

14. MAINTENANCE
AND REPAIRS

c. Pumps

During the year it was necessary to send the 8th Level pump cylinders to the shops at Ishpeming for general overhauling.

The controller for the 8th Level pump was repaired but still gives considerable trouble.

The pot heads at the collar of the shaft on the pump service cable were repaired. Previous to this blow-outs in the cable occurred due to moisture getting in to the cable.

The 6" and 8" discharge columns were repaired.

17. CONDITION OF PREMISES

As mentioned in last year's report, the dwellings in the location need paint badly. The sheds and fences also need extensive repairs.

The grounds about the houses are neat and clean.

18. NATIONALITY
OF
EMPLOYEES

<u>Americans</u>	<u>Percent</u>	<u>Parentage</u>
1	.08	Americans
2	.17	English
2	.17	Irish
1	.08	Sweden
1	.08	Dane
<u>Foreign Born</u>		
4	.34	English
1	.08	Croatian
12	100.00%	

CANISTEO MINE
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1. GENERAL:

In addition to the customary policing of the mine and washing plant premises and pit pumping, a force of approximately ninety-two men were employed on pit and washing plant equipment repair work during the first three months of the year. The employment was on the basis of three days per week, the repair work being carried forward five days per week. On the same basis, a crew of ten men were employed fencing the Canisteeo, Holman and Hill pits during January, February and the first part of March. The drainage shaft and drift, which were started in the fall of 1934, were completed late in January. A track repair crew was employed during the latter part of April and the first week of May, preparing for mining activities.

The ore operations were conducted from May 8th until September 19th, utilizing the 120-B Bucyrus electric shovels for loading and 1-1/4-yard gasoline shovel for drainage cuts, track grading and clean-up work.

The washing plant developed a little better capacity than formerly anticipated, as in a total of 87 operating days, of three 8-hour shifts each, - 605,095 tons of concentrates were secured with a daily average production of 6,955 tons. On this basis, a full season of six working days per week would produce over 900,000 tons while the full season operation, with but five days per week, would show an 840,000-ton output.

The washing plant results were quite satisfactory. The weight and iron unit recoveries both showed continued improvement, and the change over from a Dorr washer to a Log on one side of the mill was fully justified by the results obtained.

Structural drilling was undertaken during the ore season and carried forward until the end of the year. This work was for the purpose of proving up the island area in the middle and west Snyder forties and attempting to outline the ore limits in the north Bovey bottom. With the completion of the Bovey drilling in 1936, the explorations on the Canisteeo property will all be completed, with the exception of sample drilling in connection with the ore operation.

The fall stripping program was conducted on three 8-hour shifts, five days per week, from the first of October until the 18th of December. The quantity of material handled averaged 7,700 yards per day, and the cost, including all overhead, District Office, Ishpeming Office and Cleveland charges, was slightly above \$.28 per yard. Considering the fact that about 40 per cent of the material moved was hard rock and the areas were small and irregular, necessitating considerable track work, the results were satisfactory.

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1. GENERAL:
(Continued)

The pit drainage problem continued to be largely a matter of adequately handling surface water in the pit bottom, for, regardless of the shaft and drift, the fine ore was impervious to drainage and cuts from the workings to the shaft were necessary, preceding each lift in the operation.

A well was put down near the tailings pond and a 250-gal. centrifugal pump installed. This pump operated continuously from the 28th of March to the end of the year. It did not supply sufficient water during the peak operating period of July and August and an auxiliary source was secured from Pickands, Mather & Company. With steady pumping during the fall and winter of 1935-1936, we should have ample water for the 1936 ore season.

2. PRODUCTION,
SHIPMENTS &
INVENTORIES:

a. Production by Grades:

Snyder Crude, -----	538,618 tons
Bovey Crude, -----	417,523 "
Hemmens Crude, -----	<u>59,228 "</u>
 TOTAL CRUDE, -----	 1,015,369 "
 Snyder Non-Bessemer Concentrates, -----	 221,365 "
Snyder Bessemer Concentrates, -----	105,563 "
Bovey Non-Bessemer Concentrates, -----	144,912 "
Bovey Bessemer Concentrates, -----	107,954 "
Hemmens Non-Bessemer Concentrates, -----	5,883 "
Hemmens Bessemer Concentrates, -----	<u>19,418 "</u>
 TOTAL CANISTEO MINE, -----	 605,095 "

Actual ore operations started on May 8th and were completed on September 19th.

b. Shipments:

The shipments from the Canisteco Mine during 1935 were the same tonnages as shown under the production statement, as all ore mined was forwarded to Lower Lake ports.

c. Stockpile Inventories:

No merchantable ore, either concentrates or direct shipping was stocked at the Canisteco property during 1935.

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2. PRODUCTION,
SHIPMENTS &
INVENTORIES:
(Continued)

e. Production by Months:

(1) Crude Ore:

<u>MONTH</u>	<u>SNYDER</u>	<u>BOVEY</u>	<u>HEMMENS</u>	<u>TOTAL</u>
May, -----	74,842	119,911	11,726	206,479
June, -----	104,541	97,828	14,906	217,275
July, -----	135,258	111,450	3,600	250,308
August, -----	143,453	78,285	19,172	240,910
September, -----	80,524	10,049	9,824	100,397
TOTAL 1935, -----	538,618	417,523	59,228	1,015,369

(2) Concentrates:

<u>MONTH</u>	<u>SNYDER</u>	<u>BOVEY</u>	<u>HEMMENS</u>	<u>TOTAL</u>
May, -----	42,664	67,690	3,963	114,317
June, -----	56,363	56,758	5,278	118,399
July, -----	80,163	70,628	1,738	152,529
August, -----	91,604	52,102	9,185	152,891
September, -----	56,134	5,688	5,137	66,959
TOTAL 1935, -----	326,928	252,866	25,301	605,095

f. Ore Statement:

All material considered as ore, that was mined during 1935, was shipped from the property.

g. Delays:

The following delays were reported during the year 1935:

<u>Date</u>	<u>Time Lost:</u>		<u>Cause:</u>
	<u>Hours</u>	<u>Minutes</u>	
May 13th	1		30-yard car dumped wrong way at crude ore bin.
May 16th	4	30	Train derailed on curve in Bovey on single line.
May 21st	4		Broken impeller on water supply pump, necessitated running mill one side for entire shift.
May 24th	3		Waiting for Great Northern empties.
May 27th		30	Waiting for Great Northern empties.
May 29th		50	Yard plugged, waiting for Great Northern to pull out loads.
June 3rd		30	Trouble with pen conveyor pit becoming plugged.
June 4th	3		Tailings pipe plugged with pieces of wood.
June 26th	1	10	Sticky ore necessitated cleaning out chutes and conveyors.

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2. PRODUCTION,
SHIPMENTS &
INVENTORIES:
(Continued)

g. Delays:

<u>Date</u>	<u>Time Lost:</u>		<u>Cause:</u>
	<u>Hours</u>	<u>Minutes</u>	
July 1st	1		The 36" conveyor overloaded on account of wet sticky ore.
July 2nd	4		Classifier plugged, necessitating running mill on one side.
July 3rd	5		Classifier plugged, requiring running of mill on one side.
July 3rd	2		Waiting for Great Northern empties.
July 10th	1	50	30-yard car overturned in crude ore bin, due to broken control cable.
July 11th		30	Removing large rock from ore pocket.
July 12th	1		Waiting for D.M. & N. empties.
July 12th	3	45	Load track plugged, due to broken D.M. & N. car door.
July 19th	3		Running one side, due to broken wire cloth on vibrating screen.
July 26th	1	40	Load track plugged when car ran through derail.
July 26th		40	Dorr washer plugged on account of sticky ore.
August 5th	3	30	Waiting for ore. Cable broke on the No.35 shovel while the No.32 shovel was being moved.
August 6th		35	No power - electric storm.
August 9th	4		Waiting for Great Northern empties.
August 15th	4		Launder on log side plugged, necessitating running plant on one side for eight hours.
August 16th	1	30	Broken vibrating screen.
August 21st	1		Trouble with Symons crusher, plant ran on one side for five hours.
August 21st	1		Rock stuck in grizzly in crusher house.
August 28th	1	40	Waiting for Great Northern empties.
September 3rd	1	35	Broken grizzly bars.
September 4th	1		Repairing rock gun.
September 10,	2	30	Waiting for Great Northern cars.
September 16,	1	15	Repairing vibrating screen.
September 18,		55	Repairing grizzly.
September 18,	3	10	Waiting for Great Northern cars.
September 18,	4		Repairing vibrating screen, plant ran on one side for eight hours.
September 18th -		35	Repairing conveyor rollers.
Total delays	75	10	

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3. ANALYSIS:a. Mine Analysis of Production & Shipments:

	<u>Tons</u>	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alu.</u>	<u>Moist.</u>	<u>Iron</u>
								<u>Nat.</u>
✓ Snyder Non-Bess. Concts.	221,365	57.64	.082	9.75	.48	.60	8.27	52.87
× Snyder Bess. Concts.	105,563	58.98	.039	8.94	.29	.64	8.07	54.22
✓ Bovey Non-Bess. Concts.	144,912	57.84	.064	10.64	.30	.55	7.16	53.70
× Bovey Bess. Concts.	107,954	58.29	.043	10.52	.25	.58	7.25	54.06
✓ Hemmens Non-Bess. Concts.	5,883	57.21	.088	10.93	.28	.54	7.91	52.68
× Hemmens Bess. Concts.	19,418	56.76	.032	10.57	.26	.55	8.32	52.04
Total 1935,	605,095	58.00	.062	10.00	.36	.59	7.79	53.48

d. Average Analysis of Crude Ore Production:

	<u>Tons</u>	<u>Iron</u>	<u>Phos.</u>	<u>Silica</u>
Snyder Crude,	538,618	45.08	.065	29.18
Bovey Crude,	417,523	43.42	.053	32.36
Hemmens Crude,	59,228	37.46	.033	40.61
Total Crude Ore,	1,015,369	43.96	.058	31.16

e. Composite Analysis of Season's Shipments:

	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alu.</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sul.</u>	<u>Loss</u>
Snyder Non-Bess. Concts.	57.70	.084	9.82	.40	.52	.17	.13	.014	6.00
Snyder Bess. Concts.	58.90	.040	8.80	.35	.48	.18	.12	.012	5.70
Bovey Non-Bess. Concts.	57.80	.066	10.80	.25	.50	.14	.12	.011	5.20
Bovey Bess. Concts.	58.20	.042	10.50	.24	.56	.16	.12	.010	5.10
Hemmens Non-Bess. Concts.	57.10	.090	10.80	.24	.44	.14	.10	.012	6.45
Hemmens Bess. Concts.	56.80	.034	10.50	.24	.56	.20	.14	.016	6.86

4. ESTIMATE OF ORE RESERVES:a. Developed Ore:Factors Used:

	<u>Rock Deduction</u>	<u>Cu. Ft. Per Ton</u>	<u>% Recovery</u>
<u>N. Bovey:</u>			
Wash, -----	10%	14	65%
Low Grade Wash, -----	10%	15	65%
Rocky Wash, -----	20%	14	65%
<u>S. Bovey:</u>			
Wash, -----	10%	14	60%
Lean Wash, -----	10%	14	50%
Low Grade Wash, -----	10%	15	60%
Lean Low Grade Wash, -----	10%	15	50%

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4. ESTIMATE OF
ORE RESERVES:
(Continued)

a. Developed Ore; (Continued)

Factors Used:

	<u>Rock</u> <u>Deduction</u>	<u>Cu. Ft.</u> <u>Per Ton</u>	<u>%</u> <u>Recovery</u>
<u>Hemmens:</u>			
Wash, -----	10%	14	65%
Low Grade Wash, -----	10%	15	65%
Lean Low Grade Wash, -----	10%	15	50%
Rocky Wash, -----	20%	14	65%
<u>Snyder:</u>			
Wash, -----	10%	14	60%
Lean Wash, -----	10%	14	50%
Low Grade Wash, -----	10%	15	60%
Lean Low Grade Wash, -----	10%	15	50%
Rocky Wash, -----	20%	14	60%

The measurement of the volume of ore removed during the year 1935 did not change any of the factors used in the ore estimate of January 1st, 1935. A year ago, the new factors were determined and the estimate of January 1st, 1935 showed considerable variance with previous estimates. The estimate of January 1st, 1936 is the same as that for the previous year, deducting shipments mined from the several areas.

<u>Snyder:</u>		
SE ₁ -SE ₁ - Sec. 30, -----	2,548,929	tons.
SW ₁ -SE ₁ - Sec. 30, -----	857,161	"
SE ₁ -SW ₁ - Sec. 30, -----	250,955	"
Total, -----	3,657,045	
<u>Bovey:</u>		
NW ₁ -SE ₁ - Sec. 30, -----	357,227	"
NE ₁ -SE ₁ - Sec. 30, -----	172,686	"
NE ₁ -NE ₁ - Sec. 31, -----	731,915	"
Total, -----	1,261,828	"
<u>Hemmens:</u>		
SW ₁ -SE ₁ - Sec. 29, -----	1,158,774	"
Grand Total, -----	6,077,647	"

The structure drilling campaign for the year 1935 was not completed until late in December and the classification of the holes will not be completed in time to make any adjustments in our estimate of ore reserves at the Canisteco property. We are quite confident, however, that there will not be any substantial changes as the result of the 1935 drilling.

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4. ESTIMATE OF
ORE RESERVES:
(Continued)

c. Estimated Analyses:

	<u>Iron</u>	<u>Phos.</u>	<u>Silica</u>	<u>Moist.</u>	<u>Fe.Nat.</u>
Bessemer,	58.61	.037	10.05	8.00	53.92
Non-Bessemer,	57.49	.090	10.26	8.00	52.89

The Bessemer ore shows a Phosphorus content of .037 and on this basis, not over 40% of the product from the Canisteco Mine would be Bessemer. Considering all Bessemer ore as running .045 Phosphorus, approximately 50% of the total tonnage could be shipped as Bessemer, by working in some of the lower Phosphorus ore, which is set up above as Non-Bessemer, with the low Phosphorus-content Bessemer product.

5. LABOR & WAGES:

a. Comments:

(1) Labor:

Skilled labor was plentiful in the Canisteco district during the year 1935 and no trouble was experienced with our employees. Operations were conducted strictly in accordance with the proposed Mining Code. Labor Union activities practically were nil, with an increase in employment in the district.

b. Comparative Statement of Wages & Product:

Production, Concentrates,	605,095 tons.
Number of days operated:-	
3, 8-hour shifts per day.	87
Average Daily Product,	6,955
Average number of men working,	249
Average Wages per day,	4.69
Amount paid for Labor,	\$ 124,196.46

6. SURFACE:

a. Buildings, Repairs:

No repairs were necessary to the buildings at the Canisteco Mine during 1935.

The laboratory was moved from its location in the hollow west of the mill to a point just south of the washing plant fill track. A wooden floor was put in and water and drainage connections made.

As a precaution against dust, a separate crusher house was built along-side of the laboratory. This was of sheet steel construction, with a crushing and grinding room at one end and space for hand-washing samples at the other end.

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6. SURFACE:
(Continued)

c. Tracks, Roads, Transmission Lines, etc:

(1) Tracks:

A crew of sixteen men were engaged on April 15th in ditching, opening culverts and repairing wash-outs in the main lines. This force was doubled the last week in April, when the dump tracks were picked up and lined, the pit panels retied, and the third leg of a wye completed between the empty track and the Bovey lean ore spur in the yards. This afforded an opportunity to turn the cars and other equipment around and to lessen the wear on wheels, due to numerous curves, in one direction, which effects the wheel flanges on one side of the cars.

During the last week in April and the first week in May, two additional yard tracks were laid on the high line at the mill. These were graded and ballasted and afforded an opportunity to store crude ore cars. This saved a delay at the mill due to constantly shifting from one ore to another with the necessity of emptying the bin each time and it also bridged over numerous delays in the pit and transportation. With the extra cars from the Holmen, we had cars and track storage capacity for eight trains.

Upon completion of the ore season in September, the track gang was employed for ten days reconditioning all the main haulage lines. About 5,000 ties were replaced at this time.

Upon completion of the stripping season, the loading track panels were picked up and stored adjacent to the 1936 ore area. The dump tracks were also picked up and blocked to facilitate shifting in the spring.

(2) Transmission lines and Roads:

Aside from two new 2300-volt switch stations in the pit, there was only the usual maintenance on the roads and transmission lines.

(3) Fences:

In compliance with State regulations, a new steel woven wire fence was built around the Canisteeo pit.

7. OPEN PIT:

a. Stripping:

During the latter part of April and the fore part of May, it was necessary to finish the stripping and clean-up along the switch-back in the Hemmens pit bottom, and to remove some waste material along the Hemmens-Snyder boundaries, which was left over from the fall stripping program. A short clean-up cut was also made along the toe of the east bank of the Bovey. This work was completed on May 5th, moving 19,020 yards of paint-rock, sloughed surface and mud from the Hemmens; 18,690 yards of paint-rock from the Snyder and 4,260 yards of sloughed paint-rock and lean waste ore from the Bovey. In addition to the above, 780 yards of washed sand and gravel were removed from the approach tracks on the east side of the Bovey, by the gasoline shovel.

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7. OPEN PIT:
(Continued)

a. Stripping: (Continued)

The fall stripping operations were started October 1st. Three 8-hour shifts, five days per week, were worked during the first week, but the progress was so slow that the operation was stepped up to six days per week the second and third weeks. This improved the weekly output but entailed considerable Sunday work shifting dump tracks and laying new loading tracks in the pit. To offset this and to increase the daily production and lower the unit cost, it was decided to operate one shovel on the day shift and two on the afternoon and night shifts. This required the addition of but one train, and the larger power load was partially offset by shutting down the pumps on the night shift. In addition to boosting the daily yardage and lowering the stripping cost, the two shovel programs gave us a smoother and more flexible operation and decreased the delays and confusion in handling loading tracks. This operation was continued through the stripping season and furnished employment to most of the men who had been working during the ore season and allowed for the completion of the work before extremely cold weather set in.

