HOLMAN-CLIFFS MINE
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6. SURFACE:
(Continued)

a. Buildings, Repairs: (Continued)

Ho.No.	Name of Occupant:	Repair work done	Cost
12	Malkolm Olson,	Repairs to plaster. Interior painted,	$ 70.10
13	Mrs. Geo. Trombly,	New roof and cellarway,	138.28
14	Geo. Dunstan, Sr.,	New roof; repairs to porches; cellarway; windows; chimney; plumbing and broken water line. Exterior painted,	471.67
15	Thomas Wivell,	Repairs to siding; porches; windows; shed; garbage stand and furnace. Exterior painting, -	257.10
16	Hughbert Leitch,	Repairs to siding; windows; doors; chimney and exterior painting complete,	86.51
39	J. W. Griffith,	Repair broken water line,	17.17
40	T. J. O'Brien,	Repair siding and steps. Exterior painting complete,	130.33
41	Mrs.A.L.Sundquist,	Repair windows; new toilet tank. Exterior painting,	16.07
42	Mike Shipka,	Repairs to windows,	5.73
43	Lee Poore,	One new window; touching up exterior painting,	15.53
44	B. P. Axford,	Repair floors; sink and eight new storm windows,	46.16
46	Russell Wivell,	Repairs to plaster,	2.39
51	Oscar Engstrom,	Repair cellar posts and furnace. New toilet bowl,	34.64
57	August Mergle,	Repair siding; porch and windows. Exterior painting complete,	95.05
53	Claude Winkleblack,	Repairs to chimney and plaster	10.83
58	Russell Barkla,	Repair siding; porch; doors and cellarway. New house shed provided. Exterior painted,	184.28
59	George Beasley,	Repair cellarway. Eight new storm windows installed,	35.88
60	W. F. LeClair,	Repair siding; porches; floors; windows; doors; cellarway; storm windows; plaster and interior painting. Exterior painted,	268.94
61	John Laine,	Repairs to chimney,	4.91

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6. SURFACE:
(Continued)

a. Buildings, Repairs: (Continued)

Ho.No.	Name of Occupant:	Repair work done:	Cost
63	Matt Dosser,	Repair foundation;floors; doors;porch;plaster;plumbing and electric wiring. New inside toilet and six new storm sash provided,	$ 229.11
64	Vincent Soleture,	Repair plaster and interior painting,	48.11
67	Pat Maney,	New plumbing for inside toilet	89.48
68	George Lee,	Repairs to porch and sink,	11.59
70	Ambrose Hoey,	Repair siding and sink. New screens, door and wall partitions for inside toilet. Exterior painted,	159.20
71	Charles James,	Repair siding;cellarway; porches;doors;steps and windows. Exterior painted-complete,	176.93
72	Martin Fleisher,	Repair siding;porches;steps; windows and cellarway. Exterior painted,	152.06
73	George Dunstan, Jr.,	Repair siding;porches;steps and cellarway. Exterior painted,	132.49
74	John Fitzhenry,	Repair siding;porches;doors; floors;cellarway;plaster; electric wiring and plumbing. Four new storm sashes provided. The interior and exterior painted,	271.02
78	James McNeven,	Plastered and interior painted,	115.56
80	H. J. Stephens,	Plastered and interior painted,	77.27
81	Lloyd Wetherell,	New outside door; some interior painting and touching up exterior painting,	28.45
97	William Saw,	Repairs to chimney;plaster; doors;floors;plumbing and some interior painting,	113.32
98	Dan Fitzhenry,	Repairs to porch,	6.22
101	Loy Kolar,	New roof. Repairs to chimney; floors;house shed;plumbing; electric wiring and plastering. Interior painted,	493.60
102	Myron Youngberg,	Repairs to siding;porch and windows. Interior painted and one coat put on exterior,	183.44
107	Albert Embury,	Repairs to foundation;porches and doors. One priming coat put on exterior,	310.20

HOLMAN-CLIFFS MINE
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YEAR 1936

6. SURFACE:
(Continued)

a. Buildings, Repairs: (Continued)

Ho.No.	Name of Occupant:	Repair work done:	Cost
116	Carl Eggebraaten,	Repairs to foundation and siding. Four new storm sashes installed and one coat exterior paint applied,	$ 90.57
156	Lee Farr,	Repairs to plaster. Interior painted,	167.53
158	W. S. McComber,	Repairs to floors,	10.51
Camp 7	Sam Kirkes,	Repairs to windows and plumbing. New range boiler provided,	22.83
		Total Repairs Year 1936,	$ 5,362.02
	Repairs to Shop Buildings:		
	Warehouse & Laboratory,	Repair roof; windows; and painted roof,	58.51
	Sample House,	Painted roof and boarded up windows,	15.81
	Electric Shop,	Repaired and painted roof,	22.07
	Machine Shop,	Repairs to roof and windows and painted roof,	187.78
		Total Repairs to Shop Buildings, 1936 -	284.17
		GRAND TOTAL REPAIRS,	$ 5,646.19

The rent collections for the year 1936 amounted to $7,223.25. As against this revenue there were repairs to buildings $5,646.19; taxes $778.64 and insurance (estimated) of $270.00, a total of - $6,694.83. The revenue in excess of expenses amounted to $528.42.

After disposing of the two houses during 1936, the Oliver Iron Mining Company has 57 houses in Taconite, which The Mesaba-Cliffs Mining Company is obliged to keep in a state of repair in accordance with their agreement.

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 1935 and 1936:

HOLMAN-CLIFFS MINE
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10. TAXES:
(Continued)

Statement of Taxes:

	1936	1935	Increase	Decrease
Holman Brown Mine,	$ 38,235.06	37,177.48	1,057.58	
Bingham Mine,	15,013.68	14,594.53	419.15	
North Star Mine,	7,994.55	7,785.02	209.53	
Holman-Cliffs Aux.Lands,	2,474.70	2,904.98	-	430.28
Bingham-North Star Washing Plant Lands,	39.53	46.98	-	7.45
Holman-Brown Lands,	20.18	21.90	-	1.72
Holman-Cliffs Shops,	217.39	140.55	76.84	-
Holman-Cliffs Personal Property,	1,809.34	1,960.29	-	150.95
TOTAL, ----------	$ 65,804.43	64,631.73	1,172.70	-
Rented Buildings,	778.64	769.51	9.13	-
GRAND TOTAL, --------	$ 66,583.07	65,401.24	1,181.83	-
Average Tax Rate,	.831	.808	.023	

The increase in 1936 taxes over those for the previous year, is due entirely to the higher rate in effect during 1936. The Village and County levies were increased in 1936.

HILL-TRUMBULL MINE
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1. GENERAL:

During the first eleven months of the year the services of four regular watchmen were maintained, at full time, in general policing activities. No irregularities of moment were reported and no difficulty was experienced in caring for brush fires.

The mine remained in the idle class until the 21st of September, when the work of reconditioning the tracks was started. As originally planned, this job was to consist in the placing of six thousand ties in the yard, main line and approach tracks, but the favorable weather led to a further extension of the work, as well as the placing of a drainage dam on the North bank of the pit and the construction of a retaining wall at the coal dock.

In anticipation of the resumption of mining activities in 1937, the shops were reopened on November 30th, and repairing of equipment was started, as soon as the buildings were cleaned up and put in serviceable shape.

No repair work was undertaken at the washing plant during 1936, as the re-conditioning can be accomplished in the early spring months of 1937, when the weather is more favorable.

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 1936 and the reserve estimates are the same as reported a year ago:

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	"

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4. ESTIMATE OF ORE RESERVES: (Continued)

a. Developed ore: (Continued)

Trumbull Bessemer Direct Shipping,	85,000	tons.
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, 1937 is the same as that reported a year ago, as no drilling or test-pitting was done during 1936 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-THUMBULL MINE
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5. LABOR & WAGES:

a. Comments:

(1) Labor:

A new wage schedule was put into effect on November 16th, there being an increase of approximately 10%.

There was an adequate supply of labor during 1936 and the class of men was generally good. With the resumption of activities by some of the idle properties, there is the possibility of a scarcity of labor in 1937, if operations are carried forward on a forty-hour per week basis.

6. SURFACE:

a. Buildings, Repairs:

In order to eliminate the long steam line from the shop to the office, it was decided to install an independent heating plant for the office and the garage, thus effecting a considerable saving in fuel. A basement room 10' x 18' was excavated under the West side of the office, the concrete walls and floor were put in and the chimney has been built for the accommodation of the heating plant. This work was started on December 1st and was finished by December 21st. The contractor has started on the installation of the furnace, which should be put in service during the fore part of January.

The following houses received repairs during the year:

House No.8, - Furnace overhauled; rear porch rebuilt and coal bin repaired.
House No.6, - Roof and siding repaired; interior redecorated and a new hot water tank installed.
House No.7, - Furnace repaired.
House No.10 - New roof provided; interior redecorated and furnace repaired.
House No.11 - Several rooms decorated and roof repaired.
House No.12 - Doors and roof repaired.
House No.13 - Interior decorated.
House No. 3 - Wiring overhauled.

c. Tracks, Roads, Transmission Lines:

With the prospect of ore operations being resumed in 1937 it was decided to start reconditioning the tracks in the fall of 1936. This work was started on September 21st, with a crew of thirty men.

The shop tracks were the first to receive attention, so that the locomotive and locomotive crane could be taken out for use on the re-tieing job. Two of the tracks and the lead out to the empty line were reconditioned by the end of September. The crew was then engaged on the main line tracks leading to the pit and washing plant.

The empty line was retied, ballasted and tamped, from a point in the yards opposite the shops, to the Trumbull run-down switch, and the single track leading from the switch to the direct ore area was reconditioned by October 22nd. At this time it was decided to discontinue the laying of ties, because of freezing conditions and concentrate all effort on raising tracks, removing old ties and grading the bed.

HILL-TRUMBULL MINE
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6. SURFACE:
(Continued)

c. Tracks, Roads, Transmission Lines: (Continued)

The second main line was raised by the locomotive crane, from the Trumbull run-down switch to the point on the dump where the double tracks merge into the single line leading to the washing plant, and the old ties were removed and grading done by the first of November. The empty line was then raised, and the old ties removed and the grading done, from the beginning of the washing plant single line on the dump, to the point where work was originally started from - on this track in the yards. All of the ties on hand were placed in the tracks and spiked by November 28th, at which time track work was discontinued on account of inclement weather.

The three tracks connecting the mine yards to the machine and car shops, were retied early in October. This work was done in anticipation of opening the shops for repair work.

As originally planned, the track work was to consist of the placing of 6,000 ties at an estimated cost of $10,964.00 under E. & A. No. 701. There was a further authorization of the purchase and placing of an additional 5,000 ties, but instead of these ties all being laid, the tracks were raised and the grades prepared for spring work, which proved to be more practical on account of the lateness of the season.

Experience at the Canisteo Mine established the fact that a substantial saving can be effected in the electric power costs by taking all current used at the property through one meter. It was, therefore decided to re-arrange the power lines at the Hill-Trumbull, to a one meter system, whereby an estimated saving of approximately $6,000.00 a year can be realized. In accordance with this plan, the Minnesota Power & Light Company's transmission line, running from the shop location in a Southeasterly direction to the State Highway No. 169, will be purchased and a new piece of line constructed from State Highway No. 169 to the washing plant. Work was started on this line December 14th. The poles have been delivered and prepared for cross-arms, the right-of-way has been brushed out and some of the pole holes have been dug.

During the month of July, seven carloads of scrap iron were loaded from the washing plant and shop sites.

7. OPEN PIT:

d. Timbering:

	Old Ties	Oak	Tamarack	Cedar	Elm	Total
Ties Received,	-	3867	3733	617	304	9,009
Ties used,	488	3160	2708	575	000	6,931
On Hand,	000	707	1025	42	304	2,078

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7. OPEN PIT:
(Continued)

k. Water Level in Pit:

There is approximately two feet of water over the bottom of the Trumbull pit and a few small ponds in the lower spots in the Hill. Pumping operations will be started early enough in the spring to drain the water in the Trumbull, well below the level of mining operations for the 1937 season.

9. EXPLORATIONS AND FUTURE EXPLORATIONS:

No exploration work was undertaken during 1936, but it will be necessary to do considerable structure drilling in the Trumbull pit, previous to the 1937 ore season. The information now available on the Trumbull ore is very meagre and the drilling is necessary for grading and operating purposes. It is estimated that between 1,500 and 2,000 feet of drilling will be required in this program. In addition to the foregoing, it will be necessary to do structure drilling during the summer or fall, in the Hill direct ore area and in the Trumbull, for information necessary for 1938 operations.

10. TAXES:

The following statement shows the taxes and average rate at the Hill-Trumbull Mine for the years 1935 and 1936:

Statement of Taxes:

	1936	1935	Increase	Decrease
Hill Mine,	$39,665.83	37,847.01	1,818.82	
Trumbull Mine,	47,457.02	47,300.84	156.18	
Hill-Trumbull Shops,	826.66	998.02	-	171.36
Hill-Trumbull W.P.Lands,	2,835.60	3,387.64	-	552.04
Personal Property,	1,525.26	1,688.47	-	163.21
TOTAL, ----------	$92,310.37	91,221.98	1,088.39	
Village Lots,	542.32	540.86	1.46	
GRAND TOTAL,	$92,852.69	91,762.84	1,089.85	
Average Tax Rate,	.805	.805	-	

While the rate of taxation for 1936 is the same as for the previous year, the decrease which we were able to secure in surface valuations was off-set by an increase in Direct Ore valuation by the State Tax Commission.

11. ACCIDENTS AND PERSONAL INJURY:

There were no lost-time accidents during 1936.

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12. NEW CONSTRUCTION AND PROPOSED NEW CONSTRUCTION:

It will be necessary to rebuild the washing plant pump-house, which work will be undertaken during the spring of 1937.

A concrete dam was constructed in an old washout on the North side of the pit. There is a considerable drainage area in this vicinity, which is lower than the ditch to the North, and this dam will impound the water so that it can be pumped back into the ditch. A dirt dam had previously controlled this water, but it was washed out during the idle period and it was impractical to attempt a dirt dyke replacement on account of the gravel bed underlying.

Work on the new dam was started on November 11th and was completed on November 17th. The dam is about twelve feet high at the center and is forty-two feet long.

The log cribbing, which held back the fill for the track leading to the top of the coal dock, rotted out and caved down during the time the mine was shut down. During November, part of the fill was excavated by the locomotive crane and a concrete retaining wall was placed by November 27th.

13. EQUIPMENT AND PROPOSED EQUIPMENT:

A 24" heavy duty lathe was purchased from the Hill-Clarke Machinery Company and delivered at the mine December 24th.

A flue welding machine and oil furnace have been ordered, but will not be delivered until January, 1937.

The proposed equipment is as follows:

2 - 40 H.P., D.C. Motors for 25-foot logs. New conveyor belts, picking belts and power transmission belts.
2 - Vibrating screens, 4 x 6, for discharge end of logs.
1 - 1½ to 2-ton truck for general use.
1 - 10-ton Diesel tractor and attachments.
1 - 2 or 3-yard electric shovel.
1,500 feet of 3-conductor #4 cable for 120-B electric shovel.
1,000 feet of 3-conductor #6 cable for the new shovel.
1 - Water tank for locomotive supply.

14. MAINTENANCE & REPAIRS:

A crew of men was put to work preparing the shops for operation on November 30th.

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14. MAINTENANCE & REPAIRS: (Continued)

There was a large quantity of Crosby and Drew Mine equipment stored in the machine shop, and this was moved to the table floor of the washing plant, where it will be out of the way and amply protected.

The heating boiler was washed out and placed in service, and numerous leaks in the steam lines were repaired.

Repair work was started on December 7th.

Locomotive No. 19, on which the repair work had been practically completed at the time of the shut-down in 1932, was transferred from the car to the machine shop, for finishing. The principal work on this piece of equipment is the reassembling of the parts which had been removed and this was pretty well advanced by the end of the year. Some minor repairs are also being made.

Locomotives Nos. 101, 102 and 103 and No. 2 - and eleven thirty-yard cars were transferred from the Canisteo to the Hill-Trumbull Mine for general overhauling.

Locomotive No. 101 was taken into the shop and was stripped for overhauling. The drivers were removed; the hub liners were taken off the wheel centers; the bolts were cut out of the saddle frame and the holes reamed for new bolts. The pistons and steam valves were removed and some of the repair work has been started.

Four thirty-yard cars have been repaired, with the exception of new wheels, and two more are in the shop at the present time.

The following work was done on the 120-B electric shovel: The steering axle and rollers were replaced; the caterpillar drive rollers and links were put back on both sides; the dipper teeth bases and points were replaced and the bail hung. The rotating friction was replaced and the driving end of the caterpillars was opened for inspection. This work was finished by the first of the year. There are some electrical repairs to be made on this machine during the spring.

With the exception of two machinists and a blacksmith, the shops were shut down on December 24th and will resume operation on January 4th.

WASHING PLANT REPAIRS:

No work was done at the plant during 1936, with the exception of filling the pressure tank with water as a safety measure in case of dangerous brush fires.

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18. NATIONALITY OF EMPLOYEES:

NATIONALITY:	NO. OF MEN
German,	9
Irish,	9
English,	9
Swedish,	7
Jugo-Slav,	6
Norwegian,	3
French,	3
Bulgarian,	3
Finnish,	3
Italian,	2
Scotch,	2
Bohemian,	1
Welch,	1
Serbian,	1
TOTAL,	59

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY.

a. Fatal Accidents.

There were two deaths by accidents at the mines last year. One occurred at the Cliffs Shaft Mine and the other at the Canisteo Mine.

The fatality rate for the year, based on 300 man-days worked per 1000 men employed, was 1.06. The rate for 1935 was 1.52, and the average rate for the five year period from 1930 to 1934, inclusive, was 1.98.

Description of Fatal Accidents.

Fatal Accident No. 1.

Dominic Vallela was injured by a fall of ground at the Cliffs Shaft Mine on January 31, 1936, which caused his death several hours later.

Vallela and his partner, Toivo Saline, worked as trammer and scraper operator respectively, in a number of contracts located about 2000 feet east of A shaft, on sub-levels above the 6th level. It was their work to scrape ore in the stopes and when ore was not available, they scraped rock.

