a safety standpoint, is that during the hoisting period men entering or leaving the mine can ride the cage in the usual manner and have the same protection they have on the standard cage. Before this change was made, men entering or leaving the mine during the hoisting period had to ride the bail of the skip, holding on to the rope, with only a small plate over their heads to protect them from anything that might fall down the shaft.

All mechanical equipment operated satisfactorily during the year.

TILDEN MINE:

It is necessary to do considerable repairing to the equipment at this mine.

On the electric shovels the lower end of the booms will have to be riveted and new bracing angles put in to replace some that are broken. The dippers and dipper sticks are being re-built. All the motors and motor-generator sets have been taken to the General Shops for a general overhauling, cleaning and painting.

The crushers and other crushing equipment is being repaired and made ready for the coming season.

After the above repairs are completed this plant will be in good condition.

The mechanical equipment operated satisfactorily during the year.

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ATHENS MINE:

The skip hoist drum became loose on the shaft. New keys were fitted and the hoist is now in good condition.

Several changes were made to the Timber Treating Plant, which increased the capacity of the same about 50%.

Independent heating plants were installed in the engine house and office. This eliminates a long steam line which served these buildings, and should show considerable saving in heating costs.

The mechanical equipment at this mine operated satisfactorily during the year, with no trouble or delays.

MAAS MINE:

The brake band on the skip hoist broke. Heavier material was ordered and a new brake band installed.

One of the intercoolers on the Ingersoll-Rand compressor sprang a leak in the tubes. This was re-tubed and is operating satisfactorily.

At the Crushing Plant new concaves were installed in the crusher and a new pinion and shaft on the belt conveyor. Some repairs were made to the chutes and pockets.

Some repairs were made to the pockets in the shaft house. Considerable steel had to be replaced with new as the old steel was in poor condition.

The skip hoist drum has developed several cracks in the re-inforcing ribs. These cracks are being watched and if they continue to extend repairs will be made.

All other mechanical equipment operated satisfactorily during the year.

NEGAUNEE MINE:

The crosshead on the brake engine of the cage hoist broke. Repairs were made and it is in good condition.

An 8 ft. top tram sheave broke and was replaced by one from the Gwinn District.

The skip hoist drum developed a few small cracks. This drum has been repaired and is in good condition.

All mechanical equipment operated satisfactorily during the year and is in good condition.

LLOYD MINE:

A 1600 cu. ft. Sullivan compressor was installed in the engine room. This machine came from the Boeing Mine.

Considerable changes were made to the skip hoist. It was changed from

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LLOYD MINE: (Cont'd)

a double reduction geared to a single reduction. A herringbone ring gear was purchased from the Farrel-Birmingham gear company. The teeth on the old spur gear were turned off and the new gear pressed on the same spider. The pinion shaft was extended across the front of the drum and the motor connected to the pinion shaft by a solid coupling. The old 400 H.P., 360 R.P.M., motor was discarded and a 500 H.P., 450 R.P.M., motor from Republic Mine hoist was installed. This gives us a rope speed of 1200 feet per minute, while the rope speed with the old arrangement was 930 feet per minute, an increase of 270 ft. per minute. Several cracks developed in the drum and these were repaired. This hoist is now in good condition.

The old heating boiler from the Barnes-Hecker Mine was moved to the Lloyd and used as an air receiver. A cooling pond was made to take care of the water from the compressors.

The intercooler on the Ingersoll-Rand compressor is leaking a little and will have to be re-tubed.

All mechanical equipment operated satisfactorily during the year.

SECTION 6 SHAFT:

The mechanical equipment at this shaft operated satisfactorily during the year. There were no changes or additions made to this plant.

MACKINAW MINE:

All mechanical equipment operated satisfactorily during the year. No changes or additions.

SPIES-VIRGIL MINE:

Pumping only.

All equipment is in fair condition and operated satisfactorily during the year.

CANISTEO MINE:

Ore operations started May 14th and ended August 22nd, on a four and five day week basis of three 8-hr. shifts per day. A total of 430,142 tons of concentrates were shipped.