The operation was started on the rock island along the middle and west Snyder forties. A track grade was cast around the west end of the pit to shorten the haul and a loading track provided through the irregular island area along the south stripping limits. The No. 35 shovel started here loading blocky taconite and some paint-rock. The cuts ran east and west and this lift was carried toward the north. After operating ten days with our production falling behind schedule, it was decided to place the second shovel in commission.

The No. 32 shovel was moved to the Bovey stripping area in the northwest corner of the Bovey bay. This was a small area of surface and lean cretaceous ore along the main approach tracks. The first cut was loaded on the approach track, dead-ending after six hundred foot progress. The second cut was made along the crest of the pit and followed the top of the ore, loading on the inside of the first cut. A third short cleanup cut completed the Bovey stripping. The No. 35 had completed the top lift and the first sinking cut of the second lift of the Snyder stripping before the No. 32 machine was moved to this area. Aside from the fact that the cost of moving in and off of the Bovey stripping was high for a small yardage, the work there presented no difficulties.

With the completion of the Bovey stripping, both the No. 32 and the No. 35 shovels were used on the Snyder stripping. The No. 35 operated on the second lift, and carried the stripping toward the south limits. The No. 32 machine operated on clean-up, working along the top of the ore at an elevation varying from three to nine feet below the second lift. This work was practically completed on December 18th, and the loading discontinued, it being impractical to clean up along the toe at this time, due to a four foot layer of soft mud. A cut was cast through the area for drainage and the balance of the material, about 4,000 yards, will be cleaned up in the spring.

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7. OPEN PIT:
(Continued)

a. Stripping: (Continued)

The following tabulation shows the classification of the material stripped during the year 1935:

<u>LEASE:</u>	<u>WASTE MATERIAL (CU. YDS.)</u>	<u>SURFACE (CU. YDS.)</u>	<u>TOTAL (CU. YDS.)</u>
Snyder, -----	392,105	-	392,105
Bovey, -----	77,468	780	78,248
Hemmens, -----	19,020	-	19,020
TOTAL, -----	488,593	780	489,373

Of this material, 42,750 yards was removed in April and May, and 446,623 yards in October, November and December.

A total of 17,117 - thirty-yard cars of waste material were taken from the pit, the average quantity per car being 28.59 cubic yards.

The estimated cost was \$0.27 and the actual cost realized was \$.282.

d. Timbering:

The following statement shows the number of ties used at the Canisteco Mine during the year 1935:

<u>Amount</u>	<u>Kind</u>	<u>Price</u>	<u>Cost</u>
178	Standard 8 x 8 - 8' - #1,	.60	\$ 106.80
1522	" "	.77 $\frac{1}{2}$	1,179.55
171	" "	.77 $\frac{1}{2}$	132.53
1223	" "	.77 $\frac{1}{2}$	947.83
631	" " - #2,	.43	271.33
402	" " - #1,	.77 $\frac{1}{2}$	311.55
400	" "	.77 $\frac{1}{2}$	310.00
2000	" "	.77 $\frac{1}{2}$	1,550.00
320	" "	.77 $\frac{1}{2}$	248.00
Total - 6,847 Tamarack Ties,		.7386	\$ 5,057.59

All ties charged to miscellaneous mine and dump tracks during operating season. No ties on hand as of January 1, 1936.

f. Explosives, Drilling & Blasting:

Statement of Explosives Used:

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7. OPEN PIT:
(Continued)

f. Explosives, Drilling & Blasting:

<u>KIND:</u>	<u>QUANTITY</u>	<u>PRICE</u>	<u>AMOUNT</u>
60% DuPont Special Gel. 1-1/8 x 8,	1200 Lb	12.50	150.00
60% R.C. Extra 1-1/8 x 8,	250 Lb	12.00	30.00
40% DuPont Special Gel. 1-1/8 x 8,	5750 Lb	11.00	632.50
25% Quarry Gel. 3 x 10,	145250 Lb	10.00	14,525.00
R.C. Blasting #4 Bags	26400 Lb	10.50	2,772.00
Gelex A	22000 Lb	12.50	2,750.00
8' E.B. Exploders,	1000	6.15 C	61.50
18' E.B. Exploders,	750	8.65	64.88
30' E.B. Exploders,	2500	11.65	291.25
40' E.B. Exploders,	600	15.40	92.40
No. 6 Blasting Caps,	2000	11.20 M	22.40
No.20 Connecting Wire,	150 Lb	.40 Lb	60.00
Duplex Lead Wire,	300 Ft	1.40 C'	4.20
GRAND TOTAL,			\$21,456.13

CHARGED TO DRILLING & BLASTING ORE OPERATIONS:

60% R.C. Extra 1-1/8 x 8	250 Lb	12.00	30.00
40% DuPont Special Gel. 1-1/8 x 8	5750 Lb	11.00	632.50
25% Quarry Gel. 3 x 10	105250 Lb	10.00	10,525.00
R.C. Blasting #4 Bags,	26400 Lb	10.50	2,772.00
18' E.B. Exploders,	250	8.65 C	21.63
30' E.B. "	1250	11.65	145.62
40' E.B. "	600	15.40	92.40
No. 6 Blasting Caps,	2000	11.20 M	22.40
No.20 Connecting Wire,	100 Lb	.40	40.00
Duplex Lead Wire,	300 Ft	1.40 C'	4.20
Total, - - - - -			\$14,285.75

CHARGED TO DRILLING AND BLASTING - STRIPPING OPERATIONS:

60% DuPont Special Gel. 1-1/8 x 8	300 Lb	12.50	37.50
25% Quarry Gel. 2 x 10	40000 Lb	10.00	4,000.00
Gelex A	22000 Lb	12.50	2,750.00
30' E.B. Exploders,	1250	11.65 C	145.63
No.20 Connecting Wire,	25 Lb	.40	10.00
Total, - - - - -			\$ 6,943.13

CHARGED TO STRUCTURAL DRILLING:

60% DuPont Special Gel. 1-1/8 x 8	900 Lb	12.50	112.50
8' E.B. Exploders,	1000	6.15 C	61.50
18' E.B. "	500	8.65	43.25
No.20 Connecting Wire,	25 Lb	.40	10.00
Total, - - - - -			\$ 227.25
GRAND TOTAL, - - - - -			\$21,456.13

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7. OPEN PIT:
(Continued)

g. Open Pit Mining & Loading:

With the start of the ore operation on the 8th of May, the No. 35 electric shovel was cut into the high bank on the east side of the Bovey, loading on a run-down track. This track had been laid for the first cut, and thereafter to be utilized as a short run-down for empties to save the long switch-back into the west end of the pit. The cuts ran north and south along this high bank and the operation was carried eastward to the limits along the approach. After two cuts had been made and as the tracks were shifting eastward, the layer of ore below the tracks was removed. After the ore in both layers of the Bovey was cleaned up, the shovel was moved to the Snyder-Hemmens bottom, where two working levels had been established to aid the grading.

The ore in the high bank consisted of a layer of ten to fifteen feet of a lean high Silica wash material. This was separated from the lower high grade wash by a seam of hard grey taconite, varying from one to two feet in thickness. This operation developed considerable pit rock. The lower layer of the high bank was a superior wash ore, giving a high recovery and a fair Silica. The ore lying below the run-down level was a good grade wash, with a high recovery. The Bovey ore ran about 40% Bessemer grade.

The No. 32 shovel was operated in the Snyder and Hemmens pit bottom. The ore in the east end of the Snyder and Hemmens was mined to an elevation of 540. Two sinking cuts were then made along the south side of this area, the cuts running east and west and extending down to an elevation of 520 feet. The cut along the south edge was a few feet below the 520 level to provide drainage. Drainage cuts from this level to the shaft were provided on week ends. The opening of the lower bench provided two working levels in the Snyder-Hemmens bottom, one at 520-foot elevation and one at 540-foot. The No. 32 shovel was alternated on the two levels as grading required, until the No. 35 machine was moved down from the Bovey. From this time on, one shovel was worked on each level, the cuts all running east and west and progressing northward. At the end of the season there remained only a small tonnage of ore in the upper level in the rocky area, from 3500' to 4000' west, while the ore at the lower elevation was about half worked out.

The ore mined in the Hemmens was all a very lean low grade wash, with a low recovery, but it was necessary to mine it in providing the proper grade into the Snyder.

Along the Snyder bottom the ore was mostly a lean wash, being in the upper lean area. The lower layers, from 540' to 520', however, were mostly a very high grade wash ore showing a good recovery, although it contained some heavy rock layers at the west end. The upper layer of Snyder was a good grade wash, with a good recovery at the east end. The west end consisted of heavy rock layers with a

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7. OPEN PIT:
(Continued)

g. Open Pit Mining & Loading: (Continued)

fair grade of wash ore. The banks in this area contained 20% to 30% grey rock, all of which was cast aside and loaded out on week-ends. The ore in the Snyder was mostly Bessemer to the east and all non-Bessemer in the west end. The Hemmens ore ran about 60% Bessemer grade.

In addition to the pit rock which was handled during the year, - 21,200 yards of paint-rock and lean waste ore were removed and charged to the operation. Of this, - 3,960 yards were removed in cleaning up small area on the Bovey. The remaining 17,340 yards was handled in connection with drainage cuts to the drainage shaft. Of this material, 9,680 yards was taken from the Snyder and 7,740 yards from the Hemmens.

With the stripping of the westerly part of the Snyder island, the ore operation in the Snyder pit should be improved.

k. Pit Drainage:

The drainage from the ore working areas to the shaft was not as good as anticipated and our problems again developed into one of caring for surface flowage. With each sinking cut in the ore area, a connecting drainage cut was made to the sump near the shaft. The sump had to be lowered with each cut. Upon the completion of the drainage cuts, one of the 2000-gallon centrifugal pumps from the old sump was placed on a raft in the sump adjacent to the shaft and connected into the discharge line from the Layne & Bowler pump. The latter could not be cut down to handle a small flow and required an intermittent operation with continual starting and stopping. This was overcome by using the 2000-gallon pump which could be regulated to take care of the ordinary drainage and the Layne & Bowler was just cut in at flood stages. In addition to a uniform pumping operation, this change made a saving in power costs.

8. COST OF OPERATION:

a. Comparative Mining Costs:

	<u>1 9 3 5</u>	<u>1 9 3 4</u>
<u>PRODUCT:</u>		
Concentrates, -----	605,095 tons	430,142 tons
Average Daily Production, (Concts.)	6,955 "	6,058 "
Tons Per Man Per Day, (Concentrates)	22.85	21.00
Days Operated, -----	87	70
<u>COST:</u>		
<u>Total Cost at Mine:</u>		
Open Pit Wash Ore, (Concentrates)-	\$.221	\$.225
General Pit Expense, -----	.077	.095
Concentrating, -----	.175	.181
General Mine Expense, -----	<u>.101</u>	<u>.113</u>
Cost of Production, -----	\$.574	\$.614

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8. COST OF
OPERATION:
(Continued)

a. Comparative Mining Costs:

<u>COST:</u>	<u>1 9 3 5</u>	<u>1 9 3 4</u>
<u>Total Cost at Mine: (Continued)</u>		
Depreciation, Plant & Equipment, -----	\$.250	\$.250
Depreciation, Movable Equipment, -----	.001	.001
Amortization, Stripping, -----	.315	.315
Taxes, Ad Valorem, -----	.132	.111
" Occupational, -----	.069	.040
" Royalty, -----	.027	.022
 Total Cost at Mine, -----	 \$ 1.368	 \$ 1.353
 Administrative & Miscellaneous Expense, -----	 .105	 .108
 GRAND TOTAL, -----	 \$ 1.473	 \$ 1.461

The final figures have not been furnished by the Cleveland office and there may be some small adjustments to the above tabulation, but they would only effect the costs very slightly.

d. Detailed Cost Comparison:

(1) Product:

The character of the ore mined and washed during the year 1935 was very similar to that encountered in the 1934 operations. A considerable quantity of rock was handled each year.

The total cost at the mine, including Administrative and Miscellaneous Expense, was \$.012 higher in 1935 than it was in 1934. Other than Taxes, - the 1935 results were more favorable, the increase in Ad Valorem tax valuations in 1935 explaining the small increase in the total.

(2) Open Pit Mining:

There was a decrease of \$.004 in the 1935 costs under this caption, the Drilling and Blasting showing \$.008 per ton under 1934; shovel maintenance \$.005 and track expense \$.009, but these items were very largely offset by an increase of \$.018 in Locomotives and Car maintenance. The 1935 operating expenses were very satisfactory. The extensive repairs in 1935 were due to the fact that three locomotives were thoroughly overhauled, more replacements were needed on the dump cars and a larger repair crew was carried during the ore season of 1935 than was the case during the previous year.

(3) General Pit Expense:

Under this heading, while the pumping and drainage expense was considerably more in 1935, it was absorbed by the larger tonnage and the cost per ton was the same.

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8. COST OF
OPERATION:
(Continued)

d. Detailed Cost Comparison:

(3) General Pit Expense: (Continued)

The water supply expense during 1935 was very nominal and this item shows a decrease of \$.001 for the year.

Under General Pit Expense there was an 1935 increase of \$.001 per ton. This was due to safety measures, which included the construction of better stairways leading into the pit and the providing of better pit lighting facilities.

Open Pit Superintendence was nominal each year.

The expense incident to the stocking of lean materials was very low in 1935 and the cost for this item for that year showed a decrease of \$.005. In 1934, a spur was run in to the Bovey property for the purpose of handling lean material that had to be stocked from this lease.

The Waste Pile Expense was nominal each year.

Practically no test-pitting was undertaken during the year 1935 and this item shows a decrease of \$.001 per ton, as compared with 1934.

While the structure drilling program for 1935 was carried forward, the total expense was approximately \$1,900.00 less than for the previous year and with the larger ore output realized in 1935, the effect was to show a decrease of \$.012 in this item.

(4) Concentrating:

All items under this caption showed a decrease, with the exception of Transportation to Mill and Maintenance of Machinery. The actual washing cost was less in 1935 by \$.011 per ton and is due largely to the increased tonnage handled per day at the mill. This also applies to the decrease in Power and General Expense. There was considerably less work necessary on the dam and spillway in 1935 and this item showed a decrease of \$.014 as compared with the previous year.

The 1935 increase of \$.002 in Transportation to Mill is explained by the fact that the average haul was considerably longer in 1935 and it was necessary to make a substantial expenditure on the crude ore storage yard tracks at the plant.

The substantial 1935 increase in the cost of Machinery Maintenance, amounting to \$.026 per ton, was the result of extensive repairs to the Dorr washer; the changing over from the Dorr to the Log washer on one side of the mill; the installation of a new grizzly and screens and the rebuilding of the receiving bin pocket. The 1936 charges to Machinery Maintenance should be substantially lower.

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8. COST OF
OPERATION:
(Continued)

d. Detailed Cost Comparison: (Continued)

(5) General Mine Expense:

Most of the items under this caption were nominal for each year, especially Insurance, Mechanical & Electrical Engineering, Special Expense, Ishpeming Office and District and Mine Offices.

Mining Engineering was lower in 1935 by \$.004 per ton, due to the larger tonnage handled and a less amount of engineering work being required.

Analysis and Grading showed an increase in 1935 of \$.005 per ton. This was the result of the rather extensive test work undertaken in securing data on the operation of the Log, as compared with the Dorr washer; also the analytical work done by Lerch Bros. in connection with our shipping.

The Geological Expense in 1935 showed an increase of \$.003 per ton. This was the result of rather extensive work undertaken in classification of drilling and the making of ore estimates.

The same rate per ton for Depreciation and Amortization were applied in 1934 and 1935.

Ad Valorem Taxes showed an increase of \$.021 per ton. This is explained by the fact that even though the output for 1935 was substantially increased, the placing of additional ore in the active class and the increase in total tonnage by the Tax Commission more than off-set such larger production. The higher State and County tax rates also affected the 1935 costs.

The increase in the Occupational and Royalty Taxes were the result of showing a more profitable operation in 1935.

9. EXPLORATIONS
AND FUTURE
EXPLORATIONS:

A rather extensive structural drilling program was again undertaken this year, with the intention of proving up the west side of the north Bovey forty, to outline the barren area in the west Snyder area, and to attempt to outline the deep ore deposits in the bottom of the north Bovey. The first drill was started about the middle of May and continued through until the end of the stripping season. The second drill, which was started late in June, finished up on the 22nd of August. In all, 64 holes, with a total footage of 4,067 feet, were completed. This was mostly in rocky and barren areas and in rocky wash ore with a high resultant cost of approximately \$3.15 per foot, including all charges.

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9. EXPLORATIONS
AND FUTURE
EXPLORATIONS:

In the drilling on the west bank of the Bovey, six holes, with a total depth of 665 feet, were completed. The results did not warrant the continuation of drilling in this area and it limited the mining area to about 600 feet at the north end. The drill was moved to the Snyder bottom, where eight holes, totaling 351 feet, were put down in connection with the 1935 ore operations. They were sample holes for grading purposes only. On completion of these holes, the drill was moved to the north Bovey bottom to definitely disprove the existence of a direct shipping ore deposit. A high grade wash ore was found in checking the Oliver Iron Mining Company Hole No. 484, which had shown a merchantable ore. On completion of this check hole, thirty additional holes, totaling 2,159 feet, were put down in attempting to outline the ore body. This deposit was found to be very irregular, with no direct connection with the other deep ore in the pit. The drilling was discontinued late in December, with a few holes left to be put down early in the spring of 1936.