The stope where the accident occurred, was opened in 1935. There had accumulated considerable rock, which had come from blasting and barring the back. Saline and Vallela had scraped the rock at various times but there was a small pile remaining to be trammed. They scraped all morning on January 31, and blasted several large chunks at noon. After the lunch hour they returned to the stope. They first adjusted the scraper block, then Saline proceeded towards the hoist, and Vallela took his position on one side of the stope, where he would be out of the way of the scraper. As Saline reached the hoist a mass of rock fell from the hanging of the stope. It was a very large slab and an edge of it fell upon Vallela.

The stope had been inspected by the captain, foreman,and shift boss. It was only 20 feet wide and from 20 to 25 feet high and thus could be examined readily with the electric cap lamps, which throw a strong search light for inspecting high backs and walls.

Vallela had been employed 12 years at the mine. He was 43 years old and a wife and three children survive him.

This accident was classified non-preventable by the Central Safety Committee.

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11. ACCIDENTS AND PERSONAL INJURY

a. Fatal Accidents. (Continued.)

Fatal Accident No. 2.

Harry Edner, a car loader, was instantly killed at the Washing Plant of the Canisteo Mine on August 6, 1936.

Sometime during the day of this accident Edner exchanged jobs with the man who dropped the loaded cars from the concentrate pocket to the storage yard. Edner had taken down three trips of cars and was lowering for the fourth time when he was killed. A workman observed that when the fourth trip of two cars was about 400 feet distant from the pocket, Edner disappeared from the top of the front car, where he had been riding. An investigation indicated that he had fallen in front of the car and had been dragged until the cars came to a stop, a distance of 80 feet.

The Investigating Committee reported that apparently Edner was in the act of attempting to close the knuckle of the car he rode, and that he lost his balance, causing him to fall in front of the car.

Edner had been employed only a few months at the mine. He was 22 years of age and single.

This accident was classified preventable by the Central Safety Committee.

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

b. Non-Fatal Accidents.

A total of 40 lost-time accidents, other than fatal accidents, occurred during the year. 35 of them resulted in injuries that caused losses in working time of more than 6 days, and hence became compensable accidents. There were 37 compensable accidents in 1935.

The large increase in the number of man-days worked during 1936 compared with the number worked during 1935 resulted in a drop of 27 per cent in the frequency rate and a reduction of about 31 per cent in the severity rate.

Herewith is a brief description of the lost-time accidents:

Mine	Number of Accidents	Description	Days Lost
Athens	7	1. Ventilation door closed as locomotive train approached. Runner squeezed between door and locomotive. Back injury.	92
		2. Fall of ground in raise. Fractured tibia and fibula.	180*
		3. Slipped and strained right side. Hernia.	53
		4. Struck by scraper. Lacerated ankle	21
		5. Struck by pole which fell from back of drift. Contusion of back.	120*
		6. Struck by pole which fell from back of drift as he was cutting old timber to make room for new set. Bruised chest and separation of two ribs from vertebrae.	72*
		7. Struck by scraper. Fractured fibula.	72*
Canisteo	6	1. Gasoline barrel fell on foot. Fractured metatarsal.	36
		2. Stepped into a mud hole and thrown to ground. Dislocated shoulder.	22
		3. Slipped and wrenched back. Sprain.	6
		4. Slipped and fell 6 feet. Fractured arm.	36
		5. Foot caught between railroad ties. Contused ankle.	26
		6. Struck in face by flying chip of steel.	3

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11. ACCIDENTS AND PERSONAL INJURY

b. Non-Fatal Accidents. (Continued)

Mine	Number of Accidents	Description	Days Lost
Cliffs Shaft	2	1. Slipped and fell to the ground. Small fragment of bone torn from right wrist.	53
		2. Ladder twisted and struck his leg. Bruised thigh.	24
C. P. & L. Co.	2	1. Fell with line pole, a distance of 25 feet. Bruised abdomen and hip.	38
		2. Loading poles on truck; one fell on his hand. Dislocated knuckle.	4
Gardner-Mackinaw	1	1. Slipped and rolled into stope chute. Contused side.	6
Lloyd	8	1. Struck by hand tool. Fractured jaw.	19
		2. Lifting timber and slipped. Hernia.	60
		3. Tripped on cable and fell. Contused knee.	9
		4. Timber fell on his arm. Fractured arm.	37
		5. Struck by fall of ore from back of stope. Fractured ribs, and fractured vertebra.	156
		6. Struck by chunk of ore which fell from back of drift. Thumb injury which became infected.	8
		7. Haulage train pushed timber against his body. Bruised chest.	60*
		8. Slipped and fell in a sitting position. Back strain.	12
Maas	9	1. Lighting fuses and hole exploded. Lost an eye.	600**
		2. Squeezed between locomotive and timber. Fractured pelvis.	123
		3. Jumped off stage and sprained ankle.	4
		4. Struck by chunk of ore falling from breast of drift. Contusion of back.	15
		5. Struck by timber when it was moved by hoist. Bruised knee.	22
		6. Walked into blast. Injured eyes.	600*
		7. Plank fell on his foot. Contusion of foot.	41

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11. ACCIDENTS AND PERSONAL INJURY

b. Non-Fatal Accidents. (Continued)

Mine	Number of Accidents	Description	Days Lost
Maas (Continued)		8. Slipped on icy trail. Dislocated shoulder and fractured clavicle.	60*
		9. Fell off railroad car. Fractured elbow.	120*
Negaunee	4	1. Struck by lagging, which fell down raise. Bruised chest and fractured dorsal vertebra.	65
		2. Scraper hoist caught his foot. Fractured fibula and tibia.	105
		3. Scraper hoist caught his foot. Bruised foot.	11
		4. Caught between haulage car and coil of wire. Bruised legs.	36*
Maas Mine Location	1	1. Scaffold broke, causing man to fall to ground, a distance of 7 feet. Sprained ankle.	64

* Estimated lost time.

** Actually lost 23 days. Compensation payments are for 600 days.

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11. ACCIDENTS AND PERSONAL INJURY

TABLE I.

COMPARATIVE RECORD OF COMPENSABLE ACCIDENTS BY MINES FOR 1935 AND 1936

	1935			1936		
Mine or Plant	Number of Accidents	Days Lost	Rate per 1000 days	Number of Accidents	Days Lost	Rate per 1000 days
Athens	3	227	5.76	7	610	11.30
Canisteo	4	357	7.11	4	120	1.98
Cliffs-Shaft	5	241	3.77	2	77	.78
C. P. & L. Co.	1	8	.70	1	38	2.44
Lloyd	6	1,024	30.20	8	361	6.98
Maas	12	540	8.89	8	1,581	16.40
Negaunee	1	396	9.04	4	217	3.34
Gardner-Mackinaw	2	309	11.95	0	0	0.00
Tilden	0	0	0.00	0	0	0.00
Shops & Storehouse	2	67	6.02	0	0	0.00
Miscellaneous	1			1		
All Properties	37	3,192	8.10	35	3,068	5.43
	Fatalities			Fatalities		
Cliffs-Shaft	2	3,600		1	1,800	
Total		3,841	60.20		1,877	19.20
Canisteo				1	1,800	
Total					1,920	29.90
Total All Mines	39	6,792	17.25	37	6,668	11.78

Note--Days lost and worked for December were estimated

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11. ACCIDENTS AND PERSONAL INJURY

TABLE II.

COMPARATIVE RECORD OF COMPENSABLE ACCIDENTS

	5 years 1930-1934	1935	1936
Number of man days worked	1,963,767	393,663	565,000*
Number of fatal accidents.	13	2	2
Fatality rate per 1000 men.	1.98	1.52	1.06
Number of compensable accidents not including fatalities.	125	37	35
Number of days lost by compensable accidents not including fatalities	12,703	3,192	3,068*
Number of days lost per 1000 days worked not including fatalities	6.46	8.10	5.43
Number of days lost by compensable accidents including fatalities**	36,103	6,792	6,686*
Number of days lost per 1000 days worked Compensable accidents including fatalities..	18.38	17.25	11.78

* Estimate
** 1800 lost days per fatal accident

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TABLE III.

Classification of Fatal Accidents 1911 to 1936, inclusive by the Central Safety Committee.

I	Trade Risks		108
II	Negligence of the Company:		
	Violation of Rules	4	
	Failure to Provide Safety Devices	5	
	Improper Method of Doing Work	10	
	Failure to Provide Tools or Safe Place to Work	3	
	Failure to Instruct men	4	26
III	Negligence of Workmen:		
A	Injured Men-		
	Improper Method of Work	18	
	Violation of Rules	7	
	Failure to use Tools or Appliances Provided. .	4	
	Failure to use Safety Devices	2	31
B	Other Workmen:		
	Improper Method of Work.	13	
	Violation of Rules	4	
	Failure to Use Tools or Appliances Provided. .	1	18
	Total.		183

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11. ACCIDENTS AND PERSONAL INJURY.

TABLE IV.

Classification of Causes of Fatal Accidents From December 1st, 1898 to December 31st, 1936.

A	Fall of Ground or Timber.	95	
	Run of Mud or Sand	60	
	Fall of Chunk of ore from Chute	2	
	Stray Chunk or Stick down Raise or Stope. .	3	160
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.	7	
	Miscellaneous Causes.	1	30
E	Miscellaneous Causes:		
	Falling in Raise, Stope or Pocket	8	
	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	36
	Total.		304

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11. ACCIDENTS AND PERSONAL INJURY

TABLE V.

Classification of All Compensable Accidents 1936
By the Central Safety Committee.

I	Trade Risk. (Incidental and Non-Preventable.).	8	8
II	Negligence of Company:		
	1. Failure of Use Safety Devices Provided. . .	0	
	2. Failure to use Proper Tools of. . . . . Appliances Provided	2	
	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 .	0	
	6. Failure to Provide Safety Devices	0	
	7. Failure to Provide Proper Tools, Appliances or Place of Work	0	2
III	Negligence of Workmen:		
A	1. Failed to use Safety Device Provided. . . .	0	
	2. Failed to use Proper Appliances or Tools. . Provided.	1	
	3. Violation of Rules.	2	
	4. Improper Act or Selection of Improper Method of Doing Work.	23	26
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.	1	
	4. Improper Act or Selection of Improper Method of Doing Work.	0	1
	Total.		37

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11. ACCIDENTS AND PERSONAL INJURY

c. Accident Statistics.

TABLE VI

Number of days of labor performed and number of men killed and injured at U. S. Metal 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	11,095,167	189,101	107	0	5,014	9
1933	11,642,113	189,398	95	2	5,925	17
1934	14,723,215	321,909	116	4	7,892	22
1935		393,663		2		40
1936				2		40

Note: 1935 and 1936 statistics for U. S. Mines not available.

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11. ACCIDENTS AND PERSONAL INJURY

c. Accident Statistics.

TABLE VII

Fatality and Injury Rates per Thousand 300-day workers, U. S. Metal 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	2.89	0.00	135.57	14.27
1933	2.45	3.17	152.68	27.00
1934	2.30	3.60	166.81	20.00
1935		1.51		30.48
1936		1.06		21.24
Average	2.71	1.93	172.47	39.82

Note: 1935 and 1936 statistics for U. S. Mines not available.

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection

The local mines and plants were inspected each month of the year, excepting in December, when illness prevented the writer from getting to all of them. The Spies Mine was inspected twice and the Canisteo Mine once.

Working conditions may not always be found entirely satisfactory from a safety viewpoint, but failures to enforce safety standards are comparatively few to what they were a few years ago. When a danger or an infraction of a rule is invited to the attention of a member of the supervisory force, no argument is needed to obtain the remedy, nor is there needless delay in its execution.

The pits and shafts on our abandoned mines and explorations are a menace to public safety. There are many of them and they are scattered over a large area. Many miles of fencing must be kept in good condition. Thosewithin close distance to towns and settlements are subjected to much willful destruction, which otherwise would stand service over a long period.

Extensive repair work was done last summer at the Angeline, Lake, Salisbury, Hematite, Cleveland, and Jackson properties. Many isolated shafts also were given attention. Several of the large pits or caved areas required thousands of feet of new fencing. This work will have to be continued next season at the Republic pits and also at the Foster and Empire mine pits and shafts.

Central Safety Committee

This Committee held two sessions. It classified all accidents and acted on the safety subjects which required consideration and discussion before action being taken.

Conferences

A conference was held January 25 for the purpose of revising explosive standards. There were 45 men present, comprising the heads of departments, superintendents, captains and shift bosses.

The Mining Club had a banquet at the Mather Inn on March 28, with an attendance of 96 men. No business was brought up at this meeting of the club.

Mine conferences of captains and bosses were held from time to time throughout the year.

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11. ACCIDENTS AND PERSONAL INJURY.

c. Safety Inspection. (Continued)

Inspection Reports

The Safety inspection reports, which cover the equipment that is of vital importance to human life and property, to the number of 2,994 were received by the Safety Department, as follows:

TABLE VIII

Hoisting Cables	2041
Skip and Cage Roads	321
Ladderways	316
Cage Catches	92
Hoists	83
Slack Rope	70
Fire Doors	41
Fire Equipment	30
Electrical Equipment	--
	2994

Miners' Safety Bulletin.

This small publication was distributed to all employees, once every two months. A total of 9,200 copies was printed.

Safety Contest

At the beginning of the year a special safety contest was announced, which offered cash prizes and a prize for every wage earner, in another effort to obtain the cooperation of all employees in the prevention of accidents. Notices were posted at the mines and plants to the effect that $3,275 would be given to the men a few days before Christmas, and a set of seven rules stipulated the method which would govern the distribution of the awards. Every workman, who worked one-half of his allowable time in a month received a chance in that month for the prizes given out at the mine where he was employed, provided he had not caused a compensable accident to himself or to a fellow workman during the month. All cash prizes were reduced by one-half in the case of a fatal accident, which was applied to the Cliffs Shaft and Canisteo mines.

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection. (Continued)

Safety Contest. (Continued)

The expenditure involved in this contest was as follows:

TABLE IX

Mine or Plant	Cash Distribution	
Tilden	$ 75.00	
Shops and Storehouse	75.00	
C. P. & L. Co.	75.00	
Canisteo	85.00	
Cliffs Shaft	187.50	
Gardner-Mackinaw	190.00	
Lloyd	190.00	
Athens	255.00	
Negaunee	285.00	
Maas	375.00	$1792.50
2000 lunch kits		1884.20
Total cost		$3676.70

There were 30 or more lunch kits not distributed, which were placed in stock at the General Storehouse. They will be sold and their value will cover the cost of printing which the contest required.

The total cost exceeded the estimate by $401.70. There were employed in November, 1935, approximately 1600 men, whereas there were almost 2000 men working in December, 1936, who qualified for lunch kits. This increase in employment and also an increase in the cost of the kits account for the difference in the expenditure.

Electric Cap Lamps.

All underground men are now equipped with the safety electric cap lamp, thus providing more safety and also improved efficiency.

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11. ACCIDENTS AND PERSONAL INJURY.

c. Safety Inspection. (Continued)

National Safety Council

Our membership fee to this organization was $100, the same as it was in 1935, but an additional $20 was requested to enable the Council to carry on a more vigorous campaign against automobile accidents. It was paid. We received four copies of the monthly Safety News and about 1100 safety posters.

d. First Aid Work.

An instructor in first aid methods from the U. S. Bureau of Mines was at our mines eight weeks for first aid and mine rescue training of Company's employees. 235 men completed the first aid course. They were given text-books on first aid and certificates.

First aid stations were replenished weekly. The following table shows the amount and the distribution of supplies at the mines during the year.

TABLE X.

First Aid Supplies Distributed

Material	Number distributed
Mercurochrome Compresses	4,739
Ounces of Mercurochrome	166
1" Roller Gauze	575
3" Roller Gauze	209
Rolls of Adhesive Tape	61
Packages of Picric Gauze	106
Packages of Plain Gauze	390
Leather Finger Cots	244
Mercurochrome Applicators	482
Tubes of Ointment	29

e. Mine Rescue Work.

Fire partially destroyed the Negaunee Mine headframe on the evening of February 8. As it was uncertain that sparks dropping down the shaft may have extended the fire into the underground workings, it was decided to investigate via the Maas Mine. A squad of five men, wearing the Paul self-contained oxygen-breathing apparatus went from the Maas Mine to the 10th, 11th, 12th and 13th levels of the Negaunee Mine and found every place free of fire.

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11. ACCIDENTS AND PERSONAL INJURY

e. Mine Rescue Work (Continued)

Shortly after 7 A.M., May 13, fire was discovered in the Gardner-Mackinaw Mine. There was delay in reporting it to Ishpeming but in due time a crew of five men, properly equipped, entered the mine. The fire was located on the bottom level, about 1000 feet from the incline shaft station. Its origin was due to a fall of ground short circuiting the trolley wire to the haulage track. Within two hours the fire was extinguished and a supply of fresh air was turned into the stopes. Some time later the air at the working faces was tested for indication of the presence of carbon monoxide. When it was known that the air was pure, word was issued to the proper officials that the night shift crew could work in safety. This was done.

There were 30 men trained in mine rescue methods by the Bureau of Mines instructor. For this training young men who had had no previous training, were selected.

We spent about $200 in maintaining the oxygen apparatus in working condition. A gas testing machine for the Negaunee district and one for the Ishpeming district were purchased.

f. Ventilation

Ventilation investigation was extended to include analysis of the air existing at the working faces underground, with the object of ascertaining if there was much depletion of oxygen and creation of carbon dioxide. A William Gas Apparatus was bought and our Pychrometer was repaired by the maker.

Our determinations were checked by sending duplicate air samples to the Cliffs Dow Chemical Company's laboratory and also by the same method with the U. S. Bureau of Mines' chemists. No error of an appreciable amount was found.

There were 88 air samples collected at the Athens, Negaunee, and Maas mines and all of them showed atmospheres that contained no depletion of oxygen or no presence of carbon dioxide that was harmful. This investigation covered all the working headings that were operated at these mines when the samples were collected.

Mine humidity is invariably high and our mines are not excepted, but this condition causes comparatively little discomfort. Temperature

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11. ACCIDENTS AND PERSONAL INJURY

f. Ventilation (Continued)

readings that went above 72 degrees were few. A number at 75 degrees were found but they were in headings that usually were directed toward a ventilation raise or places cutting out directly beneath a heavy timber gob.

We collected 331 air samples where rock work was in progress. Of this number 128 came from the Cliffs Shaft Mine, where development work is almost entirely in rock. In our soft ore mines lean ore and jasper abound more abundantly.