In the Pit the #35 electric shovel started ore loading and kept the plant supplied during May, while the #32 electric shovel was dismantled at the Holman Mine and set up in the Canisteo Pit. Due to stripping paint rock and lean ore removal, in addition to crude ore loading, both shovels were kept busy all season. The small gas shovel was needed for track grading, sump cleaning and shaft sinking work. The 85-C steam shovel was left at the Shops.

Drainage during the summer was handled by the 2,000 G.P.M. pump on scows located in the Pit bottom. The season closed with the ore cuts down to water level,

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CANISTEO MINE: (Cont'd)

and it was necessary to sink an 8' x 12' shaft during the Fall and drive a drift under the ore. A 2400 G.P.M. vertical turbine pump, driven by motor at shaft collar, will be used in the shaft and the discharge connected to suctions of the present pumps.

After the ore season closed a Fall stripping program of four days a week, three shifts per day, was carried on from October 1st to December 21st, an average of over 6,000 yards per day being maintained. The shovels caused little delay, but the hard work developed so much wear that the motor-generator set, as well as the hoist motor, were brought into the shops for overhauling. The six American locomotives, being most economical to operate, were used for hauling. Locomotives 101, 102 and 103, purchased in 1920, reached a point where the fire boxes had to have new flue and side sheets. These are being installed during the winter overhauling. The 30-yd. car wheels are almost worn out and will be replaced as needed.

At the Washing Plant some changes were necessary before shipping season started. A second 4' x 10' Allis-Chalmrs power driven Style "B" vibrating screen was installed to replace the discarded Hummer screen. The clean water pump station was moved to prevent the tailing sand from causing trouble. It was also necessary while washing to build a dyke along the south side of lake to divert the tailings further west. Considerable make-up water was needed to complete the washing program. This water was supplied from the Danube Mine. To eliminate any make-up water shortage in the future some test weels were sunk near the plant and water bearing formation located. As soon as these wells are tested a deep well pump will be purchased.

One improvement tried out during the year was lining the 32" dia. half chute under 4" grizzly bars with chilled cast iron instead of 1/2" steel. This showed a repair labor saving of over $80.00 per month, with the liners in such good condition they should last for another year.

The receiving pocket gave some trouble from ore arching near 8 ft. pan conveyor. A change will be made in pocket to correct this. The pans on 8 ft. conveyor wore rapidly and required some patching. A scheme is being tried to absorb this wear on easily replaced wearing plates.

After shipping season was finished the Dorr washers were dismantled and found to be badly worn from the total of 700,000 tons of concentrates produced. To overhaul them with needed new parts would cost about $5,000.00 each. In order to save some of this expense it was decided to dismantle one Dorr washer and use it for repairs to the second, this washer to be replaced by a 25 ft. log and bowl classifier from the Holman plant. This combination will give plenty of opportunity to test the machines against each other to prove which is the more economical to operate.

A small hydrotator was set up for a month by the Hydrotator Company to show if additional economies could be secured from it. The additions were too small to warrant additional investment at this time.

DREW MINE:

Mining operations started May 28th and were completed September 29th, with 103,531 tons of ore shipped. Just the open pit ore was mined, as there was too little underground ore to work profitably. When mining stopped all equipment

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DREW MINE: (Cont'd)

was removed, the buildings sold and the lease surrendered.

Equipment was disposed of as follows:

1 - Locomotive left in bottom of pit.
1 - " sold for scrap.

50-B electric shovel sold to Evergreen Mining Co.
3 - 25 K.V.A., 2200/440 volt transformers shipped to Hill-Trumbull.
12-yd. Dump cars sold for scrap.
20-yd. " " shipped to Hill-Trumbull Mine.
Compressor and shop equipment shipped to Hill-Trumbull Mine.
Dorr washer and equipment " " " " "
Gyratory crusher " " " " "
Hoist and motor " " " " "

The equipment salvaged is in fair condition and satisfactory for a small mine operation.

HILL-TRUMBULL MINE:

Due to water in Pit it was necessary to secure current for a few days to move the 120-B electric shovel to higher ground.

No pumping to wet tailing sand was necessary at the washing plant this season, as the sweet clover stand on the tailings basin prevented the sand shifting with the most severe winds.

HOLMAN-CLIFFS MINE:

The 120-B electric shovel #32 was dismantled and shipped to the Canisteo Mine during the month of May.

The Minnesota Highway Department removed the railway bridge to washing plant and installed a steel structure with no center pier.