The second drill was started late in June on the Snyder island. Six holes were put down, with a total of 545 feet. This drilling reduced the barren area at the west end of the island sufficiently to warrant stripping the entire island. A series of shallow holes were put down near the toe of the island, from 4200 west to 5000 west. Thirteen holes, varying from 12 to 35 feet in depth, were drilled, all but one in ore of good grade. This work was finished about the 20th of August.

There will be but a small amount of future drilling left in the Canisteeo pit for the production of up to 2,600,000 tons. Six or eight holes will be necessary to finish the work in the north Bovey bay. A few sample holes will be advisable in connection with ore grading, the cost being absorbed in the cost of ore.

10. TAXES:

The following statement shows the Canisteeo Mine taxes and average rates for the years 1934 and 1935:

	<u>1935</u>	<u>1934</u>	<u>Increase</u>	<u>Decrease</u>
Canisteeo Mine,	\$ 75,371.63	\$ 42,779.97	32,591.66	
Washing Plant Lands,	2,730.62	2,591.36	139.26	
Personal Property,	2,200.95	2,308.65	-	\$ 107.70
Total,	\$ 80,303.20	\$ 47,679.98	32,623.22	
Village Lots,	199.29	189.51	9.78	
GRAND TOTAL,	\$ 80,502.49	\$ 47,869.49	32,633.00	
Average Tax Rate,	.804	.764	.040	

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10. TAXES:
(Continued)

Tonnages effecting valuation:

As reported May 1, 1934, -----	3,745,522 tons.
Shipments, 1934, -----	<u>430,142 "</u>
Balance, -----	3,315,380 "
Added by Company engineers, -----	<u>1,115,448 "</u>
As reported May 1, 1935, -----	4,430,828 "
Added by Tax Commission engineers, -----	<u>1,000,000 "</u>
Tax Commission tonnage, May 1, 1935, ----	5,430,828 "

The Ad Valorem taxes of the Canisteo Mine were decidedly increased for 1935, over those for 1934, as the result of increasing the tonnage in the property, as well as transferring some inactive tonnage to an active basis. There will undoubtedly be some further increase in tonnage on the part of the Tax Commission's engineers, effective as of May 1, 1936. The additional tonnage, however, will be, for the most part, in the inactive class.

In addition to the larger tonnage used by the Tax Commission, the taxes at the Canisteo Mine were increased over 1934 as the result of larger levies for State and County purposes. The net rate increase was four mills, in spite of the fact that the Village of Coleraine rate was decreased 1.4 mills.

11. ACCIDENTS
AND
PERSONAL
INJURY:

There were five lost-time accidents at the Canisteo Mine during the year 1935, descriptions of which are as follows:

NAME: E. T. Eckland DATE: February 27th.
 CAUSE: Eckland was carrying two, five-gallon cans of water for the radiator of the gas shovel. While walking along the edge of the dyke, he slipped and fell backwards a distance of approximately ten feet, striking some frost chunks and landing on a log at the bottom of the dyke.
 NATURE: Fracture of right lower rib and contusion of right lower back.
 TIME LOST: 2 Weeks, 3-1/2 days.
 COMPENSATION: \$ 29.97.

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11. ACCIDENTS
AND
PERSONAL
INJURY:
(Continued)

NAME: Louis Jelcich **DATE:** May 12th.
CAUSE: The wrecker was engaged in clamming dirt from track, after several rainstorms and Jelcich was working on the ground, guiding the clamshell bucket. The bucket was being lowered, partly open, and Jelcich took hold of same to guide it into the line of the ditch and in so doing, placed his hand on the bucket hinge. When the bucket opened to its full extent, Jelcich's finger was caught in the hinge, cutting off the end of the little finger, left hand.
NATURE: Laceration of fifth digit, left hand. Distal phalanx removed.
TIME LOST: (No time lost)
COMPENSATION: \$ 104.55.

NAME: John Salo **DATE:** May 15th.
CAUSE: Salo was attempting to dislodge a piece of rock stuck in the McClure grizzly, with an iron bar, when another large chunk of rock dropped from the 8' pan conveyor onto the bar, pushing Salo's hand against the edge of a piece of 1/2" plate on the side of the grizzly.
NATURE: Severe lacerations of left hand and thumb. Extensor tendons all exposed.
TIME LOST: 5 Days.
COMPENSATION: None.

NAME: Frank Hill **DATE:** June 11th.
CAUSE: Hill was standing on the platform at the foot of the rock chute, barring down a large rock which jammed in the rock pocket. Another rock came through the pocket, struck the rock car and bounced off, hitting Hill on the left leg.
NATURE: Hematoma, lower left leg, with comminuted fracture of lower third fibula.
TIME LOST: 12 Weeks, 4 days.
COMPENSATION: \$187.72

NAME: Mike Hecomovich (#2) **DATE:** July 12th.
CAUSE: After drilling a hole for blasting, the crew found that on account of the drive sprocket being out of adjustment, the drill would not propel itself to the site of the next hole. Hecomovich was in the act of adjusting the sprocket. The drill was "dead" and the brakes were set, but the main sprocket operates on an eccentric and apparently was stopped at a point just ready to turn over. When Hecomovich loosened the set screw to make the adjustment, the driving sprocket moved and the injured man's hand was caught in between the drive chain and the sprocket.
NATURE: Very extensive crushing injury to entire right hand. Severe laceration and crushing of all fingers and partial traumatic amputation at the first joint.

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14. MAINTENANCE
AND REPAIRS:
(Continued)

Shop & Pit Equipment: (Continued)

The track shifter and the locomotive crane were given a light overhauling, no extensive repairs being necessary.

The two structural drills and the two blast hole drills were overhauled. The crawling mechanism built up; brasses and bushings renewed and driving sprockets repaired. The motors were cleaned, bushings replaced and bent and worn-out shafts replaced.

Washing Plant Repairs:

The west Dorr washer was taken out and replaced with a 25-foot Log washer, which was moved over from the Holman plant. The 4-foot rakes on the west classifier were taken out and replaced with an 8-foot rake from the Holman plant. All the necessary alterations of chutes and conveyors required by this change of equipment were carried out.

The east Dorr washer was given a very extensive overhauling, utilizing parts of the second machine. Both machines were badly worn and the cost of placing them in shape for service would have been extensive.

A new grizzly was built and installed. New pans were installed on the 8-foot pan conveyor and wearing plates were welded on the pans.

The conveyors, crushers and screens were checked over and given the necessary repairs and all worn chutes were replaced.

A well was developed near the tailings pond at the location of test No. 4. An 8 inch casing and a 250 G.P.M. well pump was installed for pumping additional water into the tailings pond. The pump was not started until the latter part of March, too late to build up a reserve for 1935. Steady pumping from the close of the 1935 operating season to the start of ore treatment in 1936, should result in a substantial volume of water.

Upon the completion of the 1935 ore season, the comparative test having shown a decided balance in favor of a log over a Dorr washer, the second 25-foot log and the 8-foot classifier rakes were taken from the Holman and installed in place of the east Dorr machine. In addition to this work, the screens, secondary crushers and conveyors were repaired after the ore season.

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14. MAINTENANCE
AND REPAIRS:
(Continued)

Electrical Equipment:

The small electrical force cleaned and overhauled the motors and generator sets at the plant and on the shovels. They also cleaned and overhauled all the drills, pump and shop motors and the locomotive generator sets. In addition to the above, all the electric cables were taken in and inspected and the bad spots repaired and vulcanized.

18. NATIONALITY
OF
EMPLOYEES:

<u>NATIONALITY:</u>	<u>NO. OF MEN</u>
American, -----	199
Jugo-Slav, -----	31
Finnish, -----	13
Italian, -----	9
Swedish, -----	8
Austrian, -----	6
Bulgarian, -----	6
Canadian, -----	5
Norwegian, -----	4
French Canadian, -----	4
Irish, -----	3
Danish, -----	1
English, -----	1
Montenegrin, -----	1
Macedonian, -----	1
Belgian, -----	1
German, -----	1
TOTAL, -----	294

19. WASHING PLANT
OPERATIONS:

A crew of eighteen men were employed from January 7th until May 3rd on the repairs and changes at the mill. These men were employed three days per week, with a daily force of eleven or twelve men. The repairs listed previously were all completed and the mill tested out the last week in April.

The washing plant was operated from May 8th until September 19th, on a basis of three 8-hour shifts, five days per week. The operation in general was quite satisfactory and no serious difficulties presented themselves.

A very thorough comparative test was run on the Dorr and log washers. The test extended over the entire season, with all grades of ore and under all conditions. The results were very decidedly in favor of the Log side from the standpoint of volume produced; grade secured; cost of operation; maintenance and repairs. While

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19. WASHING PLANT
OPERATIONS:
(Continued)

the Dorr turned out a good product, the Log product was nearly always a little better and the volume always greater. The work and repairs on the Dorr were extensive, while those on the Log were almost negligible.

The vibrating screens gave no trouble and turned out a good clean product.

The cone crushers were taxed to capacity at times, but no trouble was experienced aside from the ordinary cleaning.

With the change in the back slope of the pocket, the ore fed uniformly onto the 8-foot pan, which at all times carried a very good load.

The new grizzly operated in a satisfactory manner, but several weak spots developed, which will be ironed out the coming season.

A study is being made to determine whether or not the installation of picking belts would warrant the expense for there is decided room for improvement in rock removal in addition to what can be taken off the 5-foot pan conveyor. In addition to improving the grade, there would be a saving of ore which is lost in having to sweep the pan when a rocky wash is being handled. Picking belts would also eliminate small pieces of wood which give considerable trouble in the cone crushers, chutes and launders.

The water supply in the storage basin was not quite sufficient to run the entire season, with the result that it was necessary to pump 15,000,000 gallons from the Danube plant in August. With continued pumping from our well, a sufficient reserve should be built up for the 1936 season. The water level in the tailings pond rose from an elevation of 772.25' at the end of the ore season to 774.0', on December 31st, and should show an elevation of approximately 776' by the opening of navigation in 1936. The well pumping will be augmented by the spring run-off.

With a 600,000-ton program, the production was very much ahead of schedule by the end of August. So much so that we had a very intermittent operation in September, working only nine days to the 19th of the month. The daily output varied from 3,875 tons of concentrates secured from 7,345 tons of crude, to 9,675 tons of concentrates obtained from 14,799 tons of crude. The latter run on May 27th was our biggest day to date, in both crude and concentrates. The recovery on this date was rather low.

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19. WASHING PLANT
OPERATIONS:
(Continued)

The average daily production for the season was 6,955 tons of concentrates.

The amount and analyses of the plant rejects for 1935 were as follows:

<u>LEASE:</u>	<u>TONS</u>	<u>IRON</u>	<u>PHOS.</u>	<u>SILICA</u>
Snyder, -----	30,273	31.32	.094	49.40
Bovey, -----	25,599	29.93	.056	52.56
Hemmens, -----	1,371	31.92	.058	48.73
TOTAL, -----	57,243	30.71	.076	50.80

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

<u>LEASE:</u>	<u>TONS</u>	<u>IRON</u>
Snyder, -----	24,525	29.48
Bovey, -----	3,555	35.66
TOTAL, -----	28,080	30.26

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

<u>LEASE:</u>	<u>TONS</u>	<u>IRON</u>
Snyder, -----	12,015	31.79
Bovey, -----	10,260	30.90
Hemmens, -----	27,090	34.66
TOTAL, -----	49,365	33.18

The tonnage and iron unit recovery realized in the treatment of Canisteco ore during 1935, was as follows:

<u>LEASE:</u>	<u>TONNAGE</u>	<u>IRON UNIT</u>
Snyder, -----	60.70%	78.19%
Bovey, -----	60.56%	80.94%
Hemmens, -----	42.72%	64.15%
Average, -----	59.59%	78.63%

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19. WASHING PLANT
OPERATIONS:
(Continued)

The analyses of the product from the several machines for the year 1935 was:

SNYDER MILL MACHINES:

	<u>IRON</u>	<u>PHOS.</u>	<u>SILICA</u>
Log Washer, -----	57.93	.067	9.32
Dorr Washer Oversize, -----	57.30	.070	10.29
Dorr Washer Rakes, -----	57.52	.060	10.53
Log Classifiers, -----	55.32	.054	14.30
Log Tailings, -----	23.59		
Dorr Washer Tailings, -----	23.55		

BOVEY MILL MACHINES:

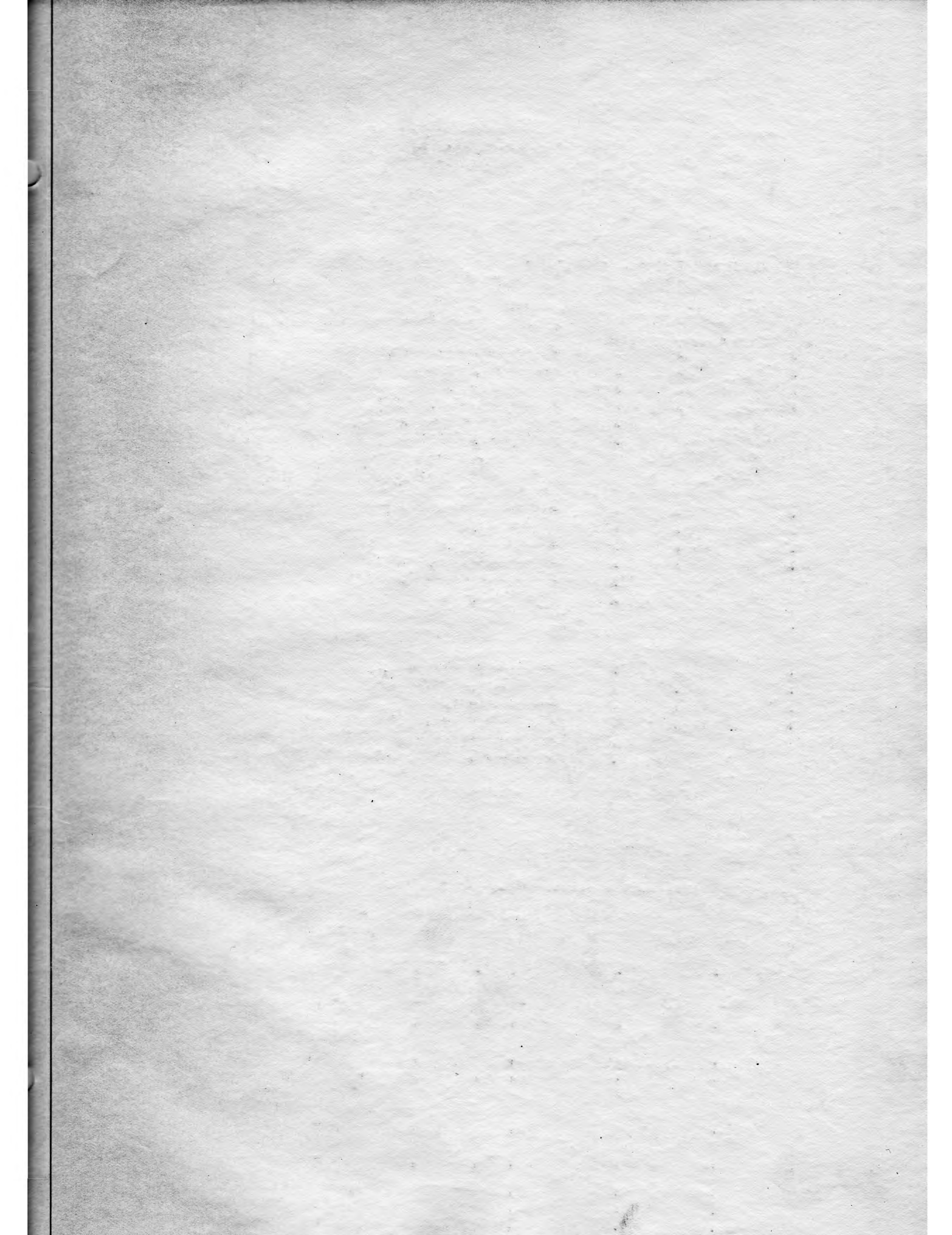
Log Washer, -----	57.95	.059	10.48
Dorr Washer Oversize, -----	57.03	.057	11.53
Dorr Washer Rakes, -----	57.94	.052	11.17
Log Classifiers, -----	55.99	.045	14.43
Log Tailings, -----	20.61		
Dorr Washer Tailings, -----	21.02		

HEMMENS MILL MACHINES:

Log Washer, -----	57.50	.045	9.22
Dorr Washer Oversize, -----	56.39	.040	11.00
Dorr Washer Rakes, -----	55.67	.040	12.18
Log Classifiers, -----	52.10	.040	17.58
Log Tailings, -----	21.28		
Dorr Washer Tailings, -----	20.06		

A recap of the data of mill operations follows:

	<u>CU. YDS.</u>	<u>TONS</u>	<u>PERCENT- AGE OF TOTAL MINED</u>	<u>ANALYSIS IRON DRIED</u>	<u>CONCENTRATE RECOVERIES MADE FROM</u>	<u>% IRON</u>
Material re- moved in min- ing operations, (exclusive of surface)	621,311	1,150,057	100.00	42.16		
Less lean ore stocked, -	-	-	-	-		
	621,311	1,150,057	100.00	42.16		
Less pit rock wasted, -	51,630	77,445	8.31	32.12		
Total to mill,	569,681	1,072,612	91.69	43.07		
Less Mill re- jects (Crusher house) -	38,162	57,243	6.14	30.71		
Total crude to Washers-	531,519	1,015,369	85.55	43.96	59.59%	78.63%
Concentrates,		605,095	52.61	58.00		
Tailings, (by deduction)		410,274	35.67	23.25		
Total Rock and Lean Ore, (from above)		134,688	14.45	31.52		



HOLMAN-CLIFFS MINE
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1. GENERAL:

From the first of January to the middle of March, there were three full-time and two half-time watchmen employed in policing the mine property and washing plant premises. During the period March 16th to the end of the year, four full-time watchmen were engaged in patrol work. No irregularities of moment were reported by the watchmen during the year.