In September two investigators from the Pittsburgh Experimental Station of the U. S. Bureau of Mines were with us to check our dust counts. This visit was in connection with a tour made at a number of mines on the Gogebic and Menominee ranges besides the Marquette range.

We have received no written report from this investigation but we were informed verbally while they were here that our counts were the most accurate they had found in this district.

There has been no particular hardship in maintaining a rigid observance of the standards which were recommended by the Saranac authorities at the beginning of our special dust investigation. Messrs. Sampson and Gardner looked over our counts late in the year and expressed themselves well satisfied that we were providing satisfactory working conditions with respect to harmful dust. They did recommend that an effort be made to collect a sufficient quantity of dust from the underground air by a method other than the impinger in order to check our present method of separating the silica proportion from the total amount present. This will be done by sucking the dust into a container by means of a vacuum cleaner.

The following table gives the number of analyses that were made:

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11. ACCIDENTS AND PERSONAL INJURY

f. Ventilation (Continued)

TABLE XI

NUMBER OF AIR ANALYSES

Mine	Oxygen	Carbon Dioxide	Humidity	Temperature	Dust Counts in Millions Light Field	Dust Counts in Millions Dark Field
Athens	18	18	18	18	34	34
Cliffs Shaft	2	2	3	3	128	128
Maas	38	38	38	38	47	47
Negaunee	32	32	32	32	60	60
Lloyd	7	7	7	7	41	41
Gardner-Mackinaw	4	4	4	4	14	14
Spies	4	4	4	4	-	-
Brownstone Shops	-	-	-	-	3	3
Tilden	-	-	-	-	4	4
Totals	105	105	106	106	331	331

g. Employees' Representation Plan

Michigan

Elections of representatives were held in January at the underground mines and also the Cliffs Power & Light Co. The Tilden men held their election on September 4. A total of 20 representatives was selected, of whom 9 were men who had not already served in this capacity.

The representatives held a meeting on January 28 for the purpose of organization, when the following General Committee was chosen:

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11. ACCIDENTS AND PERSONAL INJURY

g. Employees' Representation Plan (Continued)

Chairman, Gust Sundberg, Maas miner
Vice-Chairman, Joseph Olds, Cliffs Shaft miner
Secretary, W. J. Waters, Negaunee hoisting engineer.

There was no change made in the membership of the Company's representatives, which consists of Ernest Keast of the Mechanical Department, Capt. Richard Cattran of the Negaunee Mine, and the writer.

These two committees comprise the Joint Committee, with Ernest Keast, chairman, and W. J. Waters, secretary.

Regular sessions of both the General and Joint Committees were held, as required by Rules 2 and 3, Section VII of the Representation Plan.

The Annual Meeting was held on July 13. Prior to the business transaction of the representatives a banquet was given by the Company to which the superintendents and heads of departments were invited by the Manager. After the banquet, the Manager announced that the officials had in mind plans for vacation for wage earners and for joint insurance. When the non-representatives departed the Annual Conference voted an appreciation for the announcement and then discussed several subjects, which were reported by the secretary in his minutes.

A Special Conference of the Representatives was held on August 2, when Mr. Elliott informed them of a change to be effected immediately in the working hours and also that joint insurance would be offered to the Company's employees.

Few complaints were made during the year by employees. Excepting several that dealt with differences in the wages for specific occupations, all were taken care of with mutual satisfaction to both employee and employer.

Minnesota

The election at the Canisteo Mine was held on August 28 and three representatives were designated and two men received an equal number of votes, which latter was taken care of by drawing to determine the fourth member.

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11. ACCIDENTS AND PERSONAL INJURY

g. Employees' Representation Plan (Continued)

Minnesota

An organization was elected at a meeting of the Representatives which was held on September 9. Lee Farr, of the Skilled Labor Division, was selected chairman of the General Committee, and Joe Chrape, of the General Labor Division, secretary.

The complaints and recommendations which came from the employees were mostly about working conditions with respect to safety, as was the situation in 1935.

The number of voters eligible in the nomination and election of the representatives and the per cent of those voted are given in the following table:

TABLE XII

Mine or Plant	No. of Voters	Number voted	Per cent voted
Athens	195	184	95.3
Canisteo	287	262	92.1
Cliffs Shaft	304	252	84.0
Gardner-Mackinaw	120	120	100.0
Lloyd	155	129	83.2
Maas	279	267	95.4
Negaunee	244	222	91.0
Tilden	58	52	89.6
Shops	45	39	88.8
C. P. & L. Co.	31	31	100.0
Total	1718	1558	90.1

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

h. Department Expense

Salaries.	$ 3,088.58
Auto Expense.	148.86
Heat, Light & Power	18.73
Postage	17.64
Repairs	1.80
Stationery & Printing	175.50
Supplies.	255.59
Travel & Entertaining	145.53
Telephone & Telegraph	38.21
Personal Injury Expense	61.97
Accrual of Un-employment tax. .	31.01
General Unclassified.	155.34
Total.	$ 4,138.76

Respectfully submitted,

William Comstock

Assistant Superintendent.

22. REPORT OF THE GEOLOGIST FOR THE YEAR ENDING DECEMBER 31, 1936

A. STAFF

The staff of the Geological Department, throughout the depression years, was reduced in personnel to the Geologist in charge of the Department. Mr. Stanley W. Sundeen, a graduate of the Geological Department of the University of Minnesota was engaged as Assistant Geologist in this Department, and commenced work on Monday, June 15th. In December he received his Ph. D. degree in Geology from the University of Minnesota. Mr. Ernest Allen, who had been dividing his time between the Engineering and Geological Departments since diamond drilling was resumed in December 1935, was re-instated on a full time basis in the Geological Department on July 1st. Mr. Gustav Afuhs, for many years a draftsman in the Geological Department previous to the depression, was re-engaged and resumed work in the Department on August 8th. Table I, below, gives the personnel of the Department as now constituted:

TABLE I

Name	Occupation	Hours Lost. Sickness	Hours Lost. Absence	Hours Overtime	Net % Hours Worked
E.L.Derby,Jr.	Chief Geologist	-	91	88½	99.9
Stanley W. Sundeen	Asst. Geologist	-	54½	-	95.7
Gustav Afuhs	Draftsman	-	11	-	98.6
E. A. Allen	Assistant	-	80½	-	92.0

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

TABLE II

Total Working Days	275½ days (2003 hours)
Sundays	52 "
Full days resulting from Saturday afternoons	26 "
Holidays	12½ "
Total	366 days

Table III, below, shows the average number of men regularly employed on a full time basis on the staff of the Geological Department during the past five years.

TABLE III

Year	Average Number of Men
1932	1.5
1933	1.0
1934	1.0
1935	1.0
1936	2.4

B. GENERAL DESCRIPTION OF THE WORK OF THE DEPARTMENT

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

TABLE IV

ITEMS	HOURS WORKED	PERCENT
MINES		
Athens	29 1/2	0.6
Canisteo	469 3/4	10.0
Cliffs-Shaft	1416	30.2
Jackson Lease	28 3/4	0.6
Lloyd	125 1/4	2.7
Maas	71 1/2	1.5
Mackinaw	23 3/4	0.5
Negaunee	85 1/4	1.9
Pontiac	70 3/4	1.5
Sherwood (Virgil)	30 1/4	0.6
Tilden	125 1/4	2.7
Webster	6 1/4	0.1
Total Mines	2482 1/4	52.9%
EXPLORATIONS		
Cliffs-Shaft Mine	498	10.6
Tilden (E.& A. 680)	610	13.0
Total Explorations	1108	23.6%
MISCELLANEOUS		
Annual Report	30 3/4	0.7
Depletion Estimates	151	3.2
Engineering Department	81 3/4	1.7
General Departmental	331 1/4	7.1
Gold Leases on Company's Estate.	37	0.8
Investigating Mineral Land Offers	43	0.9
" Outside Explorations	69 1/4	1.5
Lake Superior Mining Institute..	21 1/2	0.4
Michigan Mineral Land Company ..	9	0.2
Minnesota Research Company	8 1/4	0.2
Munising Silica Sand	7 1/4	0.1
Republic Steel Corp. Interests..	151 1/4	3.2
Tax Commission Estimates	162	3.5
Total Miscellaneous ..	1103 1/4	23.5%
GRAND TOTAL	4693 1/2	100.0%

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. The largest single increment of my time, - approximately one quarter, - was taken up by activities in connection with the Canisteo Mine. Structure drilling was carried on during the entire 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 Tax Commission. A review of the Canisteo reserves for ad valorem tax purposes was made during the year and I spent considerable time in conference with engineers representing the Commission. I also planned and supervised the diamond drilling in the Cliffs-Shaft Mine and in the Tilden Mine area.

My activities, in addition to the regular routine work, and to the geological surveys and explorations which are treated separately in this report, may be summarized as follows:

In January, I went to Birmingham, Alabama at the request of Mr. Wysor, Executive Vice President of the Republic Steel Corporation and examined and appraised the value of the Shannon red ore mine which is the property of the Gulf States Steel Company. My work was under the immediate direction of the Engineers and Constructors, Inc. of Philadelphia who examined and valued all of the assets of the Gulf Company for Republic. The Republic Corp. held approximately a 35% stock interest in the Gulf Company. I spent one day in the Republic's Cleveland office in connection with this valuation.

In February, I prepared my report on the Shannon Mine for the Republic Steel Corporation. I went to the Mesaba Range and completed the classification of the remaining samples from the structure drilling done at the Canisteo Mine during 1935. I went over with Mr. E. G. Sterling all estimates being made up on the Canisteo for both operating and tax purposes and sent out to the fee-owners of the Canisteo Mine the annual drill reports. I also assisted Mr. Barber in the preparation of a complete report on operating the Pontiac Mine.

In March, I attended the adjourned annual meeting and the Director's meeting of the Minnesota Research Company in Duluth as one of its directors. I made an underground geological survey of the new development work on the Thirteenth Level of the Negaunee Mine and posted the information on the geological map of this level. I accompanied Mr. Elliott to Cleveland and from there Messrs. Geffine, Elliott and I went to Madison for conferences with Dr. Leith on tax matters in their relation to the appraisal of the Company's mineral estate which Dr. Leith had prepared in 1935 and submitted to the Securities and Exchange Commission. Later in the month, Messrs. Geffine, Elliott, Adams, Dr. Leith, and I held a conference with Mr. Pardee, State Mine Appraiser and three members of the Michigan State Tax Commission at their offices in Lansing. We then went to Cleveland and later in the month, I again went to Madison to work up additional data on these tax valuations with Dr. Leith.

In April, I went to the Mesaba Range and went over, with Mr. Everett Sterling, the completed revised estimate of the Canisteo Mine reserves to be submitted to the Tax Commission in connection with its review of this property. I also went over the drilling plans for the current season and the drilling already started on the North Bovey leases. While in Minnesota I spent one day at the University of Minnesota in Minneapolis where I offered an assistantship in the Department to Mr. Stanley Sundeen who joined the Department in June. I accompanied Messrs. Jackson, Elliott and Adams to Lansing where we had our annual conference with Mr. Pardee, State Mine Appraiser, at his office, and went over with him the valuations placed on all of our Michigan properties.

In May, I attended the Occupational Tax hearing before the members of the Tax Commission of the state of Minnesota which was held at the State Capitol, St. Paul. I also attended the hearing held at Ishpeming before the Michigan State Tax Commission. I went to the Mesaba Range and classified the accumulated samples from our current structure drilling at the Canisteo Mine. I held a meeting in Hibbing with several of the parties interested in the so-called "Wadsworth Lands" which are located in the Gwinn district. This meeting was for the purpose of consolidating the interests in this property either by purchasing the other interests ourselves or selling our interest to the other parties.

In June, I went over all of the exploration data and estimates of ore reserves which we have on the Ravenna-Prickett property with Mr. R. L. Wahl, General Superintendent for the Inland Steel Company, relative to the proposed lease of this property to the Inland Company. I spent one day in the vicinity of Munising with Mr. R. A. Brotherton, Engineer for the Land Department, going over with him the surface in the vicinity of the Munising Silica sand reserve. The Land Department was arranging to plat for sale all of the ground on the lake shore in that vicinity, desiring to reserve only that portion which may be used in connection with a future silica sand operation. I also went to the Mesaba Range to classify the current drilling at the Canisteo Mine, to lay out new drilling, and to go over with Mr. Everett Sterling, a new estimate of the tonnage reserves at the Canisteo which we might expect to mine at this property if we continue to operate it beyond the cancellation of the present lease.

In July, I spent two days showing Dr. Chrishnan the principle geological points of interest on the Marquette Range. Dr. Chrishnan is a prominent geologist and is Assistant Director of the Geological Survey of India. This visit was arranged at the special request of Dr. C. K. Leith. I made an examination of the cores from the drilling done by the Calumet & Hecla Company on the Company's lands which the Calumet & Hecla Company hold under option in the vicinity of the Ropes Gold Mine. I also made underground examinations of both the Ropes Gold Mine and the Michigan Gold Mine and covered these examinations with a special report.

In August, I went to the Mesaba Range and, in Hibbing, met Messrs. Lambert and Heilig, Engineers for the Minnesota State Tax Commission. We went over in detail the cross-sections and revised estimate of the reserves in the Canisteo Mine as of May 1, 1936. Messrs. Barber and E. G. Sterling were also present at this conference. While on the Range I classified the samples for the current structure drilling at the Canisteo and planned additional holes to be drilled in the North Bovey Bay of the Pit. On my way home I spent one day in Duluth with Mr. E. W. R. Butcher, Chief Engineer of the Republic Steel Corporation, getting data on the Hartford-Cambria Mine which I used in connection with my estimate of ore on the Jackson lease as of March 1, 1913 for depletion purposes. I spent some time as a member of the Arrangements Committee in preparation for the Marquette Range meeting of the Lake Superior Mining Institute which was held the end of August. I wrote a report to Mr. Bush on the Michigan Gold Mine, supplementing my previous report, made in July.

In September, I spent nearly half my time on matters pertaining to the Canisteo Mine and principally in connection with the current appraisal made by the State Tax Commission engineers. Messrs. Geffine, Barber and I held a conference with Messrs. Lambert and Heilig at their office in Minneapolis, discussing with them in detail the estimate figures they planned to recommend to the Tax Commission. I went to the Mesaba Range and prepared data and planned additional estimates to combat these figures. I returned to Minneapolis and held another conference with Messrs. Lambert and Heilig and also conferred with Mr. J. C. Holten, Attorney, representing us before the Tax Commission. As a result of this conference, Messrs. Lambert and Heilig agreed to delay presenting their final figures to the Tax Commission until October 15th. I went over the Sherwood Mine operations with Mr. Meyers and prepared estimates for his use in a report on the Sherwood in connection with the Virgil Mine. I also went over with Mr. Archibald all of our exploration data and estimates of the Pontiac Mine. The Cleveland office was attempting to interest Mr. Archibald in a lease on this property.

In October, I continued to spend a great deal of my time on Canisteo Mine matters, principally in connection with the new valuation for ad valorem tax purposes. This required two trips to St. Paul and to the Mesaba Range. On one of these trips I attended the public hearing on ad valorem taxes before the Tax Commission at the State Capitol. While on the Range I classified the samples from the last of the season's drilling at the Canisteo Mine and went over with Mr. Everett Sterling the estimate he was making on the maximum reserves in the Canisteo property. I made a field examination of the property South of Iron River, Michigan offered to us in Land Offer No. 1910 and reported on same. I also joined with Mr. Archibald on a report of the Michigan Mineral Land Company's estate which we submitted to Mr. Bush, and I made a report on the Webster Mine relative to the advisability of continuing to pay the taxes on this property.

Muller

In November, Messrs. Cronk and Muller of the Oliver Iron Mining Company, came to my office and I went over with them in detail the geology of the Bancroft Lease. They made an underground examination of the workings on this lease following the conference. I prepared a large amount of data in connection with the December 31, 1935 estimate of ore reserves in our various mines for use in connection with the depletion factors at these properties. Mr. Donovan, from our Hibbing office, spent one day with me relative to the Canisteo items affecting the depreciation of plant and equipment and the amortization of stripping for use in our depletion calculations and for future accounting at this property.

In December, I went to Hibbing for a conference with Messrs. Barber and J. C. Holten on Canisteo ad valorem tax matters. I consolidated the data, that had been in preparation for some time, which we anticipated using to support the May 1, 1936 estimate of reserves submitted to the Tax Commission and which were allowed tentatively, or at least in assessment of taxes for the year 1936. Mr. Barber and I held another conference with Mr. Holten at his office in Minneapolis after consolidation of this data. We then went to Cleveland and were joined by Mr. Elliott. We attended a meeting of the Mesaba Cliffs Mining Company directors and went over Canisteo Mine matters in detail. I stayed on in Cleveland the following week and with Messrs. Geffine, Sadler and Bubb, worked up depreciation and depletion figures on all of our properties as of December 31, 1935. These figures were set up on the Company's books as tax deductions in 1936.

STANLEY W. SUNDEEN. Mr. Sundeen commenced work in the Department, as Assistant Geologist, on June 15th. About two-thirds of his time has been spent on geological work connected with the Cliffs-Shaft Mine. This mine presents by far the most complicated and intricate problems in geology to be found in any of the Company's properties and probably in the entire Lake Superior district. During the past five years of the depression, this work had to be neglected for the most part because of the reduced personnel. It is impossible to make much of an impression on the geological problems in the Cliffs-Shaft Mine without devoting a lot of time and intensive study. I have found this impossible to do myself and at the same time direct the work of the Department, and this will be one of Mr. Sundeen's principal duties in the future. He has spent a great deal of time underground in the Cliffs-Shaft and in studying under the microscope, thin-sections of many samples of rock from the Mine and from the drill holes. He has also made underground geological surveys at the Lloyd Mine and the Jackson Lease and has posted the current extensions on the geological maps of the Athens, Maas and Negaunee Mines. As time permits he is familiarizing himself with the geology of the entire district and, in particular, the mining areas themselves.

GUSTAV AFUHS. Mr. Afuhs was re-engaged as Draftsman for the Department and commenced his work on August 8th. His work, as in the past before he was laid off, has, in part, consisted in preparing cross-sections of all current drilling done by the Company and

copying all exploration data submitted to this office in the form of land offers, outside explorations, etc. About two-thirds of his time, however, has been spent on a new set of geological tracings of the Cliffs-Shaft Mine. Our present set of tracings is more than twenty-five years old and in bad shape from constant handling. The job is a big one but one of the important ones confronting us at the present time. The rest of his time has been spent in general drafting work, making exploration tracings, maps and prints for my various reports and with a variety of smaller jobs making up the routine work of the Department.