A steel fence is being placed around the open pit this winter.

ELECTRICAL DEPARTMENT:

The operation of The Cliffs Power & Light Co. for the year 1934 has been very satisfactory.

A reasonable increase in revenues, particularly from outside customers, is gratifying.

The plant as a whole is in excellent condition and has been maintained to give satisfactory and reliable service at all times. We believe our employees are contented and satisfied, and our customers appreciate that they receive as good service as enjoyed by any. In general we have a very low percentage of delinquent customers, which is rather unusual, particularly among retail consumers the last few years.

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ELECTRICAL DEPARTMENT (Cont'd)

The season was rather dry early in the year, but changed later and September gave the highest precipitation we have had in many years. Storage basins are all practically full.

Principal maintenance items were:
Clearing brush along transmission line right-of-way.
Re-cover the Carp Plant surge tank.
Repair " " pipe line - E. & A. 21.
Drainage of face of Hoist Storage Dam.
New roofs on Operator's houses at McClure Plant.
Usual routine insulator replacement on transmission line.

Considerable trouble was caused by timber jobbers felling trees into our transmission lines.

The principal item of new construction was the building of a double circuit line from the McClure Plant to the Pioneer Furnace and L. S. & I. Ry. This consists of two 3-phase, #0, A.C.S.R. conductors on 40 ft. and 50 ft. cedar poles@ This is at 12,000 volts and is protected by suitable relays and circuit breakers to give practically uninterrupted service. The capacity is on the order of 4,000 K.V.A. The original Furnace feeder from the Carp Plant was dismantled.

The Cliffs Electric Company was absorbed by The Cliffs Power & Light Co. early in the year and a new consolidated rate schedule prepared and filed with the Michigan Public Utilities Commission. The rate engineer of the Commission recommended very strongly that, to avoid future complications, we buy the farmer lines in the vicinity of Eben and Chatham. This was accomplished in a satisfactory manner.

We have continued the operation of the Republic Township distribution system, which seems satisfactory to all concerned. This protects our power bill, as well as yielding us a small additional profit.

It is apparent that the general trend of Public Utilities, and also the desire of Federal authorities, that there shall be further reduction in rates, which no doubt will result in a very large increase in use of electricity in all lines of industry and in our homes. It is hoped that this will result in a greater diversity and use which will enable increased net earnings, but at a lower unit cost. Apparently, the Utilities must first lower the rates and then increase the use of electricity by some form of sales effort to build up the earnings. We think this has already been proved to be a sound business procedure.

The usual tables, diagrams and charts, indicating various analysis of our operations, are attached to this report.

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Electrical Department: (Cont'd)

Summary of Operating Conditions - 1 9 3 4 .

Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Precipitation -	1.84	0.86	1.84	2.63	1.37	2.72	4.16	2.11	6.82	1.33	5.23	1.96

Total Precipitation at Ishpeming during 1934 - 32.87"
Average " " Marquette - 32.8 (46 year record)

CARP RIVER PLANT:

Drainage area above Intake Dam,		66.66 sq. miles
Cubic feet Precipitation in 1934,	5,090,086,800	
Kilowatt Hours generated in 1934,	12,533,300	
Cubic feet water utilized (90 cu. ft. = 1 KWH.)	1,127,997,000	
" " " in Carp Storage Basin Jan. 1,1934,	306,821,900	
" " " " " " " Dec.31, "	416,495,300	
" " " stored in 1934,	109,673,400	
" " " wasted over Intake Dam in 1934,	864,206,000	
Total run-off for year 1934,	2,101,876,400	
Run-off per square mile of drainage area,	31,531,300	

	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922
Total Precipitation,	30.11	26.53	38.40	36.83	25.46	31.05	29.50	27.40	30.38	33.67
Sec.ft.per sq.mil run-off,	1.03	.67	.93	1.29	.70	.79	.83	.73	.68	1.06

	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932
Total Precipitation,	21.90	22.95	20.71	35.69	29.86	36.06	32.28	23.14	36.70	31.20
Sec.ft.per sq.mil run-off,	.59	.50	.25	.85	.98	1.11	.67	1.10	.83	1.13