A crew of seven men from the Canisteco Mine were engaged in erecting a guard fence around the open pit from January 7th to the 24th. It was necessary to do some bracing work during the summer, as the steel posts could not be effectively tamped during the severe weather when they were installed. This same Canisteco crew spent a week in February in salvaging the electric power line leading down into the Holman pit. The poles carrying the current had become submerged and the copper wire and insulators were removed while there was sufficient ice to make the work safe.

The contracting firm of A. Guthrie & Company, who stripped the taconite island from the Holman pit and the North Star surface stripping, repaired and removed their 30-yard dump cars from the shop yards. This work was done during the month of May. The A. Guthrie Company now have stored at the Holman-Cliffs property four locomotives and one 3-yard revolving steam shovel.

A crew of eight men from the Canisteco washing plant started to dismantle and remove the log washer; the Dorr bowl rakes and the hydrotator tank from the Holman mill on October 10th. This equipment was transferred to the Canisteco washing plant where it will be installed to replace the second Dorr washer. The work at the Holman mill was completed by the end of October.

The water level in the Holman pit is now several feet above the flood stage, which it had attained, when we started pumping out this property in 1929. We assumed that the high water stage had been reached in July, 1935, but due to an excessive rainfall during the fall months, the water has risen 3-1/2 feet. We do not anticipate that the water will rise from the present stage; in fact, if the normal precipitation prevails during 1936, there should be some recession, due to evaporation and seepage.

4. ESTIMATE OF
ORE RESERVES:

a. Developed Ore:

Assumption: 16 Cubic feet per ton for Wash Ore.

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

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4. ESTIMATE OF ORE RESERVES:
(Continued)

a. Developed Ore: (Continued)

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

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

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

b. Prospective Ore:

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

6. SURFACE:

a. Buildings, Repairs:

House repairs in Taconite were undertaken by a crew of four carpenters. These men were engaged on this work from June 11th to the early part of August. The crew also spent several days in September cleaning up some repair odds and ends.

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6. SURFACE:
(Continued)

a. Buildings, Repairs: (Continued)

A force of four painters were engaged from June 20th to the end of August on exterior work of such houses as needed this repair most.

A number of the houses had been painted during the summer of 1934 and it is the intention to paint such dwellings as have not been removed or painted by us to date, during 1936.

The following tabulation shows the house occupants in the Village of Taconite and also the nature and amount expended in repairs for each dwelling:

<u>Ho.No.</u>	<u>Name of Occupant:</u>	<u>Repair work done:</u>	<u>Amount Expended</u>
11	Peter Baril,	Rep. windows, roof and plumbing,	14.82
12	Malkolm Olson,	" foundation, siding, steps, roof, ext. painting and toilet,	166.54
13	Mrs. Geo, Trombly,	" roof, windows, toilet and cellar entrance,	7.12
14	George Dunstan,	" roof,	1.69
15	Thos. Wivell,	" steps, roof, chimney, windows and furnace,	17.22
16	Hughbert Leitch,	" toilet,	1.26
17	Allen Shegrud,	" foundation, siding, porch, steps and exterior painting; also roof, windows, plaster and roof of shed,	279.54
37	William Wirtanen,	" windows and ext. painting,	55.16
38	Ernest Lueck,	" toilet, new roof & windows,	194.32
39	J. W. Griffith,	" foundation, siding, plaster int. & ext. painting, plumbing and electric wiring, New roof,	523.82 198.76
40	T. J. O'Brien,		
41	Mrs. A. L. Sundquist,	Rep. siding, windows, ext. painting and roof,	94.44
42	Mike Shipka,	" windows, roof and furnace air duct.	8.84
43	Lee Poore,	" siding, windows, ext. painting, roof and electric wiring repairs,	88.42
44	B. P. Axferd,	Painting, outside trim,	1.70
45	Edwin Gustason,	Rep. roof and windows,	11.48
46	Russell Wivell,	Painting, outside trim,	1.70
47	Emil Cemilli,	Ext. painting, roof and window repairs and toilet,	59.85
48	William Hanson,	Rep. foundation, porch, rear shed, windows, siding, plaster roof and exterior painting,	434.46
50	Dan McKinnon,	Exterior painting,	69.90
51	Oscar Engstrom,	Rep. chimney; painting outside trim and plastering,	15.62

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6. SURFACE:

(Continued)

a. Buildings, Repairs: (Continued)

<u>Ho.No.</u>	<u>Name of Occupant:</u>	<u>Repair work done:</u>	<u>Amount Expended</u>
53	Claude Winkleblack,	Rep. windows,	16.50
55	Mrs. Hugh McNulty,	" roof, window and toilet,	5.53
56	Grant Hess,	" windows, roof; ext. painting (second coat)	61.40
57	August Mergle,	" roof, windows & toilet,	4.90
58	Russell Barkla,	" roof and windows,	2.26
59	George Beasley,	New roof; rep. siding, doors, windows and ext. painting,	154.69
60	W. F. LeClair,	Rep. roof, windows and doors,	5.02
61	John Laine,	" doors and toilet; ext. painting, rep. roof, windows and elec. wiring,	47.67
62	Joseph Dolezel,	Rep. roof and windows; paint outside trim,	4.52
63	Pearl Nelson,	" roof, windows, plaster, toilet and boarding up,	79.35
64	Vincent Soleture,	" plumbing and toilet,	3.80
65	Edwin Johnson,	" roof, windows, toilet and shed door,	8.79
67	Pat Maney,	" windows, ext. painting - (second coat)	52.58
68	George Lee,	" windows, ext. painting - (second coat) rep. toilet,	49.58
69	Arnold Lawson,	New roof, repr. siding, windows, and exterior painting,	171.74
70	Ambrose Hoey,	Rep. roof, windows, steps, plaster;	41.65
72	Martin Fleisher,	Rep. roof and windows,	2.82
73	Roy Elliott,	" toilet and porch,	6.22
74	Clarence Martin,	Boarding up windows,	9.88
77	(Vacant)	Rep. roof, windows and boarding up,	8.67
78	James McNeven,	Rep. roof and windows,	2.82
79	John Winkleblack,	" siding, windows, ext. painting,	78.61
80	H. J. Stephens,	" roof, windows and toilet,	5.37
81	Lloyd Wetherell,	New rear shed; painting shed - reprs. windows; roof,	104.98
97	William Saw,	Rep. roof, windows and painting outside trim,	6.67
98	Dan Fitzhenry,	Rep. roof and windows,	4.71
101	Loy Kolar,	" roof, windows, plaster and painting outside trim,	13.12
71	Chas. James,	" roof, windows and front steps	11.98
102	Myron Youngberg,	" roof, windows and chimney,	3.54
105	Dan Chamberlain,	" roof and toilet,	4.83
106	William Ryser,	" roof, doors, windows; toilet	21.96

HOLMAN-CLIFFS MINE
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6. SURFACE:
(Continued)

a. Buildings, Repairs: (Continued)

<u>Ho.No.</u>	<u>Name of Occupant:</u>	<u>Repair work done:</u>	<u>Amount Expended</u>
107	Albert Embury,	Rep. roof and windows,	6.15
116	Carl Eggebraaten,	New toilet; rep.plastering, shelves,windows,wiring; paint interior two rooms,	107.28
155	George Sullivan,	Front door lock,	1.95
156	Lee Farr,	New roof,	114.21
157	J. W. Mattson,	Rep.roof,plaster,interior painting,	72.68
5	Harry Hart,	" roof,floors,windows, plumbing and toilet,	70.70
7	Sam Kirkes,	" floors,doors,windows, plumbing and toilet,	75.34
TOTAL, -----			\$ 3,691.13

The rent collected during the years 1934 and 1935 amounted to \$10,814.07, divided - \$5,415.57 in 1934 and \$5,398.50 in 1935.

The following tabulation shows the expense of repairs, taxes, insurance and miscellaneous during the years 1934 and 1935:

Revenue:

1934 Rent collections,	\$5,415.57
1935 " "	<u>5,398.50</u>

Total rent received 1934 and 1935, \$10,814.07

Expense:

1934:

Repairs to buildings,	\$4,733.17
1933 Taxes paid in 1934,	1,393.64
Insurance,	<u>288.37</u> \$ 6,415.18

1935:

Repairs to buildings,	3,691.13
1934 Taxes paid in 1935,	767.55
Insurance (estimated),	<u>272.66</u> \$ 4,731.34 11,146.52

Revenue in excess of Expense, 1935, \$ 667.16

HOLMAN-CLIFFS MINE
ANNUAL REPORT
YEAR 1935

6. SURFACE:

(Continued)

a. Buildings, Repairs: (Continued)

The estimate of repairs for the year 1935 and the amount expended follows:

	<u>ESTIMATE</u>	<u>EXPENDED</u>	<u>UNEXPENDED BALANCE</u>
Carpentry work,	\$ 1,743.84	2,103.13	359.29
Masonry "	97.60	269.97	172.37
Painting "	1,057.00	1,270.76	213.76
Plumbing and electric repairs,	-	47.27	47.27
Total,	\$ 2,898.44	\$ 3,691.13	792.69

In explanation of the over-expenditure for repairs to the Taconite houses in 1935, a certain number of these dwellings were listed for general repairs and painting; - it was found that the carpenter, masonry and plumbing jobs were more extensive than had been anticipated and the painting was also higher, as the carpenter work included some siding and the necessity of painting two houses that we had not included in the estimate.

The following is a list of the houses in Taconite sold and removed by the Oliver Iron Mining Company during the year 1935:

<u>House No.</u>	<u>Date Sold:</u>
18	May 6th.
49	May 7th.
76	June 25th.
100	June 4th.
113	June 15th.

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 1934 and 1935:

HOLMAN-CLIFFS MINE
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YEAR 1935

10. TAXES:
(Continued)

Statement of Taxes:

	<u>1935</u>	<u>1934</u>	<u>Increase</u>	<u>Decrease</u>
Holman-Brown Mine,	\$ 37,177.48	34,567.98	\$ 2,609.50	
Bingham Mine,	14,594.53	13,570.12	1,024.41	
North Star Mine,	7,785.02	7,238.59	546.43	
Holman-Cliffs Aux.Lands,	2,904.98	2,625.97	279.01	
Bingham-North Star Washing Plant Lands,	46.98	42.47	4.51	
Holman-Brown Lands,	21.90	19.80	2.10	
Holman-Cliffs Shops,	140.55	131.95	8.60	
Holman-Cliffs Personal Property,	<u>1,960.29</u>	<u>2,061.77</u>	-	<u>101.48</u>
TOTAL, -----	\$ 64,631.73	60,258.65	4,373.08	
Rented Buildings,	<u>769.51</u>	<u>767.55</u>	<u>1.96</u>	
GRAND TOTAL, -----	\$ 65,401.24	61,026.20	4,375.04	
Average Tax Rate,	.808	.751	.057	

The increases in the 1935 Ad Valorem taxes at the Holman-Cliffs Mine are largely due to the larger levies made for State and County purposes. The Township of Iron Range rate was slightly higher, - the Village of Taconite being approximately the same as for the previous year.

The decrease in the Personal Property is explained by the fact that we took a depreciation on our equipment and deducted material sold.

HILL-TRUMBULL MINE
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1. GENERAL:

The four watchmen employed on a full-time basis throughout the year 1935, did not report any unusual occurrences in their patrolling of the Hill-Trumbull Mine premises and washing plant. Several small brush fires, which had been started by children, were extinguished without any difficulty by the watchmen.

General conditions at the mine remained practically as they were at the beginning of the year. The bottom of the Trumbull pit is covered with approximately 18" of water and the lowest bench in the Hill pit is flooded. The pumping out of the water in both of the pits could be accomplished within less than two weeks time and the conditioning of the tracks in the pits undertaken.

An inspection of the Hill-Trumbull tracks shows that a complete replacement of ties will be necessary before operations are resumed. Due to the wash from surface waters, there are several spots along the shoulder of the approach track where some filling will have to be done.

The sweet clover growth in the washing plant tailings basin was entirely adequate to afford protection against dust storms and it was not necessary to do any pumping or flooding of the basin. Thus far, the sweet clover growth has re-established itself very satisfactorily from year to year and we do not anticipate any trouble from the dust, until such time as we resume operations and tailings are run into the basins and the sweet clover growth is destroyed. We will be able to utilize one of the smaller basins and not place any tailings in the large basin during the first year that the mine is operated.

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 1935 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, -----	<u>389,323 "</u>
 TOTAL HILL ORE, -----	 2,445,198 "

HILL-TRUMBULL MINE
ANNUAL REPORT
YEAR 1935

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, -----	<u>645,992 "</u>
 TOTAL TRUMBULL ORE, -----	 3,187,091 "
 GRAND TOTAL HILL AND TRUMBULL ORE, -----	 5,632,289 "

The ore estimate of January 1st, 1936 is the same as that reported a year ago, as no drilling or test-pitting was done during 1935 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:

<u>Hill Mine:</u>	<u>Tons</u>	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Fe.Nat.</u>
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,	<u>389,323</u>	<u>60.00</u>	<u>.059</u>	<u>7.50</u>	<u>55.50</u>
 TOTAL HILL ORE, -----	 2,445,198	 58.57	 .052	 11.38	 54.87
 <u>Trumbull Mine:</u>					
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,	<u>645,992</u>	<u>59.00</u>	<u>.080</u>	<u>9.00</u>	<u>54.57</u>
 TOTAL TRUMBULL ORE, -----	 3,187,091	 58.88	 .054	 9.14	 54.38
 GRAND TOTAL HILL-TRUMBULL,	 5,632,289	 58.74	 .053	 10.11	 54.59

HILL-TRUMBULL MINE
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6. SURFACE:

a. Buildings, Repairs:

A carpenter crew of four men started repair work on the Hill-Trumbull location houses early in August, and completed the following work by the 20th of September:

New composition shingles were put on the roofs of the washing plant; watchman's house and on Houses Nos. 7 and 8.

The foundation of House No. 5 was repaired and the exterior of House No. 1 was painted.

The work of repairing and painting the washing plant was started August 2nd and completed September 25th. A carpenter crew removed the sheeting that rusted through and replaced it with new material. New roofing was placed on the North and South wings of the washing plant and some repairs were made on the roof of the main building.

The painting of the exterior of the washing plant was contracted. This job was rather hazardous and the contractor had special equipment for work of that nature. One coat of "Resinex", as a vehicle with aluminum powdered pigment, was applied. This paint job was entirely satisfactory. The work was completed September 7th.

The interior painting of the washing plant buildings was undertaken by our paint crew during the latter part of September. The same material was used here as for the exterior of the buildings.

c. Tracks, Roads, Transmission Lines, etc:

The placing of a guard fence around the Hill-Trumbull pits was started February 4th and completed on February 14th. A crew of eight men were engaged on this work. It was necessary to do some bracing and tightening of posts during the summer, as they could not be set to advantage during the cold weather.

An old box culvert, extending under our yard tracks and constructed about 25 years ago by the Oliver Iron Mining Company, was found to be completely rotted away and a replacement was necessary. The old culvert was 267 feet long and was constructed of 12" x 12" timbers. It was decided to install a 36" corrugated steel pipe, as being a cheaper method than making the necessary excavation for a new timber culvert. The pipe was drawn into the old box, adding sections to the outer end as the work progressed. This job was undertaken jointly by the Oliver Iron Mining Company and The Mesaba-Cliffs Mining Company, the expense being shared equally. The work was started August 27th and completed September 6th.

The 20" water supply pipe line, from the pump-house to the washing plant, was tested for leaks, during September. A small gasoline pump was used to fill the surge tank and the water was then let into the pipe, after blocking the exhaust end, and it was subjected to pressure. A great many small leaks were disclosed due to pit rusting, but these can be caulked and most of the line will be suitable for service for

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6. SURFACE:
(Continued)

c. Tracks, Roads, Transmission Lines, etc:

at least a season or two. It will be necessary to replace 200 feet of the pipe before operations are resumed.

9. EXPLORATIONS
AND
FUTURE
EXPLORATIONS:

No exploratory work was undertaken during the year 1935 and unless it is decided to secure some wash ore from the Hill-Trumbull Mine during 1936, no drilling is contemplated. Before mining any wash ore from this property, some structure drilling will be necessary in the bottom of the Trumbull pit. This work should be done during the spring months and it would be advisable to augment it by further drilling in the fall to determine the grade of ore for the following year's production.

10. TAXES:

The following statement shows the taxes and average rate at the Hill-Trumbull Mine for the years 1934 and 1935:

Statement of Taxes:

	1935	1934	Increase	<u>Decrease</u>
Hill Mine,	\$37,547.01	36,417.99	1,429.02	
Trumbull Mine,	47,300.84	45,514.88	1,785.96	
Hill-Trumbull Shops,	998.02	960.33	37.69	
Hill-Trumbull W.P.Lands,	3,387.64	3,118.80	268.84	
Personal Property,	1,688.47	1,797.78		109.31
TOTAL, -----	\$ 91,221.98	87,809.78	3,412.20	
Village Lots,	540.86	520.41	20.45	
GRAND TOTAL, -----	\$ 91,762.84	88,330.19	3,432.65	
Average Rate,	.805	.773	.032	

The increase in Ad Valorem taxes at the Hill-Trumbull Mine is largely due to the higher levies made for State and County purposes. There was a slight increase in the Village of Calumet levy, affecting the Hill-Trumbull washing plant, - and in the Township of Greenway. The only levy with which we have a deciding voice is the Village of Marble and this levy was decreased and the tax rate lowered.