E. A. ALLEN. Mr. Allen has spent most of his time collecting, sampling, labeling and filing diamond drill samples from the current explorations and making tests for the dip and bearing of the several drill holes, usually with the Maas Compass, whenever this data was required. He divided his time about equally between these duties and the Engineering Department until July 1st after which he has been a full time assistant in the Geological Department. Occasionally, however, he has helped out in the Engineering Department. He has accompanied Mr. Sundeen in several underground geological surveys at the Cliffs-Shaft Mine and has prepared all of the rock thin-sections which Mr. Sundeen and I have needed for microscopic studies. The rest of his time was taken up with office routine duties.

C. - SURFACE GEOLOGICAL SURVEYS

No important surface geological surveys were made during the year. However, Mr. Sundeen and I examined the surface geological conditions in the immediate vicinity of the West Pit at the Tilden Mine in connection with our current drilling. We also examined the surface geology, including several exploration shafts and test pits on a property a few miles South of Iron River, Michigan, covered by Land Offer No. 1910. Mr. Sundeen also spent a day mapping the detail of a small area comprising the old pits and adjacent out-crops on the New York Mine property in the SE$\frac{1}{4}$ of Section 3, 47-27, in Ishpeming.

D. - UNDERGROUND GEOLOGICAL SURVEYS

All of the Company's active underground mines, with the exception of the Cliffs-Shaft, (Athens, Lloyd, Maas, Mackinaw, and Negaunee Mines) operated from January 1st to February 1st with two crews working six day shifts each week, each crew getting three days work weekly. On February 1st operations were increased to six day shifts and two night shifts weekly, each crew working four days per week. On May 1st, operations again were increased to five day shifts and five night shifts, with the crews alternating so that each man received five days of work per week.

The Cliffs-Shaft Mine operated five day shifts weekly with one full crew from January 1st to September 1st when operations were increased to six day shifts per week.

The Tilden Mine operation began on April 20th and closed November 5th. Operations were conducted on two 8 hour shifts, five days per week. The Virgil Mine remained idle throughout the year but pumping continued to keep the mine free of water.

The Republic Steel Corporation commenced work on the Jackson Lease from their 6th Main Level on August 5th. The work schedule here has been two shifts per day, five days per week.

D-1. - ATHENS MINE

The geological data at the Athens Mine was mapped periodically by Mr. C. W. Allen, Engineer at the property until he was advanced to the superintendency of the Lloyd Mine about November 1st. He also posted the geological cross-sections intermittently.

Practically all of the ore the past year has been mined from the blocks between the 4th and 6th Levels. This is due largely to the necessity of speeding up the mining on the Mitchell Lease,--Lots 8, 9 and 11. Mining has been started in the Westerly half of the 4th block under the hanging wall at the 4th Level elevation. All of the ore remaining North of the Northeast-Southwest dike above the 4th Level elevation soon will be mined.

In order to facilitate the handling of the ore just above the 6th Level and for some distance below it, it was decided to open up a 7th Main Level intermediate between the 6th and 8th Levels. Work has already commenced at this elevation inside of the mine drifting toward the shaft. A shaft pocket is being cut and rock drifting will start from the shaft toward the ore body shortly. The intermediate sub between the 4th and 6th Levels which was started during 1935 was completed and mining was started from it. A new drift has also been driven on the 6th Level Southwesterly from the No. 620 cross-cut from which to handle the ore in this vicinity.

D-2. - CLIFFS-SHAFT MINE

Up to the middle of June, when Mr. Sundeen joined the Department, very little underground geological work was done during the present year. Since that time, however, Mr. Sundeen has spent two-thirds of his time making underground geological surveys, posting these surveys on the geological maps and cross-sections, and in making intensive studies of several of the areas where drilling is being done and development work being planned. During the present year we should be able to get pretty well caught up with the geological work at this property and from now on be able to cope with the problems as they arise.

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. About 68% of the total mine production was mined from "A" shaft deposits.

Development drifts were driven at the East end of the 6th Level toward the No. 3 mine to get at the deposits connected with these old workings. On the 8th Level, a drift in rock was driven Westerly from the West end of the South deposit to get under ore on the 6th Level. A rock drift was also driven Southeasterly from the Northeast end of the 8th Level and a raise put up to above the 7th Level. All of this development work has been on Company fee land. On the 10th Level a drift was driven West on Company land from the main North cross-cut leading to the Bancroft deposit. On the Bancroft Lease itself, the main East-West drift was driven 150' West encountering ore. This drift, at its East end, was extended Easterly on to Company land to get under ore on the 8th Level. A cross-cut was also driven on the Bancroft Lease Northeasterly from the main East drift to develop the ore in horizontal drill hole No. 429. The ore has been encountered and stoping started. The two raises previously started from the North-South cross-cut on the 15th Level, Bancroft, one inclined to the West and the other to the East, were continued. The raise inclined to the West was carried up and holed into the 10th Level. Developments from this raise have opened up new ore. A branch raise from the raise inclined to the East is being put up to encounter the ore found in drill hole No. 439. A raise is also being put up from the East end of the 15th Level to the ore developed on the 11th Level.

"B" shaft deposits produced about 32% of the total mine production. The ore continued to come almost entirely from floors, raises, and stopes in ore areas already developed on the various levels. The drift being driven Westerly from the Southwest end of the 10th Level toward the ore body in the West half of Section 9, was extended about 900' during the year. The objective of this drift is now only about 300' or 400' ahead of the breast. The main ore body should be encountered and development work started during the coming year. The drift is in hard ore iron formation at the present time.

D-3. - JACKSON LEASE

A lease, although not actually signed, virtually has been acquired by the Republic Steel Corporation on the North 660' of the $N\frac{1}{2}$ of the $NW\frac{1}{4}$ of Section 1, 47-27 and the North 660' of the $NE\frac{1}{4}$ of the $NE\frac{1}{4}$ of Section 2, 47-27 which adjoins their Hartford-Cambria lease on the South. It has been known for many years that the Hartford-Cambria ore body extends over in pitch and dip on to this property which is a part of the Jackson. Development work from the 6th, or bottom level, of the Cambria Mine was extended over the line on to the Jackson Lease on August 5th and has been continuous since that time. One stope has been started and 7791 tons of ore mined up to the end of the year. Mr. Sundeen has made one underground geological survey on this lease and has posted the information on a geological map.

D-4. - LLOYD MINE

The geological data at this property, the first part of the year, was mapped periodically by Mr. Brewer, Engineer, in connection with his regular surveys. Since then, Mr. Sundeen has made one complete geological

survey and has posted the information on the geological maps and cross-sections.

All of the product from the mine continued to come from the East Lloyd ore body,--most of it from Sub-Levels just above the 4th Level. Most of the balance came from slicing operations under the stope on the 990' Sub-Level.

Development work on the 5th Main Level was completed during the year and a sub-level stope started above this level in the extreme Southwest end of the main ore body. The ore area, as developed on the 5th Level elevation, is not quite as large as anticipated, a contraction being encountered on both the South and East limits of the ore. This contraction, however, may be compensated for as development progresses downward.

D-5. - MAAS MINE

At the Maas Mine, Mr. Haller, Engineer at this property following Mr. Moulton's advancement to a superintendency, has kept the geological data up to date and has posted the geological cross-sections. Mr. Sundeen has begun to take this work over, having made one complete posting of all extensions on both the geological maps and cross-sections.

The production during the year has come principally from three localities; namely, from above the 3rd Level in the riser of ore on the Race Course, formerly developed on the 4th Level but now extending to at least the 5th Level; from between the 2nd and 3rd Levels on the footwall side of the Main Deposit; and from both above and below the 4th Level under the hanging wall in the Main Deposit on both the Race Course and Maas Lease South of the Race Course. Most of the Bessemer production has come from the last locality.

On the 5th Level, development work continued with the driving of a cross-cut Southeasterly along the West boundary line of the Race Course on Maas Lease territory. This is No. 7 cross-cut and was nearly all in rock. Also the main North footwall drift was extended Southwesterly from the Race Course into Maas Lease territory to the West. It cut through lean ore and jasper and finally into ore again. Both of these drifts, however, have been stopped temporarily in order to slow up the Bessemer production tributary to this work. A considerable block of ore was developed under the hanging wall to the East of the Race Course from the new 600 series of raises that were put up from the 4th Level a year ago.

D-6. - MACKINAW MINE

Mr. Allen, while engineer at the Mackinaw Mine, kept the geological data up to date in connection with his regular surveys. The production from this property came principally from stopes above the 8th and 9th Levels although stoping had started above the 10th Level before the end of the year. The stopes above the 7th Level were pretty well mined out early in the year, except in the very high sulphur

block. The tendency for the phosphorus content of the ore to increase and the sulphur content to decrease as greater depth is attained, continued throughout the year. The increased phosphorus content has given considerably more trouble in grading the ore from this property than formerly did the high sulphur content. In grading this product, a limit of .300% Phos. was used in 1935. During the past year this limit has been raised to .400% Phos.

During the year, a footwall drift was driven on the 8th Level at the Northwest end and three stopes opened up. Also on the 9th Level a footwall drift was driven at this end and three stopes put up. Two stopes were opened up from the Southeast end of this level. The incline shaft was sunk to the 10th Level elevation. The 10th Level was opened up with about 1150' of drifting and four stopes were started. This level is approximately 1500' below the surface. The narrow portion of the ore body seems to be pinching out, particularly in the Southeast section of this ore body. The wider section at the Northwest end of the Mackinaw lease has not yet been developed on the 10th Level.

D-7. - MORRIS MINE

The Morris Mine continued to be operated under lease by the Inland Steel Company. Mining was continuous throughout the year on the basis of five double shifts per week. Mr. Trosvig, Engineer at this property until early November when he returned to the Engineering Department of this Company, continued to make frequent geological surveys and posted this data on his set of geological maps and cross-sections.

The production from the Morris Mine continued to come almost entirely from the No. 9 lease and the Cleveland-Cliffs Iron Company fee land East and South of this lease. Approximately 70% of the product has come from Sub-Level stoping and 30% from Sub-Level slicing and caving. The topmost workings are now on the 190' Sub-Level, 110' above the 7th Level. The lowest workings are on the -90' Sub-Level, 35' above the 8th Level. The Main Level development work was confined to the extension, on the 8th Level, of the South drift Westerly for about 240', from which raises were put up to develop the -90' Sub-Level. Four ore bodies are being worked: No. 33 or the main deposit on the South and East sides of the lease; B deposit; NO. 21 deposit; and No. 61 deposit.

In No. 33 deposit the ore limits were extended considerably to the West and South by the 8th Level drift and -90' Sub-Level developments, both mentioned above. The -90' Sub-Level extends Westerly on to Lease 24 and is still in ore. A new sub-level stope has been opened from this Sub-Level. This ore body is cut longitudinally by two East-West dikes and the width of the ore, North of the North dike and South of the South dike, as well as its Westerly extension is not known at this date. The area looks most promising for increased reserves on this lease.

The ore has already been developed for a distance of 305' West of its limit last year. The top workings in this deposit are now at the 100' Sub-Level or 20' above the 7th Main Level.

In No. 21 deposit, they are still stoping all the way from the 130' Sub-Level to the 190' Sub-Level. The 190' Sub-Level is the top of the ore in this deposit.

Both ends of the "B" deposit have now been stoped down to the 110' Sub-Level. Mining by slicing and caving is now being carried on in the pillar between these two stopes, the work at present being on the 190' Sub-Level elevation.

Mining by sub-level slicing and caving has continued in No. 61 deposit. This is the most Northerly deposit on No. 9 lease. On the East end of the deposit, mining is being done on the 160' Sub-Level and on the West end on the 120' Sub-Level.

D-8. - NEGAUNEE MINE

At the Negaunee Mine, Mr. Haller, Engineer until about September 15th, made periodic geological surveys in connection with his engineering work and posted the data on the cross-sections. Mr. Marjama, who succeeded Mr. Haller as Engineer at this property continued to do a small amount of geological work the balance of the year. Mr. Sundeen, however, has posted to date all of the geological maps of this property on which nothing has been done for a number of years. Gradually this Department will assume complete charge of all the geological work at this property.

The production came, principally, from three localities; namely, from the main deposit below the 11th Level, from the footwall pillar below the 10th Level and from the area South of the Main Dike also below the 10th Level.

The development work on the 13th Main Level was completed during the year. It was found that the pitch of the Negaunee Mine ore was flatter than could have been anticipated, which results in a much smaller ore area at the elevation of the 13th Level than had been estimated. Twelve raises were put up from this level after development work was completed. Ten of these raises are for the development and mining of ore. Of the remaining two, one was put up to the 215' Sub-Level, Maas Mine and the other was put up to the 13th Level from the 5th Level, Maas Mine both of them for ventilation and a second outlet.

D-9. - TILDEN MINE

It was not necessary, from an operating standpoint, to make any detailed geological surveys at the Tilden but one area in the West Pit and an area along the South footwall of the Marquette Range South of this property were studied and mapped in connection with the Tilden diamond drilling campaign. This drilling will be described in detail later in this report.

Production of siliceous ore especially low in phosphorus (.010% or under) was inaugurated in the Summit Mountain area late in 1935. During the past year, five churn drill holes were drilled in this area to try and develop an appreciable tonnage of this special grade with disappointing results. There were many individual samples that were satisfactory but they were spotty and separated by material of high phosphorus content. One shipment of this special grade, amounting to 4601 tons was made during the year. About an equal tonnage remains broken in the pit but it will have to be hand picked and the cost makes it an uneconomical operation. In the future the siliceous tonnage in this area will be graded in with the low phosphorus ore of the East Pit area.

The West Pit produced 217,225 tons and the East Pit 69,515 tons, making a total production of the property including the Summit, of 291,341 tons. The ore from the West and East Pits was graded together to produce the required low phosphorus grade (.020% Phos) and the balance shipped as standard Tilden grade.

Two stripping operations were conducted during the year. East and North of the West Pit, 46,550 cu. yds. of surface was stripped under contract. This uncovered 480,000 tons of siliceous ore above the floor of the present West Pit and 346,000 tons in the bench extending to a depth of 50' below this elevation. A small clean-up stripping operation was conducted just South and East of the East Pit by the mine crew. This amounted to 2,085 cu. yds. This does not develop new ore as the ore uncovered has been included in previous estimates of developed tonnage.

E. OPTIONS AND LEASES

Two new mining leases were acquired during the year. These include additional lands adjacent to the Gardner-Mackinaw Mine and were acquired because of the trend of the ore body in its downward extension. The description of these leases are as follows: Lease, dated April 6, 1936 from Detroit, Mackinac and Marquette Land Company covering the $S\frac{1}{2}$ of the $SW\frac{1}{4}$ of Section 35,45-25. Lease, dated June 11, 1936, from the Chicago and North Western Railway Company covering the $NE\frac{1}{4}$ of the $SW\frac{1}{4}$ of Section 35, 45-25. These leases run for the period concurrent with the original leases on the Gardner-Mackinaw as subsequently extended.

A lease has been drawn up from the Company to the Republic Steel Corporation, known as the Jackson Lease, covering a strip of land 660' wide across the Northernmost part of the $NW\frac{1}{4}$ of Section 1, 47-27 and the $NE\frac{1}{4}$ of the $NE\frac{1}{4}$ of Section 2, 47-27. This strip lies adjacent to and directly South of the Cambria Mine. Although the lease actually has not been executed, mining has been commenced on this lease by the Republic Steel Corporation.

F. EXPLORATIONS AND COSTS

Drilling explorations were carried on in 1936 in the following districts and mines:

F-1. - FROM SURFACE

DISTRICT	RANGE	MINE
Coleraine	Mesaba	Canisteo
Tilden	Marquette	Tilden

F-2. - FROM UNDERGROUND

Ishpeming	Marquette	Cliffs-Shaft

Table V, which follows, gives the footage drilled, the ore encountered and the cost per foot of drilling for both surface and underground explorations. It will be noted that the average cost of surface drilling was $3.41 per foot, excluding certain items which are not actual drilling expense but which are customarily charged to these explorations. By including these items, the average cost was $3.87 per foot. The cost of underground drilling in the same way was $1.93 per foot and $2.42 per foot, respectively. The drilling cost at the Tilden exploration was increased considerably by the cost of recovering a bit which became stuck in the bottom of the hole due to pieces of metal becoming wedged along side of it. They accidentally dropped into the hole from a flaw in the chuck on the drill machine itself. At the Canisteo Mine an abnormal percentage of hard taconite was encountered in the area where most of the footage was drilled.

Table VI, also shown below, gives a comparative cost per foot of drilling for the past five years. With the relatively large footage drilled during 1936 the costs should be considerably lower in comparison with the previous four years. Reasons for their not being are given in the preceeding paragraph.

TABLE V

SUMMARY OF DRILLING FOR 1936

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	30,	56 - 24	Minn.	-	4,105	-	4,105	-	-	* 1,375	$10,239.61	$ 2.49	$ 7,812.84	$ 1.90
Tilden Exploration (E.& A. 680)	26,	47 - 27	Mich.	179	20	4,428	4,627	38	50	128	23,524.22	5.08	21,947.29	4.74
TOTAL SURFACE DRILLING				179	4,125	4,428	8,732	38	50	1,503	$33,763.83	$ 3.87	$29,760.13	$ 3.41
UNDERGROUND DRILLING														
Cliffs-Shaft Mine	3 & 10,	47 - 27	Mich.	-	-	3,362	3,362	349½	433½	243½	$8,138.74	$ 2.42	$ 6,476.66	$ 1.93
TOTAL UNDERGROUND DRILLING				-	-	3,382	3,362	349½	433½	243½	8,138.74	$ 2.42	$ 6,476.66	$ 1.93
GRAND TOTAL DRILLING				179	4,125	7,790	12,094	387½	483½	1746½	$ 41,902.57	$ 3.46	$ 36,236.79	$ 3.00

* This is Crude Wash Ore which, when concentrated by washing, becomes First Class Ore.