	1933	1934
Total Precipitation,	32.72	32.87
Sec.ft.per sq.mi. run-off,	1.14	1.00

McCLURE PLANT:

Drainage area above Intake Dam		140.52 sq. miles
Cu. ft. Precipitation in 1934, (Hoist Plant - 35.02")	11,431,185,500.	
Kilowatt Hours generated at McClure Plant in 1934,	27,448,000	
Cubic feet water utilized, (125 cu. ft. = 1 KWH.)	3,431,000,000	
" " " wasted over Intake Dam in 1934,	1,429,992,000	
" " " in Hoist Storage Basin Jan. 1,1934,	1,871,453,800	
" " " " " " " Dec. 31, "	1,811,643,100	
" " " taken from Storage in 1934,	59,810,700	
" " " in Silver Lake Jan. 1,1934,	395,878,700	
" " " " " " Dec. 31, "	746,194,000	
" " " stored in Silver Lake,	350,315,300	
Total run-off for year 1934,	5,151,396,600	
Run-off per square mile of drainage area,	36,659,520	

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
Sec. ft. per sq. mile run-off,	1.22	1.02	1.54	0.85	0.92	0.52	1.52	1.80	2.22	1.36	1.45

	1931	1932	1933	1934
Sec. ft. per sq. mile run-off,	1.10	1.23	1.30	1.16

THE CLIFFS POWER & LIGHT CO.

SUMMAY OF OPERATIONS - 1934.

	KILOWATT HOURS GENERATED & PURCHASED								Used by Auxiliaries	Delivered to Line	KWH. Sold	Transmission Losses	
	McClure	Carp	Hoist	Au Train	Republic	Escanaba	Purchased	TOTAL				K.W.H.	%
Jan.	2,248,800	961,000	694,000	111,290	98,400	182,000	0	4,295,490	13,423	4,282,067	3,564,299	717,768	16.76
Feb.	2 065 400	948 400	574 000	122 390	89 600	231 000	0	4 030 790	11 906	4 018 884	3 352 113	666 771	16.59
March	2 223 400	851 700	548 000	119 730	89 500	205 000	0	4 037 330	11 727	4 025 603	3 393 261	632 342	15.70
April	2 336 300	979 800	628 000	132 090	78 500	190 000	0	4 344 690	12 540	4 332 150	3 564 151	767 999	17.72
May	2 216 600	1 438 800	392 000	132 830	109 500	211 000	0	4 500 730	10 470	4 490 260	3 860 595	629 665	14.02
June	2 636 600	1 078 000	697 000	99 900	82 300	231 000	0	4 824 800	12 180	4 812 620	4 096 265	716 355	14.88
July	2 768 800	836 500	886 000	253 250	80 600	221 000	0	5 046 150	12 719	5 033 431	4 287 067	746 364	14.82
Aug.	2 827 800	565 400	966 000	296 130	73 300	175 000	0	4 903 630	13 105	4 890 525	4 151 241	739 284	15.11
Sept.	2 466 100	757 300	838 000	270 180	61 100	202 000	0	4 594 680	13 145	4 581 535	3 915 604	665 931	14.53
Oct.	2 082 600	1 167 300	788 000	302 510	115 200	224 000	0	4 679 610	9 405	4 670 205	3 982 388	687 817	14.72
Nov.	1 952 700	1 308 300	740 000	306 850	113 500	215 000	0	4 636 350	11 085	4 625 265	3 980 435	644 830	13.94
Dec.	1 622 900	1.640 800	639 000	295 410	122 400	206 000	0	4 526 510	9 672	4 516 838	3 886 005	630 833	13.96
TOTAL	27,448,000	12,533,300	8,390,000	2,442,560	1,113,900	2,493,000	0	54,420,760	141,377	54,279,383	46,033,424	8,245,959	15.19

Electrical Department: (Cont'd)

The following alternating current motors are installed and operating as needed:

	INSTALLED TO JAN. 1, 1934	INSTALLED IN 1934	TAKEN OUT IN 1934	CONNECTED JAN. 1,1935 TOTALS
ANGELINE MINE:				
Hoist	250 HP.			250 HP.
CLIFFS SHAFT MINE:				
Shop	25			
No. 8 Crusher	125			
Screens	15			
Top Tram	100			
Hoist for "A" Shaft	750			
Underground Plunger Pump #1	180			
" Centrifugal Pump	250			
Allis-Chalmers Compressor	175			
Hoist for "B" Shaft	750			
Underground Plunger Pump #2	200			
Laboratory Crusher	5			
Cooling Water Pump for Compressors	10			
Ingersoll-Rand Compressor #1	400			
" " " #2	400			
Lower Tram #2	50			
Heating Plant Condensing Water Pump	5			
Underground Haulage Set #2	215			
Jaw Crusher - New Crushing Plant	75			
Magnetic Separator - " "	1½			
Underground Scrapers - 53 - 25 HP. motors	1,250	75		
Lower Tram #3	30			
Battery Charging Set, 2nd level "A" Shaft	7½			
Grinder in Drill Sharpening Shop	7½			
Rotary Screen	10			
Boiler Feed Pump at Central Office	3/4			
Undg. Haulage Set #1 (from Gen. Storehouse)	150			
Carpenter Shop	25			
Return Water Pump at Central Office	1			
Stoker " " "		3/4		
Rock Tram		50		
Laboratory Stoker		3/4		
Rock Picking Belt		5		5,344¾
BROWNSTONE SUBSTATION:				
Test Set	1/2			
Oil Filter Press	1/4			
Battery Charging Motor-Generator Set	3			
Commutator Grinder	1			
Synchronous Condenser	80			
M.G. Set on Voltage Regulator Control	1/4			
Large Oil Filter Press	2			
Drill	1			88
fwd.	5,551¼ HP.	131½ HP.	0	5,682¾ HP.

MECHANICAL DEPARTMENT
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Electrical Department (Cont'd)

	INSTALLED TO JAN. 1, 1934	INSTALLED IN 1934	TAKEN OUT IN 1934	CONNECTED JAN. 1,1935 TOTALS
brt. fwd.	5,551¼ HP.	131½ HP.	0	5,682¾ HP.
HARD ORE SHOPS:				
Machine Shop	10			
Carpenter Shop	25			
Blacksmith Shop Punch	3			
Armature Banding Machine	2			
" " "	1/2			
" " "	1/8			
Lathe Grinder	1			
Portable Drill - small (Stanley)	1/4			
" " - large	1/4			
Commutator Slotter	1/8			
Air Compressor	10½			
Water Supply Pump	7½			
Blacksmith Shop Blower	1/4			
Hacksaw	1/2			
Small Grinder	1/4			
Portable Drill (Stanley)	1			
Carpenter Shop Saw	25			
Water Pump (S.R.Elliott)	2			
Motor-Generator Set	15			
Air Compressor		60		
Hard Ore Office Stoker		1/4		
Portable Welder - Blacksmith Shop		30		
" " " "		20		
				214½
ISHPEMING HOSPITAL:				
Passenger Elevator	7½			
Dumb Waiter	3			
Large Washer	2			
Small "	1			
Extractor	2			
Vacuum Cleaner	3			
Water Supply Pump	1			
XRay Machine	1/4			
Hot Water Circulating Pump	1/2			
" " Return - high pressure	5			
" " " - low "	1½			
Vacuum Pump	3			
				29¾
TILDEN MINE:				
Compressor	150			
Centrifugal Pump	275			
Scraper on Coal Dock	15			
#29 Shovel - Motor-Generator Set	110			
" " - Air Compressor	4½			
" " - Oil Pump	1/4			
" " - Trip Motor	2			
" " - Exciter Motor	10			
fwd.	5,685¼ HP.	241¾	0	5,927 HP.

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1934

Electrical Department: (Cont'd)