Safety Department

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11. ACCIDENTS
AND
PERSONAL
INJURY.

a. Fatal Accidents.

Two fatal accidents occurred at the Cliffs Shaft mine. The other mines had perfect records in this respect.

Description of Fatal Accidents.

Fatal Accident No. 1.

John E. Oja, a miner, was instantly killed at the Cliffs Shaft mine on April 15th, 1935, by falling down a stope, a distance of 50 feet.

Oja and his partner, Sam Roberts, were mining a 4th level floor west of "B" shaft. On the day of the accident they first barred down some loose ore that they found in their stope. This kept them occupied until 10 o'clock and they then started to remove the broken ore that rested on a bench near the edge of their stope, which extended up from a lower level. The bench was 6 feet long and 2 to 4 feet wide. About 11 o'clock they encountered a slab of ore that weighed at least 1,000 pounds, which was about 30 inches from the edge of the stope. They had moved it 10 or 12 inches when Oja asked Roberts to give him the bar. Roberts stepped back to be out of Oja's way. The latter placed the chisel point of the bar under the chunk and started to pry it forward into the stope. While thus engaged the point of the bar broke, causing him to lose his balance and plunging him into the stope.

On the previous shift, as the two miners removed broken ore from the edge of the stope, they took the precautions that were necessary to guard against the hazard of falling in the stope. It was done by placing a long ladder across the edge of the stope and by tying a rope around their waists. Roberts testified that they thought that the bench had been made a safe place to work and that they were no longer in danger of falling.

Oja had worked 21 years at the Cliffs Shaft and Republic mines and was skilled in the methods of mining hard ore. He was American born, age 42 years, and is survived by a widow and four sons. The verdict of the Coroner's inquest was "accidental death and no blame attached to anyone."

Safety Department

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11. ACCIDENTS
AND
PERSONAL
INJURY.a. Fatal Accidents. (Continued.)

Fatal Accident No. 2.

Gabriel Saari, a miner, received injuries at the Cliffs Shaft mine at 3:30 P.M. July 10, 1935, which resulted in death the following day.

This accident occurred in a stope on a sub-level 75 feet above the 6th level, near the incline shaft at the east end of the mine. This was Saari's third shift in this particular place, as he was sent there to help Frank Sillanpaa bar down and make the place safe. On the previous shift Saari and Sillanpaa drilled several short holes on the hanging side of the stope in order to get down some loose ground. The day of the accident they drilled an 8 foot hole on the pillar side of the stope, which was blasted at noon. After lunch the miners barred the ground loosened by the blast and about 3 o'clock they were visited by the shift boss, Stanley Kelly. The miners told him that they had encountered a piece that they were unable to bar down and that they thought it should be blasted. This piece of ore was 9 feet above the floor and it was decided that it should be blasted down. They placed a 10 foot ladder against the pillar and Saari went up the ladder with a pick to make a place for the powder. He had finished doing this and was descending the ladder with the pick in his hand, when the slab fell striking him and breaking the ladder about 18 inches from the bottom.

The piece of ground that fell was between 6 and 8 feet long and nearly 3 feet wide at one end and tapered to a point at the opposite end. It must have weighed in the neighborhood of a ton. It actually fell in three pieces, one of the smaller pieces striking the ladder. Saari's partner and two trammers were present and witnessed the accident. The shift boss had left the place about five minutes before it occurred.

Saari had worked many years at the Cliffs Shaft mine and was numbered among the most skillful men employed there. His partner had had 26 years experience at the same mine. Both were careful men. It was evident that they had misjudged the size and extent of the loose piece, which had sounded drummy only at its lower end.

Saari was a Finn, age 52 years, and is survived by a widow and four sons. A Coroner's inquest was not held.

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11. ACCIDENTS
AND
PERSONAL
INJURY.

b. Non-Fatal Accidents.

The mines and plants reported 40 lost-time accidents other than the two fatalities. Herewith is a brief review of these accidents:

<u>Mine</u>	<u>No. of Accidents</u>	<u>Description.</u>
Athens	3	<ol style="list-style-type: none"> 1. Setting up steel scraper slide, which fell a few inches and struck man. Bruised back. Time lost 23 days. 2. Lifting gin pole in raise and ground fell from back. fractured vertebrae- Time lost 132 days.* 3. Repairing cribbing in raise and ore fell from back. Fractured bone in foot. Time lost 48 days. *
Canisteo	5	<ol style="list-style-type: none"> 1. Slipped and fell backwards. Fractured rib. Time lost 18 days. 2. Guiding wrecker bucket with hand. Got finger caught in hinge. Loss of distal phalange. Time lost 45 days. 3. Dislodging rock in grizzly with bar and chunk of rock struck hand. Lacerated hand. Time lost 6 days. 4. Barring rock which was jammed in pocket. Rock bounded and struck his leg. Fractured fibula. Time lost 76 days. 5. Adjusting sprocket of drill machine. Got hand caught between drive chain and sprocket. Crushing injury to right hand necessitated amputation forefinger at first joint. Time lost 19 days. Paid 217 compensable days.
Cliffs Shaft	5	<ol style="list-style-type: none"> 1. Lowering top tram car. Place slippery due to sleet storm. Blocking slipped and lever struck man's jaw. Severe contusion. Time lost 16 days. 2. Placing ladder against wall of stope, preparatory to barring loose. A small piece of ore fell, glanced off ladder and struck man's back. Contusion. Time lost 69 days. 3. Loading rock at slide. Chunk bounded and struck man's arm. Fractured ulna. Time lost 88 days.

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b. Non-Fatal Accidents. (Continued)

<u>Mine</u>	<u>No. of Accidents</u>	<u>Description.</u>
Cliffs Shaft (Continued)		4. Man threw short piece of lumber over side of railroad car while loading ore at stockpile. It struck another workman on head. Concussion. Time lost 8 days. 5. Locomotive brakeman failed to throw switch. Locomotive went off track and caught his foot. Fractured metatarsal bones. Time lost 60 days.
Gardner-Mackinaw	2	1. Fall of ground in stope caught miner. Fractured tibia and fibula. Time lost 161 days. 2. Fall of ground in stope caught miner. Compound fracture of right fibula. Time lost 148 days.
Lloyd	6	1. Holding trolley pole while it was moving and electric spark flashed against his eyes. Traumatic conjunctivitis. Time lost 9 days. 2. Taking chain off gin pole at head of drift and chunk of ore rolled out and fell on his ankle. Contusion. Time lost 63 days. 3. Climbing down raise and ladder loosened, causing him to fall. Contusions. Time lost 120 days.* 4. Loading at chute and ore fell on his finger. Fractured finger. Time lost 45 days. 5. Locomotive brakeman failed to throw switch and a man was struck by train. Fractured leg. Time lost 312 days.* 6. Sending cribbing up a raise and got foot caught in slack rope coil. Lacerations. Time lost 60 days.*
Maas	12	1. Picking ground and chunk glanced off pick. Eye laceration. Time lost 15 days.

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b. Non-Fatal Accidents. (Continued)

<u>Mine</u>	<u>No. of Accidents.</u>	<u>Description.</u>
Maas (Continued)		2. Scraping ore and leg of timber fell, striking man's foot. Contusion. Time lost 9 days.
		3. Hoisting timber in raise and it jammed. Got finger caught between rope and timber. Lost tip of right first finger. Time lost 105 days.
		4. Hoisting plank in raise. Plank jammed and man got finger caught between platform and plank. Fractured finger. Time lost 41 days.
		5. Trimming back in raise and chunk fell on his foot. Bruised foot. Time lost 71 days.
		6. Driving spike with axe and struck his finger. Fractured finger. Time lost 30 days.
		7. Going to work over short cut across old stocking grounds. Tripped over bent bolt in trail. Bruised knee. Time lost 37 days.
		8. Trestle lights went out. Man walked into ore pocket. Dislocated shoulder. Time lost 37 days.
		9. Hoisting timber in raise; jasper fell from side of raise and struck man's hand. Laceration. Time lost 48 days.*
		10. Pulling door out of pocket with locomotive. Runner stepped off motor, straddling rope. Door dropped and rope lifted man off his feet. Thigh burns due to rope friction. Time lost 22 days.
		11. Lifting timber and pinched his finger.. Laceration. Time lost 8 days.
		12. Hauling timber with puffer hoist. Stood too close to moving timber which swung and caught his leg. Fractured fibula. Time lost 60 days.*

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INJURY.b. Non-Fatal Accidents. (Continued)

<u>Mine</u>	<u>No. of Accidents</u>	<u>Description.</u>
Negaunee	2	<ol style="list-style-type: none"> 1. Cutting pole and chunk fell from head of drift and struck his leg. Torn thigh muscle. Time lost 6 days. 2. Placed air line conditioner on platform in drift. Train pushed it against his legs. Fracture of two legs. Time lost 312 days.*
Tilden	1	<ol style="list-style-type: none"> 1. Struck knot in plank with axe, causing axe to glance off, striking his toe. Laceration. Time lost 3 days.
Shops	2	<ol style="list-style-type: none"> 1. Large socket wrench fell through chute in pocket, striking man a glancing blow. Fractured skull. Time lost 56 days. 2. Jumped off railroad car. Wrenched knee. Time lost 11 days.
C. P. & L. Co.,	1.	<ol style="list-style-type: none"> 1. Stepped on edge of pan and opposite end struck his leg. Contusion. Time lost 8 days.
Miscellaneous	1	<ol style="list-style-type: none"> 1. Slipped on roof. Contused knee. Time lost 24 days.

* Lost time estimated.

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c. Accident Statistics.

TABLE I.

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	11,504,791	189,101	107	0	5,014	9
1933	11,767,448	189,398	95	2	5,925	17
1934		321,909		4		22
1935		393,663		2		40

Note: 1934 and 1935 statistics for U. S. Mines not available.

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c. Accident Statistics.

TABLE II.

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	2.78	0.00	130.74	14.27
1933	2.42	3.17	151.18	27.00
1934		3.60		20.00
1935		1.51		30.48
Average	2.79	2.05	173.80	45.26

Note: 1934 and 1935 statistics for U. S. Mines not available.

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TABLE III.

Classification of Fatal Accidents 1911 to 1935 inclusive
by the Central Safety Committee.

I	Trade Risks		107
II	Negligence of the Company:		
	Violation of Rules	4	
	Failure to Provide Safety Devices	5	
	Improper Method of Doing Work	9	
	Failure to Provide Tools or Safe Place to Work	3	
	Failure to Instruct men.	<u>4</u>	25
III	Negligence of Workmen:		
A	Injured Men-		
	Improper Method of Work .v.	18	
	Violation of Rules	7	
	Failure to use Tools or Appliances Provided .	4	
	Failure to use Safety Devices.	<u>2</u>	31
B	Other Workmen:		
	Improper Method of Work	13	
	Violation of Rules	4	
	Failure to Use Tools or Appliances Provided .	<u>1</u>	<u>18</u>
	Total		181

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INJURY.TABLE IV.Classification of Causes of Fatal Accidents
From December 1st, 1898 to December 31st, 1935.

A	Fall of Ground or Timber	94	
	Run of Mud or Sand	60	
	Fall of Chunk of Ore from Chute	2	
	Stray Chunk or Stick down Raise or Stops. .	<u>3</u>	159
B	<u>Shaft Accidents:</u>		
	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.	<u>5</u>	51
C	<u>Use of Explosives:</u>		
	Explosion of Powder.	16	
	Premature Blast	3	
	Fall of Ground or Timber Due to a Blast . .	4	
	Overcome by Gas	3	
	Miscellaneous Causes	<u>1</u>	27
D	<u>Mine and Railroad Cars:</u>		
	Caught by Haulage Cars	12	
	Riding or attempting to ride cars	6	
	Falling with car from trestle	4	
	Run over by railroad car	6	
Misc	Miscellaneous Causes	<u>1</u>	29
E.	<u>Miscellaneous Causes:</u>		
	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	<u>3</u>	36
	Total		302

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By the Central Safety Committee.

I	Trade Risk. (Incidental and Non-Preventable.) . . .		10
II	<u>Negligence of Company:</u>		
	1. Failure of Use Safety Devices Provided . . .	0	
	2. Failure to use Proper Tools of Appliances Provided	0	
	3. Violation of Rules	0	
	4. Improper Act or Selection of Improper Method of Doing Work. (By Foreman)	0	
	5. Failure to Instruct men as to Method of Doing Work and Hazards Incident Thereto . .	1	
	6. Failure to Provide Safety Devices	1	
	7. Failure to Provide Proper Tools, Appliances or Place of Work	<u>2</u>	4
III	<u>Negligence of Workmen:</u>		
A	1. Failed to use Safety Device Provided	1	
	2. Failed to use Proper Appliances or Tools Provided	1	
	3. Violation of Rules	1	
	4. Improper Act or Selection of Improper Method of Doing Work	<u>23</u>	26
B	<u>Other Workmen:</u>		
	1. Failed to use Safety Devices Provided . . .	0	
	2. Failed to use Proper Appliances or Tools Provided	1	
	3. Violation of Rules	0	
	4. Improper Act or Selection of Improper Method of Doing Work	<u>1</u>	<u>2</u>
	Total		42

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c. Safety Inspection.

The mines, excepting the Canisteo, were inspected monthly and the unsafe conditions encountered were reported to the proper officials for correction. Fences around pits and shafts on abandoned properties were repaired during the summer months.

Central Safety Committee.

This Committee met three times. It classified the accidents and considered safety subjects which required solution.

Conferences.

A general conference of all employees holding positions of authority was held early in the year. Conferences of captains, bosses, electricians and mechanics were held at the mines throughout the year. Safety and efficiency were the topics given consideration at all conferences.

Inspection Reports.

Safety inspection reports received by the Safety Department from the mines were as follows:

TABLE VI

Hoisting Cables	1498
Ladderways	219
Skip and Cage Roads	263
Cage Catches	92
Hoists	74
Slack Rope	44
Fire Doors	44
Fire Equipment	47
Electrical Equipment	14
	<u>2295</u>

Miners' Safety Bulletin.

This bulletin was published six times and 1650 copies of each issue were distributed to employees.

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c. Safety Inspection. (Continued)

Miners' Safety Electric Cap Lamps.

100 of these lamps were received from the Mine Safety Appliances Company for the Cliffs Shaft Mine. They were delivered on a rental basis of 75 cents per lamp monthly for a period of sixty months. When the rental period ends the lamps become mine property. During the 60 months all repair parts are supplied without additional cost.

This lamp is most desirable for miners when working in wet places and also in mines having high air velocities, such as prevail in parts of the mines in the Negaunee district. Another valuable feature in its favor is the increased safety for miners when blasting. A carbide light can always be used to light fuses and the possibility of remaining too long when engaged in this work cannot be prevented entirely and in case of a "premature" shot this light is apt to be extinguished and in case miners escape deadly injuries they cannot find their way to safety in fast time.

National Safety Council.

The Mining Department renewed its membership in the National Safety Council at a fee cost of \$100.00. Copies of the Safety News were sent to the superintendents each month and about 1000 copies of 315 safety bulletins were received and posted at the mines and plants.

d. First Aid Work.

Supplies of first aid material were kept at various places around the mines and plants and kept replenished regularly, twice or more frequently each month. No first aid training was given.

e. Mine Rescue Work.

Instruction in the wearing of rescue apparatus was given irregularly throughout the year but it was sufficient to keep trained men familiar with the use of the apparatus. Inspection of all apparatus is being done monthly.

The abandoned sample crushing building at the Negaunee Mine was

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e. Mine Rescue Work (Continued)

fitted for the headquarters establishment of the rescue equipment but six machines are kept at the Cliffs Shaft Mine for the Ishpeming district.

Expenditure in maintaining this equipment has been kept extremely low the past four years. While the type is not on par with machines of later make yet they are still serviceable and also reliable if maintained in good condition. It is believed that it will not be necessary to spend much money in 1936 to keep the entire equipment in first class condition.

f. Ventilation.

Ventilation work for the year consisted almost entirely of collecting samples of air at rock headings, when miners were drilling or scraping, and counting the dust particles contained in them. The volume of air entering each mine and its chief courses of flow were ascertained monthly, over a period of a year, and the data thus obtained were recorded on maps for future reference. The writer had the assistance of an engineer, T. W. Hill, whose time was equally divided between the Safety and Engineer Departments.

217 samples of air were collected and analysed. They were taken from the mines as follows:

Cliffs Shaft	127
Negaunee	44
Lloyd	30
Athens	14
Mans	2

A set of standards defining the correct procedure to follow in order to eliminate unsafe conditions that may arise in the air underground were adopted. Ventilation investigation is for the purpose of enabling the superintendents to comply with the standards. The work may be summed up by stating that a record is being compiled which shows the Company is maintaining working conditions that conform to the highest attainment possible for the good health of its miners.

It is desirable to extend the investigation in 1936 to the extent of making a survey of the mines which will include measuring the air cir-

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f. Ventilation (Continued.)

ulation, its temperature, moisture, oxygen and carbon dioxide, and counting the dust particles at all headings. This work will be very valuable, as it will indicate unsanitary conditions if they exist in our mines.

g. Employees' Representation Plan.

Michigan.