Note: Cost "A" includes office expense, Engineering, Analysis, Legal, Personal Injury, etc.
Cost "B" excludes " " " " " " " "

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"	
1932	63	$ 11.44	$ 3.75	
1933	4,939	3.85	3.01	
1934	8,230	2.01	1.64	Canisteo Structure Drilling Only.
1935	4,321	3.16	2.70	
1936	12,094	3.46	3.00	

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F-3. - DIAMOND DRILL CARBON

We had on hand, January 1, 1936, a total of 367.64 karats of diamond drill carbon, which inventoried at $44,637.62. We purchased from the E. J. Longyear Company, 30 rounded stones weighing 130.19 karats at a cost of $125 per karat, or a total cost of $16,273.75. They allowed us $5,707.60 for 33 old stones weighing 110.49 karats. These old stones were purchased from 30 to 35 years ago, before the present method of selecting carbon was adopted. They were too soft to use in the hard iron formation of the Lake Superior District. We consumed, during 1936, a total of 58.11 karats in our drilling in the Cliffs-Shaft Mine and the Tilden Exploration, at a total cost of $7,766.71. In addition to this we charged off from our carbon account a total of $3,617.38 which represents the difference between the cost of the old carbon to the Company and the amount allowed us for it by the Longyear Company. This left on hand, December 31, 1936, a total of 329.23 karats which inventoried at $43,819.68.

F-4. - DRILL SECTIONS

Cross-sections showing a detailed report of the drilling done during the year underground in the Cliffs-Shaft Mine and from surface at the Tilden Exploration will be found in the Annual Report Book of Maps which is submitted as a part of the Annual Report of the Engineering and Geological Departments.

Cross-sections of the Canisteo drilling have been prepared in our Hibbing office for use on the Range. Copies of these sections have been sent to the several fee owners and underlying lessees according to the terms of our lease and to our Cleveland and Ishpeming offices.

G. SURFACE EXPLORATIONS

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

A total of 53 structure drill holes were drilled in the Canisteo Pit during 1936, with a total footage of 4105'. This work is necessary in order to sample the ore layers ahead of actual mining operations and to determine, more accurately, the limits of future stripping operations,--both rock and surface material.

This drilling started the first of April and continued until the middle of October. Two drill rigs were used the first part of the season and only one the latter part.

The holes drilled were distributed as follows:

2	holes	on	the	SW¼	of the	NE¼,	Section 30, 56-24,	Bovey Lease.
4	"	"	"	SE¼	of the	NE¼,	" 30, 56-24,	" "
17	"	"	"	NE¼	of the	SE¼,	" 30, 56-24,	" "
22	"	"	"	NW¼	of the	SE¼,	" 30, 56-24,	" "
8	"	"	"	SW¼	of the	SE¼,	" 30, 56-24,	Snyder Lease.

As a result of the drilling on the Bovey Lease, between 200,000 and 300,000 tons of additional high grade wash ore was developed in a deep channel running Northwesterly to the North end of the North Bovey Bay under the main approach and North bank of the Pit. A plan has been devised to strip this portion of the Pit and relocate that part of the approach beyond the limits of this ore.

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

The campaign of drilling which was inaugurated in the middle of December, 1935 on the Tilden Mine property to explore for a deposit of high grade ore on the footwall was continued throughout the year. One diamond drill rig was used until the middle of June, after which two rigs were in constant operation for the balance of the year.

The South rim of the Marquette Range, as it passes East and West across the Tilden property is obscured under surface material. For this reason the first work in this drilling was to determine its location and its general dip to the North by sinking a series of standpipes. At the beginning of the year the first standpipe, No. 48, had just reached ledge at a depth of 57'. The ledge proved to be a clastic iron formation. This is a part of the Marquette Range Iron Formation but entirely different in its structure from any of the other known areas on the Range. Instead of being made up of alternate layers of hematite and chert, a chemical sediment, the silica is in the form of rounded or clastic grains of quartz and they are imbedded in a hematite paste and banded in the form of a regular sediment. This hole was carried down to the main footwall encountered at 214' and drilled into it to a depth of 262'. The footwall at this point was made up of a complex of altered igneous rocks, a mixture of greenstone gneiss and granite.

The next standpipe was sunk on the same meridian, 14,000 W., and 400' South of No. 48 to be sure to strike the footwall at ledge. This was accomplished at a depth of 56'. On account of the altered character of the rock, which at ledge was granite, and to eliminate the possibility of this being a narrow intrusive tongue, the hole was carried to a depth of 200'. It was all in granite and greenstone. Hole No. 50 was sunk half way between 48 and 49 to more closely determine the actual footwall contact at ledge. It encountered footwall greenstone gneiss at a depth of 84' and was drilled into it to a depth of 207', the greenstone alternating with granite but all of it showed a gneissic structure.

These three standpipes having located the iron formation - footwall contact with assurance, the next hole, No. 51, also on the 14,000 W. meridian, was located 600' to the North of No. 48. It ledged in hard ore jasper at a depth of 24'. The hard jasper, however, gave way to a typical soft ore formation at a depth of 55'. From 55' to 160', the formation was considerably enriched, seams of lean, second class, and high grade ore alternating with one another and being separated here and there by typical soft ore jasper. Good ore was encountered from 70' to 75' averaging 57.69% iron and .042% Phos., and again from 120' to 130', good ore was cut averaging 58.61% iron and .066% Phos.

Below this enrichment the drill cut soft ore jasper to a depth of 500' where enrichment was again encountered. Alternate seams of good, second class and lean ore separated by seams of jasper extended to a depth of 594'. From 500' to 505' the ore averaged 62% iron and .035% Phos., and from 585' to 594' the ore averaged 58.06% iron and .065% Phos. This last run of ore was in direct contact with a greenstone dike which extended from 594' to 685'. Below this dike, hard ore jasper was encountered. This was followed at 715' by clastic iron formation, well oxidized and similar in character to that found for the first time on the Range in Hole No. 48. Soft ore jasper, however was again encountered at 1012' and from 1050' to 1075' it was considerably enriched. A seam of good ore from 1066' to 1075' averaged 59.86% Iron and .109% Phos. This was followed by 14' of clastic iron formation and at 1089', by footwall greenstone. The hole was drilled into this footwall to a depth of 1178', the last 45' being granite. The foot contact in this hole together with the foot contact in the bottom of Hole 48 gives us an accurate dip of the main footwall on the South side of the Marquette Range in this area.

From the limited geological information that we have on the South side of the Marquette Range, we have believed a fault of major magnitude follows pretty close to and along the strike of the South side of the Range. This is confirmed in the Tilden area by the rock exposures at the West end of the West Tilden Pit where there is a wide zone of intense folding and faulting. It is to this fracturing of the iron formation and to possible intrusive dikes that we must look as the agencies controlling the allocation of bodies of high grade ore. Accordingly the next hole to be drilled on this meridian, which was No. 53, was located about 350' North of Hole No. 51 and North of the anticipated position of the Southernmost line of faulting. This hole is located on the floor of the West Tilden Pit and near the South edge. It first passed through 302' of typical Tilden siliceous ore. This was followed, from 302' to 379', by unoxidized iron formation heavily charged with siderite and magnetite. At 379' we cut into greenstone and found it to continue to a depth of 628'. This may or may not be an interbedded intrusive sheet rather than a relatively narrow and steeply dipping dike. For the purpose of working out the structure of this area it will be necessary to determine this point by additional drilling close by. Below this dike cherty magnetite siderite was again cut from 628' to 717' where the drill entered hard ore jasper, not quite the same as that found at the top of the Marquette series represented by the Cliffs-Shaft Mine area, but nevertheless a very old oxidized formation which has been metamorphosed and possibly in much the same way. None of this hard ore jasper, however, was encountered in Hole No. 51 only 300' to the South. This hard ore formation extended to a depth of 1375' where clastic soft ore formation, similar to that in Hole 48 and in the bottom of Hole 51, was cut. With the exception of a few seams of typical soft ore jasper, this clastic formation extended to a depth of 1617' where footwall chloritic schist was encountered. The last 15' of this clastic material, or from 1602' to 1617', was unoxidized. It contained a considerable amount of carbonate and some chlorite. The hole was bottomed in chloritic schist at a depth of 1638' early in January. The bottom of the hole at the end of the year was 1475' and in Clastic iron formation.

This hole, No. 53, although started vertically, flattened an unusual amount, having an inclination in the bottom of 60° and a course

of nearly due South. It clearly demonstrated the existence of a fault which has resulted in a drop in the footwall of the iron formation, between this hole and No. 51. This drilling is not sufficient to determine the amount of deformation but it proves conclusively it is a zone of imported fracturing. It would, of course, have been very encouraging to have encountered a body of high grade ore in this hole but its abnormal deflection unfortunately directed it to a less favorable position in the structure demonstrated by the hole. From the results of the drilling on this meridian the chances of finding a major structure favorable for the formation of a body of high grade ore appear to be excellent. We do not know, however, to what extent the footwall has been dropped along the fault which we have confirmed. A vertical hole should be located on this same meridian several hundred feet North of 53 and drilled with a larger diameter bit in order to keep it straighter.

In order to hasten the exploration of this area, it was decided to add a second drill to the work the middle of June. The 11,800 W. meridian was selected as the line to cross-section the formation with this drill. This meridian is 2,200' to the East of that on which the holes discussed above have been drilled and passes just East of the East Tilden Pit area. In 1930 an incline hole, No. 17, was drilled to the South, at an angle of -60° to explore for siliceous ore. It was bottomed at a depth of 240' and still in siliceous ore. It was thought best in starting the second drill to recover this hole and continue it to the South footwall of the formation before locating a deep vertical hole. Siliceous ore was found to continue to a depth of 270'. This was followed by 8' of typical soft ore jasper and, at 278', by mixed soft ore jasper and well oxidized clastic iron formation. The latter resembled in every respect the clastic material encountered along the footwall on the 14,000 W meridian. At 300' the drill cut greenstone dike, which extended to 381'. From this point to 412' the dike was mixed with chloritic schist. After drilling to a depth of 528' in this schist and without having encountered the footwall granite we felt sure enough that this dike followed by chloritic schist represented the true footwall on this meridian and so stopped the hole. All of these foot rocks on the South side of the Range are intensely altered and have lost their original identity.

The drill was then moved 350' North of Hole No. 17 and Hole No. 52 drilled vertically. It ledged in a greenstone dike at 18' but at 24' gave way to hard siliceous ore which extended to a depth of 77'. This was followed by typical soft ore jasper to a depth of 167'. At 167' the drill encountered hard ore jasper exactly similar to that found in Hole 53 and followed it to a depth of 576'. From here on down, the formation was found to be only partially oxidized, it being a hard cherty magnetite siderite. This formation continued without change, except for three narrow and insignificant dikes, the balance of the year and was drilling at a depth of 1071' at the end of the year.

When the hole had reached a depth of 805' on October 19th, it was necessary to replace the chuck on the drilling machine with a new one. When it was installed nothing unusual was noticed by the drill runner,

however, a flaw in the metal caused several pieces of steel to snap off and without warning, by an unfortunate coincidence, fell into the hole and soon became wedged between the wall of the hole and the bit, causing the latter to become firmly stuck in the hole. Every known device and the entire skill of our personnel was brought into play to loosen this bit without avail. It became necessary to back off the drill rods and cut away all of the metal of the core-barrel and a part of the bit itself before, finally, it could be removed. The bit was recovered without damage to or loss of any of the stones but it entailed a delay extending to the 9th of December, a total of 48 working shifts.

H. UNDERGROUND EXPLORATIONS

H-1. - CLIFFS-SHAFT MINE

One drill operated continuously in the Cliffs-Shaft Mine throughout the year. During this time, sixteen holes were completed and the 17th started for a total of 3,362'. These holes were numbered from 426 to 442. All of them were drilled from "A" Shaft workings. Hole No. 426 which was drilled horizontally to the South from an old stope on the Southeast side of the 11th Level was drilling in footwall siderite at a depth of 69' on the first of the year. It was bottomed in this material at a depth of 79'. The drill was then moved up to the 10th Level on the Bancroft Lease. With the exception of the last hole, No. 442, which was being drilled at the end of the year, all of the remaining holes were drilled from the 10th Level. All but 3 of these 10th Level holes were located either on the Bancroft lease or cut into the Bancroft lease before being completed. All of them, including the three holes, Nos. 432, 433 and 437 which were located on Company property, explored the so-called Bancroft ore zone.

Holes 427, 429, 431 and 432 were drilled horizontally to the North and holes 437 and 439 horizontally to the South to outline the ore at the elevation of the 10th Level and facilitate its development. Holes 428, 430, 433, 434 and 436 were drilled Northerly with dips ranging from -20° to -55° and Hole No. 440 was drilled with a dip of -45° to the South. Holes 435, 438, and 441 were drilled vertically. All these incline and vertical holes explored for the downward continuation of the Bancroft ore in order to direct the development work below the 10th Level and plan for raises to drop this ore to the 15th Level for tramming to the shaft.

The geological structure of the block of ground, containing the Bancroft ore is tremendously complicated by a series of faults and some folding. In places, too, the iron formation is quite flat and the openings from which holes had to be drilled were not, in a number of instances, located conveniently. In spite of this, however, the drilling was quite successful in developing additional ore in this zone. Before all the Bancroft area can be drilled to advantage, development openings will have to be made at several elevations between the 10th and 15th Levels. A number of years ago, when we first discovered the Bancroft ore zone by drilling and developed the major faulting, we had

hoped to find a more or less continuous ore body of fairly uniform thickness. The later drilling to date has eliminated, as ore bearing, some of this area.

At the end of the year the drill was moved from the 10th Level to the East side of the 6th Level in order to drill a hole horizontally and due North to explore the territory Southwest of the old No. 3 mine workings for a possible Westerly extension of the ore bodies in the latter property; also for the possible downward extension of the ore being mined in stope raises above the 6th Level,--contracts Nos. 8 and 28. The hole started in footwall dike material and was still in it at a depth of 136' at the end of the year.

A total of 349½' of first class ore and 433½' of second class ore were found in the years drilling. Much of this second class ore likely will be mined along with the first class ore. The drill sections included in the Book of Maps which accompanies the Annual Report of the Engineering and Geological Departments shows in detail the holes cutting this ore and the analyses of the same.

I. EXPLORATIONS AND NEW DEVELOPMENTS BY OTHER COMPANIES

The following activities on the Iron Ranges, that are of especial interest, have come to my attention during the year:

I-1. - MARQUETTE RANGE

The Inland Steel Company, at its Greenwood property, continued to mine a small tonnage of hard ore in stringers on and above the 2nd or -1100' Level. It kept a diamond drill operating off and on throughout the year but without encouraging results.

A year ago the First Level, at an elevation of 850' below the collar of the shaft, was in about 600' from the shaft. This Level was driven to the ore horizon at about 1,000' from the shaft and exploring drifts driven along the hanging. I understand that no merchantable ore has been discovered in this work.

During the past year, the 3rd Level, at an elevation of -1300', was driven to the ore horizon, a distance of 720', and a drift driven 250' West along the hanging contact. They are now planning a drift to the East along the same contact. So far, only narrow stringers of ore have been found, too small to mine. It was interesting to note, however, that an East-West fault was encountered in driving this level and located in the hanging wall about 680' from the shaft. The hanging wall contact, which is a locus of the ore bodies in the property, flattens out considerably above the main working level (-1100' Level) but steepens to its normal position below the Level. So far no ore has been found in this steeper section and it looks as though the future life of the Greenwood will be a very short one.

Two new main levels were opened up at the Blueberry Mine during the year,--the 9th Level, 900' below the surface, and the 10th Level, 1000' below the surface. These levels had just reached the ore body at

the end of the year. The shaft was also sunk an additional 100' or to a depth of 1100'. The ore in this mine occurs in a long narrow body and is almost vertical. The ore at the East end goes practically to the ledge surface.

Exploring in the so-called Gold Range to the North of Ishpeming continued throughout the year. The Calumet and Hecla Consolidated Copper Company conducted a vigorous exploring campaign in the underground workings of the old Ropes Gold Mine both by drifting and diamond drilling. They also did some diamond drilling from surface on this property; the so-called Goodney forty to the West; and on this Company's property which is also leased to the Calumet and Hecla Company by an assignment from Bjork and Lundin. It has been reported that, in the old Ropes Gold Mine proper, they have developed above the bottom level, which is a little over 800' below the surface, about 1,500,000 tons of gold ore assaying between $4.50 and $5.00 a ton. This is about on the border line for an economic operation including the construction of a mill. The drilling on the Company's land, which during the past year, was to the East of the Ropes, was discouraging. It is hoped that commercial ore will be found to extend Westerly across the Goodney property and on to this Company's property in that direction. At present there is no work being done underground but the workings are being kept pumped out. Drilling, however, is going ahead on the Goodney property.

The old Michigan Gold Mine, located in the N½ of Section 35, 48-28 has been active throughout the year. They are developing and sampling a series of several parallel veins at three elevations, 50', 150' and 250' respectively, below the surface. I visited this underground development work in July and covered the examination with a special report to Mr. Bush, dated August 3rd, 1936.

In addition to these activities, a large acreage of land was optioned from the Ford Motor Company by the Norgan Exploration Company which is said to be a subsidiary of the Hollinger Company of Ontario. A large party of geologists and assistants worked in the field all summer and fall, making geological surveys of this territory. Also one diamond drill was employed and drilled 2,000' in a number of shallow holes. Nothing of real importance has been reported from this activity but it is understood that the work will go on again during the present year as soon as the snow goes off the ground.

I-2. - GOGEBIC RANGE

In my report for 1935, I mentioned that the Republic Steel Corporation had obtained an option from the Keweenaw Land Association covering the Norrie group of mines which was surrendered in September, 1935 by the Oliver Iron Mining Company. This option was exercised and a lease taken by the Republic Steel Corporation on the Pabst and Aurora properties. They have re-conditioned these mines for immediate production. The new shaft at the Newport Mine, which was sunk in the footwall, went into production at the end of the year.

I-3. - MENOMINEE RANGE

Mr. Archibald and his Detroit associates continued to scram ore from the old Forbes Mine throughout the year. About the only ore left in this property at the present time is that below the bottom of 4th Level, at the -475' elevation. There are three sub-levels below this main level from which ore has been scrammed from stopes and raised to the level by scraping up an incline. These sub-levels are spaced at 26', 25' and 20' respectively below the 4th Level. It is anticipated that the mine will be completely exhausted by the end of the year.

The same group of interests mined a small tonnage of siliceous ore from the old Millie Mine open pit which was supplied to the Ford Motor Company. I understand that the property will be re-equipped for the coming season's operations and a much larger tonnage mined.