	INSTALLED TO JAN. 1 1934	INSTALLED IN 1934	TAKEN OUT IN 1934	CONNECTED JAN. 1,1935 TOTALS
brt. fwd.	5,685¼ HP.	241¾ HP.	0	5,927 HP.
TILDEN MINE: " "	566¾			
Cyclone Drill	10			
" Drills - 4 - 15 HP.	60			
Car Dumper	30			
Large Crusher	250			
Car Puller	10			
Sample Crusher	3			
Belt Conveyor	50			
Secondary Crushers - 2 - 100 HP.	200			
Small Hoist over Crusher	3			
#31 Shovel - Motor-General Set	110			
" " - Exciter Motor	7½			
" " - Trip "	1¼			
" " - Air Compressor	5¾			
Drill Sharpener	15			
Pump for Drills	15			
Synchronous Condenser from P.C.P.Plant	625			
Shop Motor	5			
" " #2	3			
Scraper (in service 1 month)		50	50	
Armstrong Drill (returned from Maas Mine)		15		
Blower Fan	1/2			
Fan in Crusher Bldg.	1/2			
Centrifugal Pump in Compressor Pit		2		
Booster Pump		125		
				2,113¼
ATHENS MINE:				
Cage Hoist	400			
Nordberg Compressor	325			
Compressor Cooling Water Pump	3			
Auxiliary Compressor for Hoist Brakes	5			
Underground Ventilating Fan #1	15			
Sinking Pump - 2400' station (Stored)	50		50	
Skip Hoist Set	850			
" " " Oil Pump	1			
Shop	10			
Underground Haulage Converter	150			
Skip Pit Pump	2			
Laboratory Crusher (to Negaunee Lab.)	5		5	
Underground Plunger Pumps - 2 - 400 HP.	800			
Ore Tram 2 - 50 HP.	100			
Carpenter Shop	20			
Ore Crusher	25			
Underground Ventilating Fan #2	50			
Ingersoll-Rand Compressor	450			
Rock Tram	50			
Underground Haulage Converter #2	150			
Saw Gumming Machine	1/4			
Nordberg Compressor Oil Pump		1/2		
				3,406¾
fwd.	11,117¾ HP.	434¼ HP.	105	11,447 HP.

MECHANICAL DEPARTMENT
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YEAR 1934

Electrical Department: (Cont'd)

		INSTALLED TO JAN. 1, 1934	INSTALLED IN 1934	TAKEN OUT IN 1934	CONNECTED JAN. 1,1935 TOTALS
	brt. fwd.	11,117¾ HP.	434¼ HP.	105	11,447 HP.
MAAS MINE:					
Turbine Auxiliaries	(Circulating Pump	40			
	(Injection "	25			
	(Exciter	33			
Underground Haulage Set		215			
Shop		10			
3rd level Centrifugal Pump		350			
" " Plunger Pump #1		500			
Ore Tram	2 - 50 HP. motors	100			
Coal Crushing Plant		15			
3rd level Plunger Pump #2		250			
Ingersoll-Rand Compressors -	2 - 400 H.P.	800			
Skip Hoist		700			
Cage "		400			
Skip Hoist Rheostat Pump		3			
Carpenter Shop Saw		15			
Auxiliary Compressor for Hoist Brakes		7½			
Cooling Water Pump		5			
Saw Gumming Outfit in Carpenter Shop		2			
Underground Haulage Set #2	(from Neg. Mine)	215			
5th level Aldrich Pump	(" Boeing Mine)	100			
3rd " Centri.	"	400			
" " " "	- primer	50			
5th " Prescott Plunger Pump	(from Lake Mine)	75			
" " Centrifugal "	(" Princeton)	125			
Armstrong Drill	(to Tilden Mine)	15		15	
					4,435½
NEGAUNEE MINE:					
Underground Haulage Set #1		300			
"Ilgner" Hoist Set		450			
Ore Tram	2 - 50 H.P.	100			
Carpenter Shop in Lab. Bldg.	(from Athens)		5		
Auxiliary Compressor for Hoist Brakes		3			
10th level Plunger Pumps -	2 - 300 HP.	600			
" " Centrifugal Pump		350			
" " Suction Pumps	2 - 15 HP.	30			
Compressor Cooling Water Pump		3			
Nordberg Air Compressor		325			
Shop		15			
Ore Crusher		25			
Ingersoll-Rand Compressor		400			
13th level Plunger Pump		15			
11th " " Pumps	2 - 75 HP.	150			
Exciters for 10th level Pump Motors	(2)	40			
Signal System Motor-Generator Set		1/2			
Timber Hoist - #2 Shaft		25			
Ventilating Fan " "		150			
Gravel Hoist		15			
Saw in Carpenter Shop		15			
Skip Pit Pump		5			
Underground Haulage Set #2		220			
	fwd.	15,568¼ H.P.	434¼	120	15,882½ HP.