The men employed at all the local underground mines and also the C. P. & L. Co., employees, held an annual election for representatives under the Employees' Representation Plan in January. The Tilden men had an election in November. A total of 19 representatives were elected, 7 of whom were re-elected, having served in 1934. Underground men had 9 of the total number, surface and shopmen 8, and the Tilden and C.P. & L. Co., 1 each. The annual meeting was held on January 28th, when the Executive Committee was selected. This was composed of Gust Sundberg, a Maas Mine miner, chairman; John Gray, a Cliffs Shaft mine watchman, Vice-Chairman; and W. J. Waters, a Negaunee Mine hoisting engineer, Secretary.

A special session of the representatives was called on February 7th when they were notified by the Manager that the mines would go on a three-day per week basis. The Executive and Joint Committees met regularly in compliance with the by-laws.

The representatives have consulted with the superintendents when they have had any adjustments which they deemed necessary, and consequently the Executive Committee has had little business to transact. At the annual meeting group insurance was discussed but no action was taken.

All the local mines, with the exception of the Negaunee Mine, held picnics during the summer months, which were sponsored largely by the representatives. The picnics were events that cemented a feeling of good fellowship among the men and the representatives felt that they were rendering service worth while in assuming leadership of these affairs.

Minnesota.

The annual election of representatives at the Canisteo Mine was held in August. The men of the mine were divided in three voting groups, namely: skilled labor, general labor, and washing plant. All representatives elected were men who had served in the same capacity in 1934 and the officers of the Executive Committee remained unchanged. Regular

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INJURY.g. Employees' Representation (Continued)Minnesota. "

meetings of both committees were held during the year.

A number of recommendations came from the employees, mostly for improved safety conditions. Similar recommendations at our mines in Michigan would come direct to the Safety Department. A request for group insurance was made.

The number of votes in the nomination and election of representatives at each mine or plant is given in the following table:

<u>Mine or Plant</u>	<u>Number of Voters.</u>	<u>Primary Vote</u>	<u>Per cent Voted</u>	<u>Election Vote</u>	<u>Per cent Voted.</u>
Athens	188	172	90.1	162	96.2
Canisteo	251	225	87.6	244	97.2
Cliffs Shaft	298	237	79.5	253	84.9
Gardner-Mackinaw	98	98	100.0	98	100.0
Lloyd	132	123	93.2	133	85.6
Maas	294	200	68.0	204	68.4
Negaunee	218	193	88.5	182	83.5
Tilden	49	41	83.6	46	97.9
Shops	31	26	83.9	29	93.9
C. P. & L. Co.,	<u>27</u>	<u>25</u>	<u>92.7</u>	<u>26</u>	<u>96.3</u>
Total	1586	1330	83.8	1357	85.5

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h. Department Expense.

Salaries	1,794.12
Auto Expense	189.14
Postage	16.88
Stationery & Printing	175.00
Supplies	9.48
Traveling and Entertaining	83.52
Telephone and Telegraph	19.80
Papers and Periodicals	35.00
Personal Injury Expense	36.23
General Unclassified	<u>114.45</u>
Total	\$ 2,454.66

Respectfully submitted,

William C. Curtis
Assistant Superintendent.

22. REPORT OF THE GEOLOGIST FOR THE YEAR ENDING DECEMBER 31, 1935

A. STAFF

The staff of the Geological Department, regularly employed throughout the year, continued to be confined, as it has been since June 1, 1932, to one man, - Geologist in charge of the Department. Frequent assistance has been obtained, however, from several members of the Engineering Department. Since the resumption of diamond drilling in the Cliffs Shaft Mine early in December, Mr. Ernest Allen, formerly in the Geological Department but recently in the Engineering Department, has helped with the drill samples and will divide his time between the two departments beginning with January 1, 1936. Table I, below, gives the personnel and percentage of time actually employed:

TABLE I

Name	Occupation	Hours Lost		Hours Overtime	Net % Hours Worked
		Sickness	Absence		
E.L. Derby, Jr.	Geologist	14 $\frac{3}{4}$	74 $\frac{1}{2}$	90	99.5

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

Table II

Total working days	271 days (1991 $\frac{3}{4}$ hours)
Sundays	52 "
* Saturdays	29 "
Holidays	13 "
Total	365 days

* Although the forty hour week was adhered to throughout the year, the time was redistributed the middle of February. Previous to this date the schedule was five days of eight hours each per week, with no work on Saturdays. Commencing with Saturday, February 16th, a half day was worked on Saturday, with the corresponding time deducted from the five full days. This schedule was still in force at the end of the year.

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

<u>Year</u>	<u>Average Number of Men</u>
1931	3.5
1932	1.5
1933	1.0
1934	1.0
1935	1.0

B. GENERAL DESCRIPTION OF THE WORK OF THE DEPARTMENT

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

TABLE IV

<u>ITEMS</u>	<u>HOURS WORKED</u>	<u>PERCENT</u>
<u>MINES</u>		
Athens.....	22 $\frac{1}{4}$	1.1
Barnum.....	3	0.2
Canistee.....	719	36.3
Cliffs Shaft.....	148 $\frac{3}{4}$	7.5
Hill Trumbull.....	21 $\frac{1}{2}$	1.1
Holman Cliffs.....	50 $\frac{1}{4}$	2.5
Lloyd.....	90 $\frac{3}{4}$	4.6
Maas.....	63 $\frac{1}{4}$	3.2
Mackinaw.....	21	1.1
Negaunee.....	33 $\frac{1}{2}$	1.7
Pontiac.....	16 $\frac{1}{4}$	0.8
Tilden.....	67 $\frac{1}{2}$	3.4
Virgil.....	10 $\frac{1}{2}$	0.5
Total Mines.....	1,267 $\frac{1}{2}$	64.0%
<u>EXPLORATIONS</u>		
Tilden (E.&A.680).....	15 $\frac{1}{2}$	0.8
<u>MISCELLANEOUS</u>		
Annual report.....	30 $\frac{1}{2}$	1.5
Appraisal of Company's Mineral Estate.....	138 $\frac{1}{4}$	7.0
Beneficiation of Iron Ores.....	40 $\frac{1}{4}$	2.0
General Departmental.....	240 $\frac{1}{2}$	12.1
Gold Leases on Company's Estate..	25	1.3
Investigating Mineral Land Offers	118 $\frac{3}{4}$	6.0
" Outside Explorations	87 $\frac{1}{2}$	4.4
Minnesota Research Company.....	18	0.9
Total Miscellaneous....	699 $\frac{1}{4}$	35.2%
GRAND TOTAL.....	1,982 $\frac{1}{4}$	100.0%

Approximately twelve percent of my time during the year was taken up with the routine work of the office and the numerous miscellaneous duties peculiar to the Geological Department. I was without any regular assistant during the entire year. The largest single increment of my time, - approximately a third, - was taken up with activities in connection with the Canisteo Mine. Structure drilling was carried on there 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. I made occasional underground geological surveys in the Cliffs Shaft and Lloyd Mines. I also planned and supervised the diamond drilling started late in the year in the Cliffs Shaft Mine and from surface in the Tilden Mine area.

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

In January, I made two trips to Hibbing in connection with the revised estimate of the Canisteo mine reserves which was made following the season's structure drilling. A new pit map and complete set of revised cross-sections were submitted to both Mr. E. C. Congdon and his engineer, Mr. J. C. Richards. I conferred with Mr. Congdon and Mr. Richards in the former's Duluth office. We convinced both Messrs. Congdon and Richards that our new figures were reasonable, even though the totals were materially less than they had heretofore admitted. I prepared a report for Mr. Congdon, giving all the details discussed by us and used in this revised estimate.

In February, I spent nearly half my time in connection with the proposed ten year operating plan of the Mesaba-Cliffs Mining Company and the estimates and calculations relating thereto. I made one trip to Hibbing on this work and also accompanied Mr. Barber to Cleveland where we conferred with Messrs. Brown, S. L. Mather, Geffine and Bubb. I made my semi-annual examination of the exploration work being done on the lands leased from this Company by Bjork and Lundin in the vicinity of the Ropes Gold Mine and reported same to Mr. Bush, Land Agent. I also spent a few hours in the laboratories of the Michigan College of Mining & Technology at Houghton, observing the progress being made in the concentration of lean iron ores by the use of heavy mediums in jigs.

In March, I checked over budget estimates and Occupational tax reports of our Mesaba Range properties, also the statement of additional royalties to the Canisteo Mining Company on the Canisteo Mine. I spent several days going over the tonnage estimates of our various properties with Mr. F. G. Fardee, State Appraiser of Mines.

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In April, I went to Hibbing and then accompanied Messrs. Barber and Donovan to St. Paul where we conferred with Mr. H. M. MacCraw, Secretary to the State Tax Commission, on Canisteo Occupational tax matters. I took Mr. Stakel to Iron Mountain where we met Messrs. E. A. Jones and J. R. Comstock of the Globe Iron Company, of Jackson, Ohio. Mr. Meyers also joined us and we examined the Clifford-Cornell property, recently leased by the Globe Iron Company, and then came to Ishpeming and showed Messrs. Jones and Comstock our Tilden Mine operation.

In May, I attended the Minnesota Occupational Tax hearing at the State Capitol in St. Paul with Mr. Donovan and then went to Hibbing. While in Hibbing I went over the estimate figures being prepared by Mr. E. G. Sterling for the review of the Canisteo Mine by the Tax Commission and its engineers. I also went over the proposed drilling to be followed at the Canisteo pit during the operating season.

In June, I went to the Mines Experiment Station at the University of Minnesota in Minneapolis and saw the new so-called "Wade" jig, which is being developed there by Mr. Wade of the Station and Mr. Gleason, research engineer for Pickands Mather & Company. From there I went to Hibbing and worked up factors of rock deductions, cubic feet per ton, density of crude ore and percentage of tonnage recovered, all on Canisteo ore, at the request of Mr. Congdon and conferred with him on my way home. I also accompanied Messrs. Bush and McCallum to the Ropes Gold Mine, now sub-leased to the Calumet & Hecla, together with adjacent lands of this Company. We conferred with Capt. Richards relative to his operation and the plans for exploring this Company's lands under the sub-lease.

In July, I prepared maps and cross-sections of the Lloyd Mine together with estimates of tonnage, grade, etc., which were submitted to the Inland Steel Company during negotiations for a lease or contract for a definite annual tonnage of this ore. In this connection, I spent a day in Chicago with Messrs. Greene and Elliott. Also, while there Messrs. Brown, S. L. Mather, Elliott, Barber, Geffine, Bubb and I had a conference with Messrs. Congdon and Garver on Canisteo matters, - particularly relating to additional royalty settlements on the Canisteo operations for 1934. Another day was spent at Chicago on Bowe-Burke matters embracing the Malta and Minorca Mines.

Mr. Barber and I witnessed a mill test on the new "Wade" jig at the Mines Experiment Station in Minneapolis. A lean Canisteo ore was used in this test and a satisfactory product was made. From there I went to Hibbing to prepare data for the conferences in Chicago mentioned above.

A group of bankers and finance men came to Ishpeming on July 22nd, accompanied by Messrs. W. G. Mather and Greene. I gave them an illustrated talk on the general geological features of the Marquette Range.

In August, nearly two thirds of my time was taken up with work in connection with the Canisteo mine. This was divided between supervision of structure drilling and classification of drill samples; work in connection with the Tax Commission's valuation of the property; and preparation of estimates and cost data in co-operation with Mr. Barber in connection with the proposed five year operating plan.

I spent a week on the Mesaba Range. While there I entertained the members of the Minnesota Tax Commission and went through the Canisteo pit and over the estimate data with Prof. Lambert and Mr. McAdams, engineers for the Commission. I also examined and reported on the progress of exploration work on our gold leases adjacent to the Ropes Gold Mine, sub-leased to Calumet & Hecla Company.

In September, I continued to spend a considerable time on Canisteo mine matters. I conferred with Prof. Lambert at his office in Minneapolis about his revised estimate of Canisteo reserves and worked in Hibbing on operating plans with Mr. Barber.

I prepared a large amount of data for Dr. Leith and assisted him in his work of appraising the value of the Company's mineral estate which was used in the Company's financing plan. This required two trips to Dr. Leith's office in Madison, Wis.

In October, I joined Messrs. Barber and Donovan in attendance at the public hearing of mining company officials before the Minnesota Tax Commission on ad valorem taxes in the State Capitol at St. Paul. I also went to the Mesaba Range and classified samples of the Canisteo structure drilling and layed out a plan for a new Canisteo reserve estimate, based on this drilling, to combat Prof. Lambert's high tax estimate figures. I continued to spend considerable time working on data for Dr. Leith. Dr. Leith spent two days with me at Ishpeming in this connection.

In November, I spent a short time at Hibbing and with Prof. Lambert at his office in Minneapolis in continuation of the revised estimate figures with which we hope, during 1936, to come to some satisfactory settlement with the Tax Commission as to the reserve value of the Canisteo property.

In December, I accompanied Mr. Elliott on an examination of the Tweedy-Frazier manganese property near Lynchburg, Va., which was offered to us, through our Cleveland office, under Land Offer #1923. We spent a day at the Cleveland office both going and returning. I then

went to Hibbing for a few days and worked with Messrs. Barber and Bubb on proposed Mesaba Cliffs operations in anticipation of issuing a three year notice of cancellation of the Canisteo lease. Late in the month I went over Pontiac mine estimates and other data with Messrs. Elliott, Stakel and Meyers in preparation for a complete review of the property to determine whether to operate it or surrender it for taxes.

C. - SURFACE GEOLOGICAL SURVEYS:

No detailed surface geological surveys were made on the Company's mineral estate during the year, except the work done by the Calumet & Hecla on the property adjacent to the Ropes Gold Mine, sub-leased by them. This work consisted of a dip needle survey, and in outcrop and contour mapping of a portion of Section 30,48-27 in the vicinity of the trenching and diamond drilling done by them during the summer months. The survey was made for the Calumet & Hecla Company by Dr. C. O. Swanson of the Michigan College of Mining and Technology faculty.

D. - UNDERGROUND GEOLOGICAL SURVEYS:

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

The Athens, Lloyd, Maas, Mackinaw and Negaunee Mines worked four days per week, single shift from January 1st to February 11th, each half crew getting two days of work per week. During the balance of the year these mines worked six days per week, single shift, with each half crew working three days per week.

At the Cliffs Shaft Mine, the regular day shift crew worked two days per week, - Mondays and Wednesdays, - mining, tramming and hoisting ore, from January 1st to February 11th. The men on rock worked Tuesdays and Thursdays during the same period. From February 11th to October 1st, the first crew worked Mondays, Wednesdays and Fridays, and the rock men Tuesdays, Thursdays and Saturdays. During the balance of the year the first crew worked Mondays, Tuesdays, Wednesdays and Thursdays. The rock men also averaged four days per week but on various days.

The Tilden Mine worked more or less regularly on full time during the shipping season. A small crew worked most of the winter months churn drilling for blast holes.

D-1. - ATHENS MINE

The geological data at the Athens Mine was mapped periodically by Mr. C. W. Allen, engineer at the property. He has also posted the geological cross-sections intermittently.

For the past several years the product came about equally from the blocks between the 4th and 6th Levels, and the 6th and 8th Levels. During the past year, however, most of the product has come from the blocks between the 4th and 6th Levels. This is due largely to the necessity of increasing materially the mining on the Mitchell lease, - Lots 8 and 9.

The principal development during the year, and a most important one, geologically, was driving of No. 610 cross-cut South on the 6th Level and 150' East of No. 620 cross-cut. It proved the downward continuation of the mass of mixed ore and paint-rock which, previously, had been disclosed on the footwall at the Southeast end of the 4th Level. This possibility had earlier been foreseen, however, so that the estimate of ore reserves was not reduced, materially. A sub-level intermediate between the 4th and 6th Levels was started during the year.

D-2. CLIFFS SHAFT MINE:-

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

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. Seventy-two percent of the total mine product was mined from "A" shaft deposits.

Developments were carried on in ore from the Northeast and Southeast ends of the 6th Level; from the Southeast end of the 7th Level; from the Northeast end of the 8th Level and the East end of the 10th Level; and in rock, to get up under ore stopes above, from the Southeast end of the 8th Level and the Southeast end of the 12th. All of this work was on fee property. On the Bancroft lease the Bancroft ore bodies are being developed from four raises put up from the 10th Level. The two raises started from the North-South drift on the 15th Level, Bancroft, one inclined to the West and the other to the East, were continued. Ore had just been encountered in the former at the end of the year.

"B" shaft deposits produced twenty-eight percent 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 from the Southwest end of the 10th Level toward the ore body in the West half of Section 9 was extended about 450'

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during the year. It was driven in dike most of this distance but encountered one lense of ore. A small amount of exploration work in this ore did not disclose a mineable quantity. The Section 9 ore body is still some 1200' to 1300' ahead. A drift was driven North-easterly in rock from the main deposit on the 10th Level a distance of 200' and a raise started to get up under and develop the downward extension of the ore in No. 3 contract on the 8th Level.

D-3. LLOYD MINE

The geological data in this property was mapped periodically by Mr. Brewer, engineer, in connection with his regular surveys. I made a geological survey of the new 5th Level development in October.

All of the product continued to come from the East Lloyd ore body, - most of it from sub-levels immediately above the 4th Level by top slicing and caving. The balance came from a sub-level stope above the 990' sub-level.

The 5th Main Level was opened from the shaft plat for a distance of approximately 2000' in the footwall. Two cross-cuts were driven South from this drift. The most westerly cross-cut (No. 5) was driven across the ore formation for about 300' and cut 80' of ore at the South end. No. 4 cross-cut to the East, also driven South and for approximately 100', had just cut into the ore body at the end of the year.

D-4. MAAS MINE

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

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

The new development work during the year was confined to raising from the 5th to the 4th Levels. Two raises were completed, nine additional ones, put up and another started during the year.