I-4. - MESABA RANGE

The diamond drilling which was done from the surface West of the Alexandria Mine by the Republic Steel Corporation failed to develop additional ore in commercial quantities and the work was discontinued. Mr. R. S. Archibald and associates are exploring wash ore lands on the West side of Pekogema Lake. They have drilled a number of structure drill holes and, I understand, have checked pretty well the tonnage found by former drilling and are planning to open a pit possibly the coming season. The principle obstacle here is the proximity of the lake itself and the danger of opening cracks or encountering water courses directly connected with the lake.

The experimental concentrating unit located at the Harrison Mine of the Butler Brothers near Nashwauk continued in operation throughout the operating season. This plant is treating jig tailings and concentrating magnetically after roasting the feed. Butler Brothers have now taken the operation of this plant over from the Mines Experiment Station staff under whose direction the plant was designed and operated during the experimental stage.

Mr. W. W. Wade, assistant metallurgist at the State Mines Experiment Station and Mr. A. J. Gleason, research engineer with Pickands Mather have continued their experiments at the Station with the new type of pneumatic-water pulsation jig which they have designed. There have been a number of difficulties to iron out but they believe they have accomplished this quite satisfactorily. I have not been in tough with them recently but shall do so at my first opportunity. The jigging of ore material at the West end of the Mesaba Range from which a satisfactory product cannot be made in the ordinary washing plant, certainly will be an important department in the future benification of these ores.

J. EXAMINATION OF MINERAL LAND OFFERS

A total of 38 land offers were received by this office during the year 1936. Eighteen of these offers were mineral land offers. Of the remaining twenty, nineteen of them were offers of surface property in the City of Negaunee. The other was an offer of a surface description in Iron River, Michigan. The offers and their numbers are as follows:

Offer No.	Description	Remarks
1929	S½, Lot 7, Block 35, P. I. Co. Plat, Negaunee, Michigan	Purchased March 25, 1936.
1930	Lot 5, Block 1, Corbitt's Addition and Lot 17, Block 36, P.I.Co. Plat, Negaunee, Michigan	Declined.
1931	Lot 15, Block 1, Corbitt's Addition, Negaunee, Michigan	Declined.
1932	Iron ore in Ohio.	"
1933	Lot 5, Block 14, P. I. Co. plat, Negaunee, Michigan.	"
1934	Iron ore in Venezuela.	"
1935	Warner Mine, near Amasa, Michigan.	"
1936	Iron ore in Canada.	"
1937	Iron and manganese ores in Utah.	"
1938	Lots 1 and 2, Block 36, P. I. Co. plat, Negaunee, Michigan.	"
1939	House and Lot 8, Block 29, P. I. Co. plat, Negaunee, Michigan.	Offered $4,500, no deal.
1940	3 houses and Lot 8, Block 24, and 2 houses and Lot 10, Block 33, P. I. Co. plat, Negaunee, Michigan.	Declined
1941	House on Lot 13, Reed & Winter's Addition, Negaunee, Michigan.	"
1942	Buckeye Iron Mine in Minnesota.	"
1943	Breitung Hotel, Negaunee, Michigan.	"
1944	House and W½, Parcel D in Lot 17, Block 2, J. I. Co. Add. Negaunee, Michigan.	"
1945	Chrome Deposit in Canada.	"
1946	W½ of Lot 75, Sterling Add. and parts of Lots 5 and 6, Harveys' Play, Negaunee, Mich.	Pending.
1947	Iron and coal lands near Gadsden, Alabama	Declined.
1948	Iron lands near Hovland, Minnesota.	"
1949	Magnetite and potash deposits in Virginia.	"
1950	House and Lot 12, Block 2, Corbitt's Addition, Negaunee, Michigan.	"
1951	Surface parcel in Iron River, Michigan.	"
1952	Various descriptions in St. Louis County, Minnesota.	"
1953	Mineral lands near Portland, Oregon	"

Offer No.	Description	Remarks.
1954	House and Lot 37, Block 5, J. I. Co. Addition, Negaunee, Michigan.	Declined.
1955	Iron ore lands in Illinois.	"
1956	Lot 8, Block 2, Maitlands' Add. Negaunee.	Pending.
1957	Farm and mineral lands in Maple Ridge Township near Rock, Michigan.	Declined.
1958	Lot 5, Block 27, P.I.Co. Plat, Negaunee.	"
1959	Same as Offer No. 1940	"
1960	NE¼, Sec. 24, 46-28, Marquette County, Mich.	"
1961	Lot 7, Block 33, P.I.Co. plat, Negaunee, Mich.	Pending.
1962	Lot 5, Block 2, Corbitts' Add. Negaunee, Mich.	Declined.
1963	Limestone and dolomite on East end of Drummonds Island, Michigan.	"
1964	Fayal Lease, No. 1, Eveleth, Minnesota	"
1965	Various descriptions in Sands District, Marquette County, Michigan	"
1966	House and Lots 1, 2, 3, and West 10' of Lot 4, Block 1, Maitland's Addition, Negaunee, Michigan.	Pending.

K. EXPENSE STATEMENTS

Tables VII and VIII which follow, show a detailed statement of charges to Geological expense for the year 1936 and a comparative statement of these charges for the last three years. They are self-explanatory.

TABLE VII

STATEMENT OF CHARGES TO GEOLOGICAL EXPENSE FOR THE YEAR 1936.

Salaries	$ 8,383.15
Travel & Entertainment	1,453.10
Operating Automobiles	463.95
Supplies & Office Expense	726.14
Personal Injury	168.27
Accrual of Unemployment Tax	80.86
Unclassified	37.29
Total	$ 11,312.76

TABLE VIII

COMPARATIVE STATEMENT OF CHARGES TO GEOLOGICAL DEPARTMENT FOR LAST THREE YEARS.

	1936	1935	1934
Salaries	$ 8,383.15	4,774.00	4,620.00
Travel & Entertainment	1,453.10	1,101.79	1,234.07
Operating Automobiles	463.95	491.07	176.30
Supplies & Office Expense	726.14	512.36	273.34
Personal Injury	168.27	95.48	88.62
Accrual of Unempl. Tax	80.86	-	-
Unclassified	37.29	12.85	37.49
Total	$ 11,312.76	6,987.55	6,429.82

L. RESEARCH DEPARTMENT

No one was employed regularly on research work during the year 1936.

Respectfully submitted,

E. L. Derby, Jr.

Geologist

ELD:DWC

ANNUAL REPORT OF THE MINING ENGINEERING DEPARTMENT FOR THE YEAR ENDING DECEMBER 31, 1936.

The usual books of photographic maps, showing the areas mined on the various sub levels, etc. in the different mines during 1936, accompany this report. 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 portions mined or development work, and the sections show in color the unmined parts. Books have been prepared for the different companies interested in the various properties, the following list shows the companies for which books have been prepared, and the mines included therein:

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

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

Similar books were made for the following:

Person	Mines
E. C. Congdon, Fee owner	Canisteo
M. H. Barber, District Superintendent	Canisteo
H. C. Bolthouse, Superintendent	Canisteo
W. W. Graff, Superintendent	Athens and Negaunee
H. O. Moulton, Superintendent	Maas
C. W. Allen, Superintendent	Lloyd

B. MAP REPORTS

Two sets of blue prints of the mine maps, scale 1" equals 50', were made at the end of each month, one for the General Superintendent and the other for the mine superintendent. These maps showed in red the areas mined during that month. It was not feasible to make similar monthly report maps of the Cliffs-Shaft Mine, as it is impossible to survey

the mine completely oftener than every three months, besides, the advances per month, except for development drifts, would hardly warrant more frequent surveys. Several sets of maps of this mine were prepared for the General Superintendent during the year, and the development work posted frequently.

Besides the above map reports, other reports were prepared for outside parties, as follows:

ATHENS MINE

Two sets of monthly report blue prints of the Athens Mine were sent to the Cleveland office for the Pickands, Mather & Company, colored to show the areas mined.

GARDNER MACKINAW MINE

A set of blue prints of the Mackinaw Mine were sent at the end of each quarter, to Mr. G. P. McCallum, Ann Arbor, Michigan, showing the areas mined, and the work done during the previous three months.

MAAS MINE

Blue prints of those portions of the Maas Mine workings in the Roman Catholic Cemetery were sent monthly to Mr. R. S. Archibald, Negaunee, Michigan, showing in red the areas mined.

NEGAUNEE MINE

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

A set of blue prints, scale 1" equals 50', of the cross-sections of the Negaunee Mine, were sent at the end of the year to Mr. W. L. Cummings, Bethlehem Mines Corporation, Bethlehem, Pa.

MICHIGAN STATE TAX COMMISSION

New ore reserve estimates of the Athens, Cliffs Shaft, Gardner-Mackinaw, Lloyd, Maas and Negaunee Mines were made as of December 31, 1936 and annual report maps prepared showing the areas mined, new development drifts, geology, etc. of these mines, for the Michigan State Tax Commission.

C. REMARKS ON MISCELLANEOUS DOCUMENTS AND ABSTRACTS

All documents affecting the Company's lands and holdings, pass through the Engineering Department for record and approval, irrespective of the Department from which they originate. These documents have been handled by Mr. Brewer and placed by him on the Mining Department records. After the descriptions are approved, they are initialed by him. Copies of those documents which affect the mineral lands are kept on file in the Department.

The following table shows the number and classification of such documents as have passed through the Department and have been initialed:

CLASSIFICATION	Number Received	Last File Number
Mining Leases	2	68
Miscellaneous Documents	24	1317
Easements	3	394
Rights of Way	0	219
Water rights	0	58
Surface leases	260	4303
Applications for sale	6	162
Sales	180	1036
Tax histories	0	702
Legal Opinions	0	195

The following comments cover the various documents, etc. that were placed on the Department records during 1936:

MINING LEASES

There were two new mining leases acquired during the year, both of which include additional lands adjacent to the Gardner-Mackinaw Mine. They were as follows: Lease, dated April 6, 1936, from Detroit, Mackinac and Marquette Land Company to the Cleveland-Cliffs Iron Company, covering the $S\frac{1}{2}$ of the $SW\frac{1}{4}$ of Section 35, 45-25; Lease dated June 11, 1936, from the Chicago and North Western Railway Company to the Cleveland-Cliffs Iron Company covering the $NE\frac{1}{4}$ of the $SW\frac{1}{4}$ of Section 35, 45-25.

MISCELLANEOUS DOCUMENTS

This classification covers all documents of every nature involving transfer of rights affecting the mineral lands. Fourteen of these documents covering purchases of land, such as City of Negaunee lots, etc., and lands acquired by the Cliffs Power & Light Company. There was six highway rights of way granted over mineral lands and four miscellaneous documents including liquor sale permits at Gwinn and contracts for use of electric lamps underground.

EASEMENTS

These documents all cover transmission line rights of way acquired by the Cliffs Power & Light Company and consisted of two railroad crossings and one right of way.

RIGHTS OF WAY

This file covers all railroad rights of way across mineral lands. None were received during the year.

WATER RIGHTS

These are permits granting rights for mine water discharges, etc. across lands adjacent to the various mines.

SURFACE LEASES

The surface leases cover all sorts of permits for the use of Company lands for residence, gardens, farms, camping, etc., and all originate in the Land Department.

APPLICATIONS FOR SALE

These also originate in the Land Department and are the preliminary report covering the area to be sold and are for the most part, issued for farm lands off the mineral formation.

SALES

This classification covers sales of all kinds. There were 111 documents covering the sale of various parcels of land off the mineral formations. These include sales to the United States for forest lands, farms, and miscellaneous parcels for residence purposes. There were 33 rights of way for highways, telephone lines, etc. Thirty-two documents covered sales of houses in the various locations that were owned by the Company and were being disposed of to various individuals. There were also four various other contracts, mostly being timber cutting permits.

TAX HISTORIES

There were no Tax Histories received during the year. These are usually secured when lands are being purchased to make sure that all taxes have been paid.

LEGAL OPINIONS

This file is for ready reference of legal opinions as to the title of lands. None were received during the year.

ABSTRACTS

Although Mr. Brewer did quite a good deal of work on keeping up the abstracts of title and accompanying maps on the mineral lands of the Cleveland-Cliffs Iron Company and the holdings of the Cliffs Power & Light Company, he was unable to do very much toward bringing the abstract books up to date. Only such information as passed through the office was added to the records. It will still require several months to bring the abstracts up to date.

TAXES

The 1936 tax lists of the lands under the Mining Department and the Cliffs Power & Light Company were prepared as usual during October. The tax receipts were checked with the tax lists before the taxes were paid.

During the spring the State of Michigan advertised that the sale of land for delinquent taxes would be held on the first Tuesday in May. This was the first sale to be held since 1932 and contrary to previous custom, the lands to be offered were not published but were placed on file in the Treasurer's office of the various counties. It was agreed between the Land and Mining Departments that the Land Department would look after the Cleveland-Cliffs Iron Company's delinquent tax lands including those under the jurisdiction of the Mining Department, while the Mining Department would look after the lands of the Cliffs Power & Light Company. Messrs. Brewer and Chenneour made trips to Marquette, Munising and Manistique in connection with determining what lands were reported delinquent in which the Cliffs Power & Light Company were interested. The Supreme Court held, however, that the non-publication of delinquent lands was illegal and the sale was cancelled. Certain back taxes, however, were paid and several corrections made on the books where errors had been found.

COMPANY LANDS

The list of lands under the Mining Department, showing acreages held under the various forms of ownership, that was started last year was completed early in the year.

D. THE FORCE

There have been many changes in the Engineering Department during the year and nearly the whole personnel has been changed. Mr. H. O. Moulton was made superintendent in January and Mr. C. W. Allen in November. Mr. R. J. Chenneour was taken very seriously ill on October 12th and was not in the Department after that date. Mr. F. J. Haller re-entered the Department on January 6th after an absence since February, 1932 and Mr. J. Trosvig came back into the Department in November, having been with the Inland Steel Company at the Morris Mine since he left the Department since 1932. Mr. A. D. VanScoy came with the Company on February 1st and left the latter part of October. Mr. Oni Marjama entered the Department in September and Mr. W. R. Atkins in November. Mr. A. Koski has been with the Department the entire year as helper. Mr. D. W. Carlson was employed as Stenographer for both the Engineering and Geological Departments in August and he has also assisted in some of the underground and surface surveys.

The following table shows the personnel of the Department during the year, their position and period employed in 1936:

Name	Position	Entered	Left	1936 Employment
C. Brewer	Chief Mng. Engr.			12 months
R. J. Chenneour	Engineer			12 months
H. O. Moulton	"		Jan. 15th	½ "
C. W. Allen	"		Nov. 2nd	10 "
F. J. Haller	"	Jan. 6th		12 "
A. D. Van Scoy	"	Feb. 1st	Oct. 31st	9 "
O. Marjama	"	Sept. 15th		3½ "
J. Trosvig	"	Nov. 9th		2 "
W. R. Atkins	"	Nov. 16th		1½ "
A. Minnear	Draftsman			12 "
E. A. Allen	Helper		July 1st	6 "
A. Koski	"	Jan. 2nd		12 "
D. W. Carlson	Stenographer	Aug. 18th		4½ "

The following table shows the length of service in the Engineering Department of the men now employed:

Name	Date Entered	Years of Service	
C. Brewer	August, 1906	18 years, 3 months	
R. J. Chenneour	October, 1907	28 " 9 "	
F. J. Haller	June, 1930	2 " 7 "	(1)
O. Marjama	September, 1936	3½ "	
J. Trosvig	June, 1911	19 " 10 "	(2)
W. R. Atkins	November, 1936	1½ "	
A. Minnear	June, 1917	15 " 2 "	(3)
A. Koski	January, 1936	1 "	
D. W. Carlson	August, 1936	4½ "	

(1) Not employed by Company from February 1, 1932 to January 6, 1936.
(2) Not employed by Company from October 15, 1914 to December 1, 1915, also from June 1, 1932 to November 9, 1936.
(3) Not employed by Company from February 1, 1932 to March 1, 1935.

The above "Years of Service" does not in all cases cover the entire length of service with the Company, as several of the men have been employed in other Departments, either before or at intervals since first entering this Department.

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

Name	Working Days	Days Worked	Days Overtime	Days Sick	Days Absent
C. Brewer	275½	266½	3½	3	9½
R. J. Chenneour	275½	214½		59	2
F. J. Haller	273	259	2½	1	15½
J. Trosvig	38½	38½			
O. Marjama	81	81			
W. R. Atkins	33½	32			1½
A. Minnear	275½	266½			9
A. Koski	275½	272½			3
D. W. Carlson	100½	100½			
C. W. Allen	234½	231	9½		13
H. O. Moulton	11	11			
E. A. Allen	138	136		1	1
A. D. Van Scoy	208½	205	3½		7

The next table shows the distribution of the days spent underground, in the field or in the office during 1936. This table includes overtime.

Name	Underground	Field	Office	Total
C. Brewer	25½	55	186	266½
R. J. Chenneour	64	31	119½	214½
C. W. Allen	53½	39½	138	231
F. J. Haller	76½	17½	165	259
J. Trosvig	7½	1	30	38½
O. Marjama	19	14½	47½	81
W. R. Atkins	10	½	21½	32
A. D. Van Scoy	53	37½	114½	205
H. O. Moulton	2		9	11
E. A. Allen	14	7	115	136
A. Minnear	57	17½	192	266½
A. Koski	111½	49	112	272½
D. W. Carlson	2½	4½	93½	100½
TOTAL	496	274½	1343½	2114
%	23.5	13.0	63.5	100.0

The following is a brief summary of the work done by each person in the Department during the year:

CARL BREWER, Chief Mining Engineer, had charge of the Department and exercised general supervision over all of the work. He entered on the records all documents that were received by the Mining Department and made such reports on them as were necessary. He compiled the annual report books, estimates of ore reserves, and maps for the Michigan State Tax Commission, stockpile estimates, etc. During the early part of the year, he looked after the engineering work at the Lloyd Mine, made the weekly inspections and monthly map reports until he could turn over this work to Mr. Van Scoy. During May, he spent three weeks in Cleveland making an estimate of the ore in stock at the Otis Steel Company plant which estimate was reported directly to the Cleveland office. He did what abstract work that was done during the year towards keeping up the records in the office. He was on the survey at the Hoist Dam and assisted in the plumbing of the Athens shaft in connection with the re-alignment of skip runners. He also assisted in the surveys in the Jackson Lease to the Republic Steel Corporation at the Cambria Mine, both in the joint boundary survey on surface and plumbing the shaft and underground work. He assisted in the stockpile estimates in September and October.