D-5. MACKINAW MINE

Mr. Allen, engineer, has kept the geological data up to date at this property in connection with his regular surveys.

The production came principally from stopes above the 8th and 9th Levels, - about an equal amount from each level, - but some tonnage continued to come from stopes above the 6th and 7th Levels, - the amount being dependent upon the grade of ore mined below. For years back the sulphur content of Mackinaw ore was the principal contaminating element but below the 7th Level the phosphorus content in parts of the deposit has been abnormal, - thus introducing a second handicap in grading the ore. The product used to be graded on a .200% Phos. limit but this now has been raised to .300% Phos. Fortunately however, the high phosphorus areas on the 8th and 9th Levels are confined mainly to the narrow parts of the ore body.

During the year, two development drifts were driven in the wide part of the ore body at the Northwest end of the 7th Level, and two stopes opened up. The 8th Level was extended about 500' Northwest and two stopes started. The 9th Level was extended North along the West boundary of the property a distance of 120' and two stope raises put up to the 8th Level preparatory to stoping.

D-6. MORRIS MINE

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

The mine operated continuously throughout the year on the basis of about 18 shifts (all day shifts) per month. The production continued to come from No. 9 lease and the Cleveland-Cliffs fee land East and South of this lease. Approximately 70% of the product has come from sub-level stopes and 30% from sub-level slicing and caving. The topmost workings were on the 210' sub level, or about 130' above the 7th Level, and the lowest workings on the -80' sub-level about 45' above the 8th or bottom level. The South drift on the 8th Level was extended Westerly and raises put up to develop the ore on the -80' sub level. Four ore bodies are being worked: No. 33 or the Main deposit on the South and East; B deposit; No. 21 deposit; and No. 61 deposit.

In No. 33 deposit the limits of ore on No. 9 lease have been expanded by development work. Sub level stoping is about to be started where this ore body extends over onto Cleveland-Cliffs fee

property. Sub level slicing and caving in this deposit was carried on both above and below the 7th Level on the 130', 70', 20' and 10' sub-levels. The ore area in this deposit South of the main dike on the 7th Level, was developed during the year on the 120' sub level and partially developed on the 140', 160' and 180' sub levels above the 7th Level and on the -80' sub level below the 7th Level. On the 120' sub level it is 150' long by 70' wide. It is larger in horizontal area and extends higher than anticipated.

In No. 21 deposit developments continued to expand the former known ore limits to the East. This limit has been located on the 110' sub level but not above this elevation. It now looks as though this ore above the 7th Level will extend East of the main Southwest drift on the 7th. A new sub level stope has been opened in this deposit between the 130' and 190' sub levels and stoping started.

The top of the ore in "B" deposit is now at the 210' elevation. Stoping continues in the East half of the deposit but has given way to slicing and caving North of the dike on account of a soft hanging wall.

Mining by sub level slicing and caving continues in No. 61 deposit which is the most Northerly deposit on No. 9 lease. On the West end, the ore body is mined down to the 140' sub level and on the East end down to the 190' sub level.

D-7. NEGAUNEE MINE

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

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

Two raises were put up from the 11th Level to the 10th in the South footwall area. Two raises were put up from the 12th Level to the 11th, - one from number 5 crosscut and the other from number 8 cross-cut. In March the shaft plat on the 13th Level, part of which had been cut previously, was completed. Drifting to open up the level progressed the balance of the year and had reached a distance of 1100' at the end of the year. It had just cut the south contact of the ore body which was found to be about 100' farther North than expected. If no compensating boundaries offset this change in dip of the ore, the ore area on the 13th Level will be somewhat smaller than anticipated.

D-8. TILDEN MINE

No detailed geological survey or mapping was necessary at this siliceous ore open pit mine in connection with the ore production but I made several surveys of portions of the property in connection with the planning of a diamond drilling campaign to explore for high grade soft ore in depth.

A low phosphorus siliceous ore area was stripped on the South slope of Summit Mountain about one quarter of a mile East of the East Pit and production was started October 23rd. The product from the West and East Pits was mixed during most of the season. These pits produced 186,032 tons and the Summit Pit 4,479 tons, - a total of 190,511 tons from the property.

A series of churn drill holes has been planned to explore for a larger tonnage of low phosphorus siliceous ore in the Summit area. The demand for this special grade (Phos. of .010% and under) has developed recently and there is a very limited known supply elsewhere in the Lake Superior District.

E. OPTIONS AND LEASES

A 30 day option for lease, dated November 21, 1935, was taken from Cleveland parties by our Cleveland office on a manganese property in Campbell County, Virginia, about 16 miles South of Lynchburg, Virginia. The property comprised two adjoining parcels, - one of 184 acres and one of 194 acres. Mr. Elliott and I examined the property on December 2nd and 3rd and, upon our recommendation, the option was not exercised.

The lease on the Empire Mine, the fee of which is owned by the Company, was surrendered by the Empire Iron Company on January 1st, 1935.

The lease on the Barnum Mine, also owned in fee by the Company, was surrendered by the Oliver Iron Mining Company on March 30, 1935.

The Mesaba-Cliffs Mining Company gave to the Canisteo Mining Company, a three year notice of surrender of the Canisteo mine as of December 31, 1935.

F. EXPLORATIONS AND COSTS

Drilling explorations were carried on during 1935 in the following districts and mines:

F-1. FROM SURFACE

<u>DISTRICT</u>	<u>RANGE</u>	<u>MINE</u>
Coleraine	Mesaba	Canisteo
Tilden	Marquette	Tilden

F-2. FROM UNDERGROUND

Ishpeming	Marquette	Cliffs Shaft
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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 \$2.72 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 \$3.20 per foot. The cost of underground drilling in the same way was \$2.23 per foot and \$2.34 per foot, respectively.

Table VI, also shown below, gives a comparative cost per foot of drilling for the past five years. The cost at the Canisteo Mine was abnormal in 1935 as compared with all previous structure drilling at this property for two reasons. In the first place, nearly two thirds of the footage drilled was at or near the north end of the North Bovey leases, where there is a large amount of relatively hard decomposed taconite. Secondly, the pit bottom is very uneven resulting in costly moves from hole to hole and somewhat difficult set-ups. In 1934, for example, when all but one of the holes drilled were on the Snyder and Hemmens, leases, the actual cost of drilling, with the same wage scale, was only \$1.63 per foot compared with the \$2.69 per foot as shown above for 1935.

TABLE V
SUMMARY OF DRILLING FOR 1935.

PROPERTY	DESCRIPTION			STAND	CHURN	DIAMOND	TOTAL	FIRST	SECOND	LEAN	TOTAL COST "A"	COST		TOTAL COST "B"	COST	
	SEC.	T.	R.	PIPING FT.	DRILLING FT.	DRILLING FT.	DRILLING FT.	CLASS ORE FT.	CLASS ORE FT.	ORE FT.		PER FT. "A"	PER FT. "B"		PER FT. "B"	
<u>SURFACE DRILLING.</u>																
Canisteo Mine.	30	56	24	Minn.	134	3,918	-	4,052	140	-	1,865*	\$12,799.99	\$3.16	\$10,888.41	\$2.69	
Tilden Mine (E&A 680)	26	47	27	Mich.	56	1	-	57	-	-	-	353.94	6.21	306.35	5.37	
TOTAL SURFACE DRILLING					190	3,919	-	4,109	140	-	1,865	\$13,153.93	\$3.20	\$11,194.76	\$2.72	

*This is Crude Wash Ore which may be concentrated to a First Class Ore by Washing.

UNDERGROUND DRILLING.

Cliffs Shaft Mine.	3 & 10	47	27	Mich.	-	-	212	212	11	96	9	496.92	2.34	472.23	2.23
TOTAL UNDERGROUND DRILLING.					-	-	212	212	11	96	9	\$ 496.92	\$ 2.34	\$ 472.23	\$ 2.23
GRAND TOTAL DRILLING, 2					190	3,919	212	4,321				\$ 13,650.85	\$ 3.16	\$ 11,666.99	\$ 2.70

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"
1931	8,031	\$ 3.59	\$ 3.05
1932	63	11.44	3.75
1933	4,939	3.85	3.01
1934	8,230	2.01	1.64
1935	4,321	3.16	2.70

Canisteo Structure Drilling Only.

F-3. DIAMOND DRILL CARBON

We had on hand, January 1, 1935, a total of 368.41 karats of diamond drill carbon which inventoried at \$44,747.87. We consumed, in 1935, a total of 0.77 karat in our drilling (all in the Cliffs Shaft Mine) at a cost of \$110.25. This left on hand, December 31, 1935, a total of 367.64 karats which inventoried at \$44,637.62.

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 Mine 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 will be prepared at our Hibbing office for use on the Range. Prints of these sections will be sent to the several fee owners and underlying lessees according to the terms of our lease.

G. SURFACE EXPLORATIONS

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

A total of 64 structure churn drill holes were drilled in the Canisteo pit during 1935 having a total footage of 4,052'. 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.

Drilling started the first part of May, coincident with the season's mining operations, and continued until the latter part of December. Two drill rigs were used much of the time.

The holes drilled were distributed as follows:

18	holes	on	the	NE	Bovey,	NE $\frac{1}{4}$ -SE $\frac{1}{4}$,	Sec. 30.
23	"	"	"	NW	Bovey,	NW $\frac{1}{4}$ -SE $\frac{1}{4}$,	Sec. 30.
11	"	"	"	East	Snyder,	SE $\frac{1}{4}$ -SE $\frac{1}{4}$,	Sec.30.
12	"	"	"	Middle	Snyder,	SW $\frac{1}{4}$ -SE $\frac{1}{4}$,	Sec.30.

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

A campaign of diamond drilling was started the middle of December to try and discover a body of high grade Bessmer ore. There has never been any exploring done within this area along the South side and bottom of the Negaunee iron formation. For this reason,

and because the South contact of the range is covered with soil, it is necessary, first, to sink several standpipes to ledge and locate this contact.

The area selected for the initial test is the low ground South of the West Tilden Pit. The first standpipe, Hole No. 48, was sunk vertically from a location of S. 22,400 and 14,000 W. It encountered soft ore formation at ledge at a depth of 56' and had drilled into it one foot, depth 57', as the year closed.

H. UNDERGROUND EXPLORATIONS

H-1. CLIFFS SHAFT MINE

Diamond drilling, with one drill operating five day shifts each week, was resumed in the Cliffs Shaft Mine on December 9th. The first drilling consisted of a series of three holes drilled from the floor of an old stope on the Southeast side of the 11th Level "A" Shaft. Contract No. 5, working on the 12th Level beneath it, has been trying to find the downward extension of the ore mined from this stope, without success.

The first hole, No. 423, was drilled vertically and Nos. 424 and 425 inclined to the Southeast at angles of -45° and -29° , respectively. The results were disappointing since the ore was found to extend only a very short distance below the floor of the stope. Negative though this drilling was, it will save several times its cost by discontinuing the futile attempt of No. 5 contract on the 12th Level.

Hole No. 426, was being drilled horizontally to the South from the same 11th Level stope to explore for the downward continuation of a seam of ore encountered in Hole No. 355 drilled from the 9th Level on the same meridian. It cut 14' of 54% material and 6' of ore averaging 57.30% iron and was drilling in siderite at a depth of 69' at the end of the year. Evidently the hole cut this ore seam near its bottom.

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 Mine, continued

to mine a small tonnage of hard ore in stringers on and above the 1100' Level. It kept a diamond drill operating almost continuously but without very encouraging results. At present, the 1100' Level is the only Level connecting with the shaft. Work is well underway, however, driving another level at the 850' elevation. It was in from the shaft about 600' at the end of the year. Preparations are being made to sink the shaft for another lower level and speed up the thorough exploration of the property.

Activities in the Gold district just north of Ishpeming continued brisk throughout the year. The principal activity was at the Ropes Mine under lease to the Calumet & Hecla Consolidated Copper Company. The old shaft was unwatered and reconditioned. Drifting both East and West from the shaft along the vein has progressed several hundred feet in each direction and several diamond drill holes have been drilled to the North. It is reported that every hole has encountered pay ground over a good width. The company also drilled five holes, totalling 2092', near the West quarter post of Section 30, 48-27 about a mile and a quarter West of the Ropes on land leased from the Company. A gold vein was found and will be followed up by additional drilling but so far, it is not rich enough to open up.

I-2. GOGEBIC RANGE

Since the Oliver Iron Mining Company surrendered its lease in September on the so-called Norrie group of mines, located at Ironwood, several companies have examined one or more of them. M. A. Hanna and Pickands Mather both looked without anything developing. The Republic Steel Corporation has an option on them at present and its engineers are busily engaged with their examination. The mines have been kept pumped and accessible by the fee owners.

I-3. MENOMINEE RANGE - IRON RIVER DISTRICT

R. S. Archibald and his Detroit associates reopened the Forbes mine early in the year and have produced ore steadily since then.

The Hanna Company also began production from the Hiawatha No. 2 which, formerly, was the Dober Mine of the Oliver.

I mentioned last year that the Bates ore body was found to cut out very suddenly in depth. A vigorous campaign of underground diamond drilling was carried on the past year looking for new ore in other folds in the formation, but, I understand with little success. It is anticipated that the new Level being opened or prepared for at this time will be the bottom of the Bates operation.

The Judson and Warner leases were surrendered by Pickands Mather and the Aaronson by Republic. The Hanna Company has leased the Minckler property just west of the Aaronson and Southeast of its Homer Mine. The Minckler was leased by Republic for many years until some time in 1934.

I-4. MESABA RANGE

The State Mines Experiment Station continued to operate its concentrating test unit at the Harrison Mine of Butler Brothers near Nashwauk, during much of the operating season. This unit is an experiment in a magnetic concentration following a reducing roast. The material treated is the rejects from the jigging plant nearby. The first part of the operating season was spent in rebuilding the roasting furnace as a result of the previous season's work. I understand the plant is now metallurgically satisfactory. I have not heard anything of its economic performance, however.

At the washing plant, erected at the St. Paul Mine just before the close of the 1934 ore season, the commercial size Hydrotator, I was told, gave results exceeding all expectations. I have been notified, by the designers, of important improvements in design since the machine at the St. Paul was erected. I have always been favorably impressed with this machine for the treatment of the finer sizes of Mesaba iron ore. Improvements in design make it possible now to apply the principles involved to the coarser sizes up to 1 inch and, I believe, even larger. Most, if not all of the structural weaknesses in the earlier machines used on iron ore, have been eliminated.

Mr. W. W. Wade, assistant metallurgist at the State Mines Experiment Station and Mr. A. J. Gleason, research engineer with Pickands Mather, have worked diligently on the design, construction and perfection of a new type jig to treat lean ores and rich taconite of the Mesaba Range. The water pulsation is accomplished by means of a jet of air introduced into the hutch compartment below the bed. This type of pulsation, with its simple and easy control between wide limits and conditions, appears to make a separation hitherto impossible. This results in a higher grade product and a larger recovery at the same time. I am watching this development with much interest, which my close contact with both these men allows. I have already seen the experimental machine in operation during one test at the Minneapolis Station.

J. EXAMINATION OF MINERAL LAND OFFERS

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

<u>Number</u>	<u>Description</u>	<u>Remarks</u>
1909	40 Acres of Iron Ore in Missouri	Declined
1910	Iron lands in Southern Iron County, Mich.	"
1911	Iron ore in Central Eastern Texas	"
1912	Iron, coal & Oil on Cumberland Plateau, Tenn.	"
1913	Mineral rights of Muck Tract, Maas Mine	"
1914	Fargo's stock in Vermillion Range Land Co. Minn.	"
1917	Small fee interest in Race Course, Maas Mine	Pending
1918	Iron lands in Dickinson County, Mich.	Declined
1920	Lands in Baraga County, Michigan	"
1921	Wadsworth lands in Gwinn District	"
1923	Manganese property near Lynchburg, Va.	"
1924	Kloman Mine at Republic, Mich.	"
1925	Offer to buy or lease lands in Yellow Dog District, Mich.	"
1927	Iron ore lands 22 miles north of Canadian, Soo	"

A thirty day option was taken on land offer No. 1923, a manganese property near Lynchburg, Va., but it was not exercised after a two day examination on the ground by Mr. Elliott and me early in December.

K. EXPENSE STATEMENTS

Tables VII and VIII, which follow, show a detailed statement of charges to Geological expense for the year 1935 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 1935

Salaries	\$ 4,774.00
Travel & Entertainment	1,101.79
Operating Automobiles	491.07
Supplies & Office Expense	512.36
Personal Injury	95.48
Unclassified	12.85
Total	<u>\$ 6,987.55</u>

TABLE VIIICOMPARATIVE STATEMENT OF CHARGES TO GEOLOGICAL DEPARTMENT
FOR LAST THREE YEARS

	<u>1935</u>	<u>1934</u>	<u>1933</u>
Salaries	\$ 4,774.00	4,620.00	4,544.62
Travel & Entertainment	1,101.79	1,234.07	482.32
Operating Automobiles	491.07	176.30	337.74
Supplies & Office Expense	512.36	273.34	218.02
Personal Injury	95.48	88.62	-
Unclassified	12.85	37.49	8.35
Total	\$ 6,987.55	6,429.82	5,591.05

L. RESEARCH DEPARTMENT

No one was regularly employed on research work during the year 1935.

Respectfully submitted

E. L. Derby, Jr.
Geologist

ELD:DP

ANNUAL REPORT OF THE MINING ENGINEERING DEPARTMENT FOR THE YEAR ENDING
DECEMBER 31, 1935.