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

Property	Underground	Field	Office	Total	%
General Engineering		13½	155½	169	63.5
Cliffs-Shaft Mine		3½		3½	1.3
Athens Mine	4½	½	3½	8½	3.2
Negaunee Mine	½	2	1	3½	1.3
Lloyd Mine	19	4	7	30	11.3
Maas Mine	⅓	½	½	1½	.6
Mackinaw Mine		½		½	.2
Hartford Mine	1	5	2½	8½	3.2
Spies-Virgil Mine			6½	6½	2.4
Francis Mine		2		2	.7
Maas E. & A.		2	4	6	2.2
C. P. & L. Co.		5½	5½	11	4.1
Otis Steel Co.		16			6.0
TOTAL	25½	55	186	266½	
%	9.6	20.6	69.8		100.0

REGINALD J. CHENNEOUR, Engineer, did all the engineering work at the Cliffs-Shaft Mine until he was taken ill in October. He made special studies of underground conditions for Mr. Stakel, and made the estimate of the ore in stock in September. He assisted in making up the lists of lands of the Cliffs Power & Light Company on which delinquent taxes had been reported and looked after the routine work of the office in the absence of Mr. Brewer.

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

Property	Underground	Field	Office	Total	%
Cliffs-Shaft Mine	63	18	116½	197½	92.0
General Engineering	0	3	1½	4½	2.1
E. & A.		5½	½	6	2.8
C. P. & L. Co.		4½	1	5½	2.6
Hartford Mine	1			1	.5
TOTAL	64	31	119½	214½	
%	30.0	14.4	55.6		100.0

HENRY O. MOULTON, Engineer, was only in the Department until January 16th, when he was made Superintendent of the Lloyd Mine. During the two weeks, he assisted Mr. Haller in becoming familiar with the Maas and Negaunee Mines and completed the ore reserve estimates of these two properties.

The following table shows the distribution of his time for the two weeks he was in the Department:

Property	Underground	Field	Office	Total	%
Maas Mine			4	4	36.5
Negaunee Mine	2		4	6	54.5
Lloyd Mine			½	½	4.5
Athens Mine			½	½	4.5
TOTAL	2	0	9	11	
%	18.2	0.0	81.8		100.0

CHARLES W. ALLEN, Engineer, did all the engineering work at the Athens, Gardner-Mackinaw and Tilden Mines until he left the Department in November. He made the weekly inspections at the Athens Mine, the monthly surveys and map reports of the Gardner-Mackinaw Mine, and he looked after the churn drilling and supervised the blasting and stripping at the Tilden Mine. He also made estimates of the stripping done under contract at the West Pit and that which was done by the Company at the East Pit. He left the Department on November 4th to become Superintendent of the Lloyd Mine in place of Mr. Moulton who had been transferred to the Maas Mine.

The following table shows the distribution of his time for the ten months he was in the Department:

Property	Underground	Field	Office	Total	%
Athens Mine	29	1½	49	79½	34.4
Mackinaw Mine	24½	6	41½	72	31.2
Tilden Mine		30½	44½	75	32.5
General Engineering		1	3	4	1.7
Francis Mine		½		½	.2
TOTAL	53½	39½	138	231	
%	23.2	17.1	59.7		100.0

F. JOSEPH HALLER, Engineer, entered the Department on January 6th. He looked after the engineering work at both the Maas and Negaunee Mines until September when he took over than in the Jackson-Cambria Lease. After the departure of Mr. Allen, he has taken care of what engineering work that was done at the Tilden. He made the weekly inspections, monthly map reports, and assisted the superintendents with their written reports of mines under his care throughout the year.

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

Property	Underground	Field	Office	Total	%
Maas Mine	39	6½	88½	134	51.7
Negaunee Mine	31	2½	55	88½	34.2
General Engineering			2½	2½	1.0
Gardner-Mackinaw Mine			1	1	.4
Geological Department			4	4	1.5
Cliffs-Shaft Mine	½		3½	4	1.5
Tilden Mine		5½	3½	9	3.5
Spies-Virgil Mine			2½	2½	1.0
Hartford Mine	6	3	4½	13½	5.2
TOTAL	76½	17½	165	259	
%	29.5	6.8	63.7		100.0

ALFRED D. VAN SCOY, Engineer, was in the Department from February 1st to October 30th. During the time he was with the Company he took care of the engineering work at the Lloyd Mine, making the weekly inspections and monthly map reports of that property. He ran the surveys on the Hoist Dam and vicinity and made the estimates of the rock excavation for the rip-rap on the Dam. During the spring he made the preliminary foundation plans of the Maas Mine houses that were to be moved during the year.

The following table shows the distribution of his time for the nine months he was in the Department:

Property	Underground	Field	Office	Total	%
Cliffs-Shaft Mine	1½	1½	2	5	2.4
Negaunee Mine	1½	1	2	4½	2.2
Lloyd Mine	44½	16	79½	140	68.4
General Engineering			5½	5½	2.7
Athens Mine	3	1	2½	6½	3.2
Maas Mine	½		4½	5	2.4
Tilden Mine		1	4	5	2.4
C. P. & L. Co.		7½	4	11½	5.6
Mackinaw Mine	2	½		2½	1.2
Hartford Mine			½	½	.2
Francis Mine		1½		1½	.7
Maas E. & A.		7	10	17	8.4
Gwinn E. & A.		½		½	.2
TOTAL	53	37½	114½	205	
%	25.9	18.3	55.8		100.0

ONNI MARJAMA, Engineer, entered the Department on September 14th. Since spring he had been doing the engineering work in Negaunee in connection with the moving of houses into the Cleveland-Cliffs Iron Company's Second Addition. He took over the engineering work at the Negaunee Mine from Mr. Haller in September and that of the Athens Mine in November at the departure of Mr. Allen.

The following is the distribution of his time for the three and one-half months that he was in the Department:

Property	Underground	Field	Office	Total	%
Maas Second Addition		6½	1	7½	9.3
Negaunee Mine	12½	2	36½	51	63.0
Hartford Mine		1		1	1.2
Lloyd Mine		1½		1½	1.9
Maas Mine		3		3	3.7
Athens Mine	6½		9½	16	19.7
Tilden Mine		½	½	1	1.2
TOTAL	19	14½	47½	81	
%	23.5	17.9	58.6		100.0

JOHN TROSVIG, Engineer, re-entered the Department on November 9th and took over the Engineering work of the Cliffs-Shaft Mine which has occupied his entire time for the balance of the year.

The following table shows the distribution of his time for the two months he has been in the Department:

Property	Underground	Field	Office	Total	%
Cliffs-Shaft Mine	7½	1	30	38½	100.0
TOTAL	7½	1	30	38½	
%	19.5	2.6	77.9		100.0

WILLIAM R. ATKINS, Engineer, entered the Department on November 16th and has looked after the engineering work at the Lloyd and Gardner-Mackinaw Mines for the remainder of the year.

The following table shows the distribution of his time for the month and a half he has been in the Department:

Property	Underground	Field	Office	Total	%
Lloyd Mine	7	½	17	24½	76.6
Gardner-Mackinaw Mine	3		2	5	15.6
Athens Mine			2½	2½	7.8
TOTAL	10	½	21½	32	
%	31.3	1.6	67.1		100.0

ARCHIBALD MINNEAR, has been in the Department the entire year. Most of his time has been occupied in drafting and in assisting in calculating surveys with the other engineers. He has made several surveys underground at the Cliffs-Shaft and Gardner-Mackinaw Mines and has helped on other underground surveys and surface work.

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

Property	Underground	Field	Office	Total	%
Cliffs-Shaft Mine	47	9½	65½	122	45.9
Tilden Mine		2	1½	3½	1.3
Negaunee Mine	2½		12	14½	5.4
Athens Mine	2½		4½	7	2.6
Geological Department			14	14	5.2
Maas Mine		½	15½	16	6.0
General Engineering		1	45½	46½	17.5
C. P. & L. Co.			3	3	1.1
Gardner-Mackinaw Mine	4½	½	4½	9½	3.6
E. & A.		1	15	16	6.0
Lloyd Mine	½	3	7½	11	4.1
Hartford Mine			3½	3½	1.3
TOTAL	57	17½	192	266½	
%	21.4	6.6	72.0		100.0

ERNEST A. ALLEN was in the Department until July 1st as helper. He assisted in the underground and surface surveys and made blue prints, etc. in the office but a growing proportion of his time was spent in the Geological Department looking after the core. This work increased so much that since July 1st he has spent his entire time with the Geological Department.

The following table shows the distribution of his time during the six months he was in the Department:

Property	Underground	Field	Office	Total	%
General Engineering			64½	64½	47.4
Lloyd Mine	1½			1½	1.1
Geological Department	1	1	50½	52½	38.6
Athens Mine	3			3	2.2
Negaunee Mine	2			2	1.5
Cliffs-Shaft Mine	2½	½		3	2.2
Maas Mine	4			4	2.9
Tilden Mine		3½		3½	2.6
Maas E. & A.		2		2	1.5
TOTAL	14	7		136	
%	10.3	5.1		84.6	100.0

ALFRED KOSKI entered the Department on January 2nd as helper. He has assisted in all of the underground and surface surveys, looked after the automobiles of the Department and made blue prints, etc. He has also made tracings and helped with the survey calculations and similar work.

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

Property	Underground	Field	Office	Total	%
General Engineering		2	100½	102½	37.6
Cliffs-Shaft Mine	54½	4	6½	65	23.8
Negaunee Mine	11½	2	2	15½	5.7
Mackinaw Mine	18½	1½		20	7.3
Maas Mine	5	5½	½	11	4.0
Lloyd Mine	17	10½	1½	29	10.6
Athens Mine	4	1		5	1.9
Maas E. & A.		6½		6½	2.4
Tilden Mine		7½	1	8½	3.1
C. P. & L. Co.		4½		4½	1.7
Hartford Mine	1	3		4	1.5
Francis Mine		1		1	.4
TOTAL	111½	49	112	272½	
%	41.0	18.0	41.0		100.0

DONALD W. CARLSON entered the Department on August 18th as Stenographer for both the Engineering and Geological Departments. Some of his time has been spent assisting in underground and surface surveys.

The following table shows the distribution of his time for the four and one-half months he has been in the Department:

Property	Underground	Field	Office	Total	%
Stenography			93½	93½	93.0
Hartford Mine		1		1	1.0
Mackinaw Mine		½		½	.5
Cliffs-Shaft Mine	2½	2		4½	4.5
Athens Mine		1		1	1.0
TOTAL	2½	4½	93½	100½	
%	2.5	4.5	93.0		100.0

E. DISTRIBUTION OF TIME

Practically all the work of the Department has been in connection with the operating mines throughout the year such as making the weekly inspections, monthly map reports and special surveys underground and on surface. All of the work in connection with the mines have been charged to that property and all other work such as miscellaneous reports, blue printing, etc. has been classified under General Engineering.

The following table shows the distribution of time spent underground, in the field or in the office for the various operating mines, of the entire Department:

Property	Underground	Field	Office	Total	%
General Engineering		20½	378½	399	18.8
Cliffs-Shaft Mine	179	40	224	443	20.9
Athens Mine	52½	5	72	129½	6.1
Negaunee Mine	63½	9½	112½	185½	8.8
Lloyd Mine	89½	35½	113	238	11.3
Maas Mine	49	16	113½	178½	8.4
Mackinaw Mine	52½	9½	49	111	5.3
Hartford Mine	9	13	11	33	1.6
Spies-Virgil Mine			9	9	.4
Francis Mine		5		5	.2
Maas E. & A.		30½	30½	61	2.9
C. P. & L. Co.		22	13½	35½	1.7
Otis Steel Company		16		16	.8
Geological Department	1	1	68½	70½	3.3
Tilden Mine		50½	55	105½	5.0
Gwinn E. & A.		½		½	.1
Stenography			93½	93½	4.4
TOTAL	496	274½	1343½	2114	100.0
%	23.5	13.0	63.5		100.0

F. COSTS

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

	1934	1935	1936
Salaries	$9,668,78	$ 12,426.53	$ 13,675.58
Auto Expense	280.68	253.20	253.60
Furniture & Fixtures			28.07
Heat, Light & Power	53.83	52.17	189.24
Insurance	194.06	108.34	142.25
Postage	14.93	29.60	18.00
Repairs	117.99	11.27	280.07
Stationery & Printing	35.40	8.80	75.72
Supplies	365.07	807.40	1,017.43
Taxes	41.46	41.35	44.49
Traveling & Entertaining			79.44
Personal Injury Expense	192.27	250.98	279.62
Telephone & Telegraph	68.69	73.59	102.33
Papers & Publications	6.00	6.20	7.00
Janitor & Cleaning	7.04		
Accrual of Un-employment tax			139.81
General - Unclassified	25.71	74.16	96.83
TOTAL	$11,071.91	$14,143.59	$16,429.48

H. AUTOMOBILES

The Ford Sedan and Ford Station Wagon owned by the Department, have continued in use throughout the year. These cars are six years old and the Sedan should be replaced with a new car. The Station Wagon is still in good condition and will give good service for some time yet. The following table shows the mileage traveled by these cars in 1936, the total mileage and date purchased:

Car	Miles		Date Purchased
	1936	Total	
Sedan	4,332	39,160	July 9, 1930
Station Wagon	3,553	25,210	Nov. 10, 1930

I. MINES

The following summary covers the work done in the Department in connection with the various mines, that has not been mentioned heretofore:

GENERAL

Weekly inspections of soft ore mines are made by the engineer in charge. These inspections are made in company with the Mining Captain and are very important from both the operating and engineering point of view. The regular monthly map reports of the operating mines were prepared and in many cases the mine superintendent was assisted by the engineer in writing the underground portion of the monthly and annual reports. During the year numerous studies were made for proposed development work, ventilation, underground water conditions, etc., as the occasion required.

ATHENS MINE

During July both skip roads were plumbed and careful measurements taken of the position of the skip runners in the circular part of the shaft. In this portion of the shaft the sets are 10' apart. The plumbing showed that the runners were out of line which interfered with the smooth traveling of the skips. The realignment of the runners was done under the supervision of Mr. Allen. During November plans were made for the development of the 7th Level and lines given for the commencing of this work. In June, the 10th annual inspection of experimental treated timber was made to Mr. F. S. Crawford of the U. S. Bureau of Mines and Mr. R. M. Wirka of the U. S. Forest Laboratory, Madison, Wisconsin. These timbers were placed in the mine in 1926. The summary of this report is as follows:

Preservative	Number of Timbers Placed.	Condition			Removed	
		Good	Partly Decayed	Badly Decayed	Decay	Crushed
Borax	15	-	5	2	5	3
Sodium Fluoride	27	-	-	4	17	6
Zinc Chloride	15	12	-	-	-	3
Untreated	12	-	-	-	12	-

The average life of the untreated timber was 3.8 years.

CLIFFS-SHAFT MINE

During February, Mr. Chenneour assisted the Mechanical Department in redesigning underground ore chutes. Mr. Chenneour drew up the plans for the new surface dry and gave lines for the extension of the rock trestle. During the year the locations of drill holes were surveyed and located as required. A survey was run on the 4th Level of the old Incline mine. More surveys will be made into both the No. 3 and Incline Mines when the levels are unwatered and better access to them is made available.

GARDNER-MACKINAW MINE

Lines were given for the sinking of the incline shaft to the 10th Level and plans and surveys made for the driving of the 10th Level. Lines for the various stopes on the different levels were given as required.

JACKSON-CAMBRIA LEASE

In August and September a joint survey was run with the Engineers of the Republic Steel Corporation to determine the boundary line between the Cambria and Jackson properties. This survey was run from the North quarter corner of Section 2 to the Northeast corner of Section 1 and two concreted iron pins set near the Hartford shaft for the baseline for the underground and surface surveys. In October, a survey was started to determine the South boundary of the Jackson Lease to the Republic Steel Corporation. This survey was not finished before snow fall but will be

completed next season. The joint surveys were carried down the shaft to the 6th Level and a very close check was made with the underground surveys. During the latter part of the year weekly inspections were made of the underground workings on the Jackson property.

LLOYD MINE

The development of the 5th Level required a great deal of engineering, lines being given for the various cross-cuts, raises, etc. The development of the stopes above the 5th Level were carefully watched and mapped and geologized to determine the possible extensions. On surface the new combination office, dry and shops was staked out for the foundations, etc. Also the garage was staked out in the field as required. Plans were drawn for the new rock trestle and top tram lay-out.

MAAS MINE

Most of the underground surveying at this property was in connection with the Sub-Level development below the 4th Level. On surface, the seven churn drill holes to determine the water level, were surveyed and mapped.

NEGAUNEE MINE

The 13th Level development required constant attention for lines, etc. as the various drifts advanced. A study is being made of the possible available ore above the 9th Level left in the shaft pillars adjacent to No. 1 and 2 shafts.

SPIES-VIRGIL MINE

Mr. Brewer drew up an isometric projection of the underground workings below the 6th Level. This work was for the Pension Department in connection with compensation matters.

TILDEN MINE

Early in the year the contract stripping at the West Pit required monthly estimates for payments to the contractor. During the season, the locations for churn drill holes were given and plans drawn up for the various blasts, etc., and other development work.

J. MISCELLANEOUS

SHAFT RUNNERS

During April and May the shaft runners in all of the operating shafts were gauged and the results were reported to the various superintendents.

VENTILATION

In February and August the volume and direction of air currents at the various mines were checked and the ventilation maps in the Engineering office and the various mine offices were posted up to date.

STOCKPILES

The engineers estimates of ore in stock at the various mines were made during October. The following table shows the engineers estimates, book figures and overruns that were reported on the dates shown:

Date reported	1935 October 1st	1936 November 1st.	Difference
Adjusted Engineers Estimate	1,643,294 tons.	1,071,167 tons.	-572,127 tons
Book Figures	1,468,784 "	799,358 "	-669,426 "
Overrun	174,510 "	271,809 "	+97,298 " .

OFFICE HOURS

The office hours during the year were as follows:

	A.M.	P.M.	Saturday
From January 1st to December 31st	8:30-12:00	1:15-5:00	8:30-12:15

HOLIDAYS

The following holidays were granted during the year:

January 1st	New Years Day
February 22nd	Washington's Birthday (½ Day)
April 6th	Local Election Day
April 10th	Good Friday
May 30th	Memorial Day
June 24th	Midsummers Day
July 4th	Independence Day
September 7th	Primary Election Day
November 3rd	General Election Day
November 11th	Armistice Day
November 26th	Thanksgiving Day
December 24th	½ day
December 25th	Christmas Day
December 26th	½ day
December 31st	½ day.

Carl Brewer

Chief Mining Engineer

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CLIFFS SHAFT MINE:

A new combination double deck cage and skip was put in operation at "B" Shaft on May 10th. This skip and cage is built of aluminum, with steel lining plates in the skip box, and its total weight is 10,515 lbs. This skip was built at the Hard Ore shops and cost $2,654.22. A spare skip box has been built which can be used at either shaft.

The rock picking belt in the crusher was re-built in July, and spare parts were purchased to take care of any replacements that may be necessary. A new metal screen belt guard was installed around the crusher belt to replace a wood guard that was a fire hazard and in poor condition. A wooden partition enclosing the crusher motor and starting equipment was replaced with steel.

During the week the mine was idle because of the vacation period, motors were changed on the top tram plant, a 125 HP motor being installed in place of the old 100 HP, on which there were several coils burned out.

A new double-truck lump ore stocking car which was built at the Hard Ore shops was put in operation on December 21st. The capacity of the new car is 165 cu. ft., compared to the capacity of the old one of 125 cu. ft., a difference of 40 cu. ft. This change should avoid some of the delays at the crushing plant.

A new set of air operated chute fingers were installed below the screen to load the above car.

All mechanical equipment operated satisfactorily during the year.

The light and power circuits for the old shops and the crushing plant were all replaced and put in approved condition, with necessary protective devices.

New lighting equipment was installed in the laboratory.

TILDEN MINE:

A piece of metal became lodged in one of the 10" Crushers in April, bending the head shaft. This shaft was replaced with a spare shaft we had on hand. The old shaft has been repaired and can be put in service if required.

The oiling system became plugged on the 10" Crusher. It was necessary to re-babbitt the eccentric and install a new oil pump.

A new set of concaves was installed in the 10" Crusher in June to replace a set that was completely worn out.

A pinion on the swing machinery on No. 29 Shovel stripped two teeth on May 11th., repairs were made and a new pinion purchased and installed May 23rd.

A second hand two (2) yard Marion electric shovel was purchased from the Nelson Mining Co., of Minnesota., and it was put in operation in July. This shovel was in very good condition.

There are considerable repairs to be made on the equipment at this mine during the winter. The shovels, cars, crushers and locomotives all require some repairs.

All mechanical equipment operated satisfactorily during the year.

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ATHENS MINE:

The old lumber and paper sheeting enclosing the Shaft House was taken off and replaced with Truscon Ferroboard steel sheeting.

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

Use of circuit breaker equipment was extended for all scraper motors, and the general standard of current supply improved. Practically all burn-outs in motors were eliminated; a more reliable and continuous source for mining being the result.

MAAS MINE:

We had some trouble with the No. 1 air compressor in June. This compressor caught fire in the first stage unloading pocket on the high pressure cylinder. We have equipped the compressors at all of the mines with a Thermostatic control, which will stop the machine before the temperature becomes too high and sets the oil on fire.

We have built at the Hard Ore shops, three skips of a new design. Two are now in operation and the third is a spare. The frames of these skips are built with cast steel bail, with connections for side angles and guides in one piece, eliminating several riveted joints at this point. The lower end of the frames are built with two steel castings connected together with two 3" steel axles pressed tight in the castings. This eliminates several reiveted joints that gave us considerable trouble keeping the rivets tight, and when tied together with the bail and side angles it makes a very rigid frame. The capacity of the box on these skips was increased by about one ton, and is a complete welded job, with the corners rounded. The bottom is spherical, of cast steel in one piece, and it is attached to the box by welding and connected to the axles on the frame with two cast steel self-oiling bearings. The advantages obtained by this type of skip are that the ore does not stick on the spherical bottom, and this eliminates cleaning the skip during the working hours. They should operate considerably longer than the old skips, with less repairs.

All mechanical equipment operated satisfactorily during the year.

The circuit breaker protection and improved wiring for scrapers was carried to completion.

We have practically eliminated burn-outs and expensive delays in this equipment.

NEGAUNEE MINE:

On February 8th. we had a bad fire in the head frame of the Shaft House. The steel above the landing was twisted very badly, and some of the steel had to be replaced. Replacements were made with steel taken from the Barnes-Hecker head frame, and by doing a lot of patching, the head frame was put in good condition. This frame has been enclosed with Truscon Ferroboard steel sheeting from the landing to the head sheaves.

The intercooler on the Ingersoll-Rand air compressor started leaking. Some of the tubes were rolled, the leaks stopped, and it is now in good condition.

A new spherical bottom skip was put in operation on May 31st. It is operating satisfactorily.

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NEGAUNEE MINE: (Cont'd)

All mechanical equipment has operated satisfactorily during the year.

Some trouble developed in motor-generator sets for haulage and scraper service. These were repaired and are now in good condition.

LLOYD MINE:

The intercooler on the Ingersoll-Rand air compressor was leaking and it was necessary to retube it. 3/4" copper pipe was used for tubes, which put this cooler in good condition.

The top tram equipment is in very poor condition. It is being replaced by two 8 ft. rubber lined sheave plants that were formerly used in the Gwinn district.

The head frame from the landing up to the sheaves, and the crushing equipment have been enclosed with Truscon Ferroboard sheeting.

A new boiler, with stoker, has been purchased for heating the head frame and crusher.

All mechanical equipment operated satisfactorily during the year.

Electric wiring and motor protection has been improved, and is now in good condition.

SECTION 6 SHAFT:

All mechanical equipment operated satisfactorily during the year.

MACKINAW MINE:

The pinion on the intermediate shaft on the hoist became loose. A new shaft was made at the Hard Ore shops and installed March 14th. All the bearings on the shaft were rebabbitted and the shaft lined. This hoist is now in good condition.

The wooden enclosure on the head frame was taken off and replaced with Truscon Ferroboard steel sheeting for fire protection.

All mechanical equipment operated satisfactorily during the year.

We had some trouble with the underground haulage sets and this machine has been sent in for a re-wind. Present service is by a set borrowed from the Athens Mine.

It is expected burn-out repairs will soon be completed.

SPIES-VIRGIL MINE:

Some repairs are being made to the equipment at this mine. The underground cars, skips, and cage are being repaired at the Hard Ore shops.

The 8" pump discharge pipe in the shaft is in very poor condition, from surface down 320 ft. We are going to replace this pipe with second hand material

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SPIES-VIRGIN MINE: (Cont'd)

that was formerly used as an air line between the Maas and Negaunee Mines.

The mechanical equipment is in good condition.

At all the mines there has been carried forward a gradual improvement in the type of electrical work done, and a higher standard of protection.

We have also improved the general illuminating in the shops and offices to more nearly approach modern standards.

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CLIFFS POWER & LIGHT CO.

The general operating conditions prevailing in the Cliffs Power & Light Co. system were very satisfactory in every respect throughout the year. The total amount of current produced in our own plants was somewhat limited because the year 1936 had appreciably less than normal precipitation. This necessitated the purchase of something like 3,000,000 K.W.H., the greatest amount we have purchased in any one year during the company history. The total amount generated and purchased was approximately 75,000,000 K.W.H., and the total amount sold was slightly more than 65,000,000 K.W.H. The total amount generated shows an increase over the highest previous year (1930) of approximately 20%, and an increase of approximately 21% in total sales.

In general the service was continuous throughout, practically the only interruptions occurring being those on the Republic circuit, with the exception of those which were necessary in connecting in the new Au Train substation.

Within the generating plants proper there were no major expenditures for maintenance and operation; the only expenditure other than routine being the rewinding of the #1 generator at the Hoist Plant.

Our substations caused little trouble and maintenance was purely normal. During the year some four (4) high tension bushings were replaced, dur to failure from age.

A new substation was installed at the Au Train plant. This station consists of 3 - 333 K.V.A. transformers, 2400/66000 volts, together with steel substation structure, with proper sectionalizing switches and lightning protection; also a bank of 6600 volt "Y" connected transformers for the Chatham-Eben-Rumely rural service. The 30,000 volt distribution in this areaswas abandoned. The old transmission line from Au Train to Munising was dismantled and also the section from Au Train to Rumely. The local distribution in the Chatham-Eben area is now 12,800 and 2,300 volt service. The only service into Munising is on the 66,000 volt line. This change was made under E. & A. 31 at a cost of about $20,000.00.

Fire-proofing material was installed for protection in the Brownstone substation.

Our dams and pipe lines are in good condition, maintenance on the same being as follows.

Under E. & A. 29 facing work was done on the Hoist dam, being practically completed before cold weather set in.

Under E. & A. 28, rip-rapping of the Hoist levee, was completed.

The slide which occurred on the Au Train levee was caused by the stoppage in the drainage system under the down stream toe. This has been repaired, and larger tile placed. A very substantial rock toe was built to add weight, and also to provide sure drainage. The down stream slope was flattened and completely sodded.

Our transmission lines are all in excellent operating condition and will require little attention in the succeeding year, with the exception of those that have reached their practical age limit. It seems probable that it will be necessary to rebuild the circuit between North Lake and Republic during the present season. This line is somewhat over twenty years old. Within one or two years it will be necessary to rebuild the pole line section of the McClure Plant circuit and also the pole line from the Maas circuit to the Hoist Plant.

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CLIFFS POWER & LIGHT CO. (Cont'd)

Due to the rapid increase in our load, and also to a lesser degree because of the sub-normal precipitation, it was necessary for us to discontinue supplying current to Marquette City, requiring them to make up their deficit by the operation of their Deisel engines.

The Cliffs Dow Chemical Co. installed a low pressure turbine, with 1,000 K.V.A. capacity and put it in operation near the close of the year. It appears that this will reduce their purchases by about 150,000 K.W.H. per month.

The contract with the Munising Paper Co. was renewed for an additional five year period, and we have been purchasing a liberal amount of current from them during the latter part of the year.

We have completed the contract with the Wisconsin Michigan Power Co. for a connection with our 66,000 volt line at Gwinn. This connection presumes the purchase of off-peak power at a staisfactory rate and makes available for our use not less than 4,000 K.W., in the event of trouble in our own system. We consider this arrangement a very satisfactory one as it gives us a tie-in with one of the larger utilities in this section, and stabilizes our own system. The work of connecting the two systems is under way at the close of the year, with the right-of-way cleared for practically the entire distance and several miles of poles placed. We are furnishing the Wisconsin Michigan Power Co. with crews of men under adequate supervision. Our progress has been much faster than any progress the Wisconsin Michigan Co. have been able to make on their portion of the line. We anticipate that this will work out very satisfactorily. This work should be completed very close to the contract date of March 1st.

Early in the year a new rural line schedule was brought into effect by the request of the State Utilities Commission. This was approved February 21, 1936 by the Commission. The rates and requirements are similar to those of the other utilities within the state. We consider it fair and satisfactory.

The operation of the Republic Township plant for them has been satisfactory and is working out just about as was planned. The revenue shows a substantial increase, and collections are satisfactory. The Republic Township officials and residents seem to be very pleased with the arrangement. The previouse arrangement for financially assisting rural extensions was brought in to include some additional customers, and our company advanced the money and labor necessary beyond the amount they were able to secure under the WPA set-up. A WPA set-up was arranged, approved and completed early in the year, covering work on the reservoir and water mains in the village of Republic. This was a very satisfactory piece of work, done under the supervision of our foreman. Their water system is now better than they have had for years.

The graph showing a history of the load increase of the Cliffs Power & Light Co., together with probable further increase, is compared to the McGraw-Hill graph for increases throughtout the United States. This indicates very clearly the necessity for providing additional capacity to meet the practically sure needs of the territory which we serve.

We look forward to a record breaking year for 1937, and a strong possibility of additional increases during the next few years.

THE CLIFFS POWER & LIGHT CO.

STATISTICAL DATA - 1 9 3 6

	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.	2,458,900	1,245,000	795,000	402,800	69,200	185,000	0	5,155,900	12,818	5,143,082	4,443,459	699,623	13.60
Feb.	2 863 800	1 028 200	902 000	369 940	55 800	200 000	0	5 419 740	12 385	5 407 355	4 664 916	742 439	13.73
March	2 948 000	1 143 100	916 000	213 080	78 700	197 000	0	5 495 880	13 180	5 482 700	4 729 821	752 879	13.73
April	2 508 100	1 684 700	778 000	248 360	68 900	228 000	0	5 516 060	12 137	5 503 923	4 808 512	695 411	12.63
May	2 990 100	1 859 500	879 000	304 810	258 300	275 000	0	6 566 710	12 339	6 554 371	5 842 619	711 752	10.85
June	3 414 500	1 486 300	1,032 000	165 300	156 500	232 000	0	6 486 600	12 745	6 473 855	5 668 349	805 506	12.44
July	3 594 600	998 900	1 224 000	454 290	109 200	233 000	153,000	6 766 990	13 959	6 753 031	5 856 884	896 147	13.27
August	3 288 300	1 090 200	1 114 000	227 190	42 300	138 000	781 000	6 680 990	15 585	6 665 405	5 830 972	834 433	12.51
Sept.	3 176 300	1 423 200	1 073 000	236 300	75 700	382 000	256 000	6 622 500	17 643	6 604 857	5 866 145	738 712	11.18
Oct.	3 451 100	1 006 900	1 207 000	184 130	62 400	266 000	787 000	6 964 530	20 184	6 944 346	6 148 489	795 857	11.46
Nov.	3 043 200	1 601 100	989 000	325 660	58 900	371 000	450 000	6 838 860	17 534	6 821 326	5 888 087	933 239	13.68
Dec.	2 823 700	1 234 600	911 000	173 970	82 600	274 000	891 000	6 390 870	18 651	6 372 219	5 458 967	913 252	14.33
TOTAL	36,560,600	15,801,700	11,820,000	3,305,830	1,118,500	2,981,000	3,318,000	74,905,630	179,160	74,726,470	65,207,220	9,519,250	12.73

Losses are low in May because K.W.H. to Inland Lime & Stone Co covers 36 days.

Figures for first eight months corrected account of K.W.H. from and to Paper Mill.

MECHANICAL DEPARTMENT
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Electrical Department: (Cont'd)

Statistical Data - 1936

Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Precipitation -	1.86	2.41	2.54	1.03	4.37	1.81	0.46	6.22	3.46	2.47	1.87	1.73

Total Precipitation at Ishpeming during 1936 - 30.23"
Average " " Marquette - 32.8 " (46 year record)

CARP RIVER PLANT:

Drainage area above Intake Dam,	66.66 sq. miles
Cubic Feet Precipitation in 1936,	4,683,102,800
Kilowatt Hours generated " "	15,801,700
Cubic feet water utilized (90 cu.ft. = 1 KWH.)	1,422,153,000
" " " in Carp Storage Basin Jan. 1,1936,	303,166,100
" " " " " " Dec.31, "	179,639,700
" " " used from Storage,	123,526,400
" " " wasted over Intake Dam in 1936,	571,536,000
Total run-off for year 1936, (cubic feet)	1,870,162,600
Run-off per square mile of drainage area,	28,055.240

	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.persq.mile 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.mi. run-off,	.59	.50	.25	.85	.98	1.11	.67	1.10	.83	1.13

	1933	1934	1935	1936
Total Precipitation,	32.72	32.87	27.10	30.23
Sec.ft.per sq.mile run-off	1.14	1.00	.79	.89

McCLURE PLANT:

Drainage area above Intake Dam,	140.52 sq. miles
Cu. Ft. Precipitation in 1936, (Hoist Plant - 32.16")	10,498,827,000
Kilowatt Hours generated at McClure Plant in 1936,	36,560,600
Cubic feet water utilized, (125 cu. ft. = 1 KWH.)	4,570,075,000
" " " wasted over Intake Dam in 1936,	494,712,000
" " " in Hoist Storage Basin Jan. 1,1936,	864,911,100
" " " " " " Dec. 31, "	534,404,800
" " " used from Storage in 1936,	330,506,300
" " " in Silver Lake Jan. 1,1936,	491,875,500
" " " " " " Dec. 31, "	402,798,500
" " " used from Silver Lake in 1936,	89,077,000
Total run-off for year 1936, (cubic feet)	4,645,203,700
Run-off per square mile of drainage area,	33,057,200

	1920	1921	1922	1923	1924	1925	1926	1927	1928
Precipitation - Hoist Plant -		35.10	42.03	26.60	30.49	24.06	43.85	35.51	43.80
Sec.ft. per sq.mi. run-off,	1.22	1.02	1.54	.85	.92	.52	1.52	1.80	2.22

	1929	1930	1931	1932	1933	1934	1935	1936
Precipitation - Hoist Plant -	38.75	30.81	37.02	32.54	35.07	35.02	29.96	32.16
Sec.ft. per sq.mi. run-off,	1.36	1.45	1.10	1.23	1.30	1.16	.90	1.05

MECHANICAL DEPARTMENT
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Electrical Department: (Cont'd)

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

	INSTALLED TO JAN. 1 1936	INSTALLED IN 1936	TAKEN OUT IN 1936	CONNECTED JAN. 1,1937 TOTALS
ANGELINE MINE:				
Hoist (stored)	250 HP.		250	
				0 HP.
CLIFFS SHAFT MINE:				
Shop	25			
No. 8 Crusher	125			
Screens	15			
Top Tram	100	125	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			
Underground Scrapers - 66 - 25 HP. motors	1,375	275		
Lower Tram #3	30			
Battery Charging Set, 2nd Level "A" Shaft	7-1/2			
Grinder in Drill Sharpening Shop	7-1/2			
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			
Machine Shop Stoker	1			
Bit Grinders - 4 - 2 HP.	6	2		
Small Hoist "A" Shaft (stored)	20		20	
Laboratory Compressor		5		
				5,697-1/4
BROWNSTONE SUBSTATION:				
Test Set	1/2			
Oil Filter Press	1/4			
Battery Charging Motor-Generator Set	3			
Commutator Grinder	1			
Synchronous Vondenser	80			
M.G. Set on Voltage Regulator Control	1/4			
Large Oil Filter Press	2			
Drill	1			
				88
fwd.	5,748-1/4	407	370	5,785-1/4 HP.