The usual books of photographic maps, showing the areas mined on the various sub levels, etc. in the different mines during 1935, 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, Canisteco, Cliffs Shaft, Gardner Mackinaw, Lloyd, Maas, Negaunee and Tilden.
Bethlehem Mines Corporation	Negaunee
Hanna Ore Mining Company	Canisteco
Inland Steel Company	Canisteco
Jones & Laughlin Steel Corporation	Canisteco
Otis Steel Corporation	Canisteco
Pickands, Mather & Company	Athens
Pittsburgh Steel Corporation	Canisteco
Republic Steel Corporation	Canisteco
Wheeling Steel Corporation	Canisteco

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	Canisteco
M. H. Barber, District Superintendent	Canisteco
H. C. Bolthouse, Superintendent	Canisteco

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

A set 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 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, 1935 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. These documents have been handled by Mr. Brewer and initialed by him as to placing on Mining Department records and in some cases, as to description. Copies of

some of the documents are kept on file in the Department, but only such ones as affect the mineral lands.

The following table shows the number and classification of such documents as have been initialed.

Classification	Number Received	Last File Number
68 Mining Leases	0	68
1243 Miscellaneous Documents	50	1293
383 Easements	8	391
219 Rights of Way	0	219
58 Water rights	0	58
3944 Surface leases	99	4043
139 Applications for sale	17	156
729 Sales	127	856
702 Tax histories	0	702
193 Legal opinions	2	195

The following comments relate to the various papers, etc. placed on the records of the Department during 1935.

MINING LEASES

No new mining leases were received during the year, but applications have been made and leases prepared to cover three forty acre parcels lying west of the Gardner-Mackinaw Mine. Lease #55 covering the Barnum Mine, the S $\frac{1}{2}$ of the NE $\frac{1}{4}$ of Section 9, 47-27, was surrendered by the Lake Superior Iron Company as of March 31st, 1935. The litigation over Lease #11, covering the Empire Mine - the E $\frac{1}{2}$ of the SW $\frac{1}{4}$ of Section 19, 47-26, was settled during the year, and the lease was surrendered as of January 1, 1935.

MISCELLANEOUS DOCUMENTS

This classification covers all documents of every nature involving transfer of rights affecting the mineral lands. Thirty nine of these documents were copies of various agreements affecting the Mesaba Cliffs Mining Company's lands in Minnesota, which had not been previously entered on the Engineering Department records. These copies were furnished by the Cleveland office. Two were releases covering the surrender of the above mentioned Barnum and Empire Mine leases. Four were transfers of land between subsidiary companies. Two were purchases of land by the Company, and the remaining three miscellaneous agreements.

EASEMENTS

These documents all cover transmission line rights acquired by the Cliffs Power & Light Company. Six are for railway crossings, one lease of lands where sub-stations are located, and one for a part of the McClure Plant - Cliffs Dow Chemical plant pole line, which was built last year.

SURFACE LEASES

These leases cover all sorts of permits for use of Company lands, farms, residence, gardens, camping, etc. and 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. These applications usually cover land sold to individuals for farms, etc., and are off the mineral lands, and submitted for the approval of the Mining Department.

SALES

These also originate in the Land Department and cover sales to outside parties for various purposes. There were forty-four deeds, including nine to the United States for forest lands; thirty nine farm land contracts; eighteen options to sell to the United States; nineteen highway and fire line rights of way; four bills of sale for houses; and three timber cutting permits.

LEGAL OPINIONS

The two opinions placed on file were copies that were made from letters in Mr. Elliott's files, written several years ago and were merely placed here for ready reference.

ABSTRACTS

Comparatively little work was done on the abstracts of either Company mineral lands or those of the Cliffs Power & Light Company during the year, toward bringing them up to date. Mr. Brewer has been doing the work and he has not had sufficient time to put consecutive effort on that part of the job. While there has not been very many changes in 1935, nevertheless, the records and maps are so far behind that about four months steady application is needed to post the records and maps to the present time. Such information as has passed through the office has been noted and is ready for putting in the book at some future time.

TAXES

The 1935 tax lists of lands under the Mining Department and the Cliffs Power & Light Company have been prepared as usual during October.

COMPANY LANDS

A list of lands under the Mining Department, showing acreages held under the various forms of ownership, leases, etc. is being prepared at the request of the Land Department. The last acreage list was prepared under Mr. Jopling in 1914, together with the Land Department, and while that Department has been making such changes as have been possible, the total acreage and division of ownerships, etc. is neither correct or complete. This work has not been completed as yet, but is nearly so.

Messrs. Brewer and Chenneour, under the direction of Mr. Berg, prepared the list of lands, metes and bounds descriptions, etc. for the Mining Department in connection with the general mortgage trust deed.

D. THE FORCE

There has been one addition to the staff of engineers, helpers, etc. during the year. Mr. Archibald Minnear has been employed since March as a draftsman. He had formerly been in the Department as engineer and helper entering in 1917 but was laid off in 1932 due to curtailment. Mr. Pellow was also employed as draftsman for two months.

The following table shows the personnel of the Department during the year, their position and period employed during 1935

Name	Position	Entered	Left	1935 Employment
C. Brewer	Chief Mng.Engr.			12 months
R.J.Chenneour	Engineer			12 "
H. O. Moulton	"			12 "
C. W. Allen	"			12 "
A. Minnear	Draftsman	March 1st		10 "
K.C.Pellow	"	Oct. 1st	Dec.1st	2 "
E. A. Allen	Helper			12 "
T. W. Hill	"		Dec.31st	12 "

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	17 $\frac{1}{4}$ years
R. J. Chenneour	October, 1907	27 $\frac{3}{4}$ "
H. O. Moulton	April, 1910	24 $\frac{3}{4}$ "
C. W. Allen	June, 1925	9
A. Minnear	June 1917	14-1/6 "
E. A. Allen	September, 1931	2-7/8 "
T. W. Hill	July, 1934	1 $\frac{1}{2}$ "

The above "Years of Service" does not in all cases cover the entire length of service with the Company, for several of the men were 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 are not included.

Name	Working Days	Days Worked	Days Overtime	Days Sick	Days Absent
C. Brewer	271	246	-2 $\frac{1}{2}$	1 $\frac{1}{2}$	26
R. J. Chenneour	271	247 $\frac{1}{2}$	1	4	20 $\frac{1}{2}$
H. O. Moulton	271	261 $\frac{1}{2}$	2 $\frac{1}{2}$		12
C. W. Allen	271	265 $\frac{1}{2}$	7		12 $\frac{1}{2}$
A. Minnear	229	217 $\frac{1}{2}$		1 $\frac{1}{2}$	9
K. C. Pellow	46 $\frac{1}{2}$	46 $\frac{1}{2}$			
E. A. Allen	271	264 $\frac{1}{2}$	$\frac{1}{2}$	1 $\frac{1}{2}$	5 $\frac{1}{2}$
T. W. Hill (1)	147 $\frac{1}{2}$	147 $\frac{1}{2}$			

(1) T. W. Hill was employed part time in the Safety Department and worked as helper and draftsman in the Engineering Department the balance of his time. This arrangement terminated at the end of the year as he will spend all of his time in the Safety Department hereafter.

The next table shows the distribution of the days spent underground, in the field or office during 1935, exclusive of overtime:

Name	Underground	Field	Office	Total
C. Brewer	44	6 $\frac{1}{2}$	193	243 $\frac{1}{2}$
R. J. Chemneour	74 $\frac{1}{2}$	24 $\frac{1}{2}$	147 $\frac{1}{2}$	246 $\frac{1}{2}$
H. O. Moulton	83	22	154	259
C. W. Allen	58	73 $\frac{1}{2}$	127	258 $\frac{1}{2}$
A. Minnear	11	5	201 $\frac{1}{2}$	217 $\frac{1}{2}$
K. C. Pellow			46 $\frac{1}{2}$	46 $\frac{1}{2}$
E. A. Allen	80	26 $\frac{1}{2}$	157 $\frac{1}{2}$	264
T. W. Hill	20 $\frac{1}{2}$	14	113	147 $\frac{1}{2}$
TOTAL	371	172	1140	1683
%	22.1	10.2	67.7	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 office and exercised general supervision over all the work in the Department. He entered on the records all the documents that were received by the Mining Department and made such reports on them as were necessary. He compiled the Annual Report books, stockpile estimates and ore reserve estimates and maps for the Michigan State Tax Commission. He made the acreage list of lands of the Mining Department and Cliffs Power & Light Company and the list of lands for the mortgage deed. He looked after the engineering work at the Lloyd Mine, made the ore reserve estimate, monthly survey and map reports, and weekly mine inspections. He did what abstract work was done during the year toward bringing these records, especially those of the Cliffs Power & Light Company, up to date. During the absence of Mr. Allen at the Tilden Mine during September and October, he also did the engineering work at the Athens Mine, including the monthly map reports.

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

Property	Underground	Field	Office	Total	%
General Engineering	2	2	155 $\frac{1}{2}$	159 $\frac{1}{2}$	65.6
Athens Mine	3 $\frac{1}{2}$		1	4 $\frac{1}{2}$	1.8
Cliffs Shaft Mine	1 $\frac{1}{2}$			1 $\frac{1}{2}$.2
Lloyd Mine	36 $\frac{1}{2}$	2	34	72 $\frac{1}{2}$	29.8
Maas Mine		$\frac{1}{2}$		$\frac{1}{2}$.2
Negaunee Mine	1 $\frac{1}{2}$		2 $\frac{1}{2}$	4	1.6
Tilden Mine		2		2	.8
TOTAL	44	6 $\frac{1}{2}$	193	243 $\frac{1}{2}$	100.0
%	18.1	2.7	79.2	100.0	

REGINALD J. CHENNEOUR, engineer, has been doing all the engineering work for the Cliffs Shaft Mine throughout the year. He made the surveys, map reports, etc. in connection with the property and besides has made some special studies for Mr. Stake. He spent nearly two months studying the underground haulage system with respect to the location of the mining contracts, in order to obtain a better distribution of ore movement and the reduction - if possible - of the number of levels on which haulage is done. The wide area over which the contracts are scattered, and the long and diverging routes to the shafts, made such study imperative to reduce haulage, etc. The results of this study disclosed the unequal electric load distribution throughout the mine and this led to a further study with the Electrical Department to revamp the electric cable system underground. Mr. Chenneour also laid out the stocking trestles, made the estimates of ore in stock and ore reserves.

The following table shows the distribution of his time:

Property	Underground	Field	Office	Total	%
General Engineering		1	12½	13½	5.5
Cliffs Shaft Mine	74	23½	135	232½	94.3
Negaunee Mine	½			½	0.2
TOTAL	74½	24½	147½	246½	100.0
%	30.2	10.0	59.8	100.0	

H. O. MOULTON, engineer, took care of the engineering work at the Maas and Negaunee Mines during the entire year. He made the monthly surveys and map reports, weekly inspections, and the surveys and estimates of ore in stock at both these mines as well as that in stock at the Athens, Mackinaw and Lloyd Mines. He spent two weeks during May in Cleveland, estimating the ore in stock at the Otis Steel Corporation plant. He made the estimate of ore reserves in the Maas and Negaunee mines at the end of the year.

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

Property	Underground	Field	Office	Total	%
General Engineering		11	6	17	6.6
Athens Mine		3	½	3½	1.3
Gardner Mackinaw Mine		1	1	2	.8
Lloyd Mine	1	3	1	5	1.9
Maas Mine	36½	1½	72½	110½	42.7
Negaunee Mine	45½	2½	73	121	46.7
TOTAL	83	22	154	259	100.0
%	32.0	8.5	59.5	100.0	

CHARLES W. ALLEN, Engineer, did the engineering work at the Athens, Gardner Mackinaw and Tilden Mines. He made the weekly inspections at the Athens Mine, the monthly surveys and map reports of the Athens and Gardner Mackinaw and looked after the churn drilling and supervised the blasting at the Tilden. He planned and staked out in the field the track system to develop and mine the Summit Pit at the Tilden Mine and estimated the stripping removed hydraulically. During September and October he was shift boss at the Tilden Mine for six weeks.

The distribution of his time for the year is shown in the following table:

Property	Underground	Field	Office	Total	%
General Engineering			6 $\frac{1}{2}$	6 $\frac{1}{2}$	2.5
Athens Mine	29	1 $\frac{1}{2}$	46	76 $\frac{1}{2}$	29.6
Gardner Mackinaw Mine	29		43 $\frac{1}{2}$	72 $\frac{1}{2}$	28.1
Maas Mine			1 $\frac{1}{2}$	1 $\frac{1}{2}$.2
Tilden Mine		72	30 $\frac{1}{2}$	102 $\frac{1}{2}$	39.6
TOTAL	58	73 $\frac{1}{2}$	127	258 $\frac{1}{2}$	100.0
%	22.4	28.5	49.1	100.0	

ARCHIBALD MINNEAR entered the department on March 1st as a draftsman and has remained the rest of the year. Most of his time has been spent making the new maps of the Cliffs Shaft Mine. During the latter part of the year, he did some surveying both in the Cliffs Shaft and Gardner Mackinaw Mines during the absence of the regular engineer. He has also assisted the various engineers in survey calculations, and has helped Mr. Chenneour with his annual report maps of the Cliffs Shaft Mine.

The distribution of his time for the year is shown in the following table:

Property	Underground	Field	Office	Total	%
General Engineering			24	24	11.1
Athens Mine			$\frac{1}{2}$	$\frac{1}{2}$.2
Cliffs Shaft Mine	8 $\frac{1}{2}$	2	162	172 $\frac{1}{2}$	79.4
Gardner Mackinaw Mine	2		2	4	1.8
Lloyd Mine		1	4	5	2.3
Maas Mine			$\frac{1}{2}$	$\frac{1}{2}$.2
Negaunee Mine	$\frac{1}{2}$	2	5	7 $\frac{1}{2}$	3.4
Tilden Mine			3 $\frac{1}{2}$	3 $\frac{1}{2}$	1.6
TOTAL	11	5	201 $\frac{1}{2}$	217 $\frac{1}{2}$	100.0
%	5.1	2.3	92.6	100.0	

KENNETH C. PELLOW was employed as draftsman during October and November to help prepare maps of the Company's properties for the Cleveland office in connection with the report by Prof. C. K. Leith. He also made new current tracings for the Athens and Lloyd monthly report maps.

ERNEST A. ALLEN was in the Department the entire year as helper. He assisted in the underground and surface surveys, looked after the automobiles and made the blue prints in the office. He also spent a little time during December looking after the diamond drill core for the Geological Department.

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

Property	Underground	Field	Office	Total	%
General Engineering		1½	154½	156	59.2
Geological Department			2½	2½	.9
Athens Mine	3	3½		6½	2.5
Cliffs Shaft Mine	33½	3½		37	14.0
Gardner Mackinaw Mine	20	1		21	8.0
Lloyd Mine	15½	2½		18	6.8
Maas Mine	1	2		3	1.1
Negaunee Mine	7	½		7½	2.8
Tilden Mine		12	½	12½	4.7
TOTAL	80	26½	157½	264	100.0
%	30.3	10.0	59.7	100.0	

THOMAS W. HILL has been dividing his time between the Safety and Engineering Departments in the proportion of 45.6% and 54.4% respectively for the entire year. In the Engineering Department he has been chiefly engaged in making the new mounted maps for the Cliffs Shaft Mine and the tracings thereof. He has also assisted in the underground and stock-pile surveys, etc.

The following table shows the distribution of the time spent in the Engineering Department:

Property	Underground	Field	Office	Total	%
General Engineering		½	27½	28	19.0
Athens Mine	½	1½		2	1.4
Cliffs Shaft Mine	8½	2	85½	96	65.1
Gardner Mackinaw Mine	3			3	2.0
Lloyd Mine	2	3		5	3.4
Maas Mine	2½	2		4½	3.1
Negaunee Mine	4	2		6	4.0
Tilden Mine		3		3	2.0
TOTAL	20½	14	113	147½	100.0
%	m 13.9	9.5	76.6	100.0	

E. DISTRIBUTION OF TIME

There has been comparatively little work done in the Department during the year outside of that directly connected with the operating mines and preparing maps, reports, etc. for the Cleveland office. All work in connection with the mines has been charged to that property and all other work such as map reports, list, etc. for the Cleveland office, blue printing and such, has been classified under general engineering.

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

Property	Underground	Field	Office	Total	%
General Engineering	2	16	433	451	26.8
Athens Mine	36	9 $\frac{1}{2}$	48	93 $\frac{1}{2}$	5.6
Cliffs Shaft Mine	125	31	382 $\frac{1}{2}$	538 $\frac{1}{2}$	32.1
Gardner Mackinaw Mine	54	2	46 $\frac{1}{2}$	102 $\frac{1}{2}$	6.1
Lloyd Mine	55	11 $\frac{1}{2}$	39	105 $\frac{1}{2}$	6.3
Maas Mine	40	6	73 $\frac{1}{2}$	119 $\frac{1}{2}$	7.1
Negaunee Mine	59	7	80 $\frac{1}{2}$	146 $\frac{1}{2}$	8.7
Tilden Mine		89	34 $\frac{1}{2}$	123 $\frac{1}{2}$	7.3
Geological Department			2 $\frac{1}{2}$	2 $\frac{1}{2}$	0.0
TOTAL	371	172	1140	1683	100.0
%	22.1	10.2	67.7	100.0	

F. COSTS

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

	1933	1934	1935
Salaries	\$ 3,279.59	\$ 9,668.78	\$ 12,426.53
Auto Expense	348.16	280.68	253.20
Heat, light & power	28.25	53.83	52.17
Insurance	206.09	194.06	108.34
Postage	13.63	14.93	29.60
Repairs		117.99	11.27
Stationery & Printing	8.55	35.40	8.80
Supplies	157.35	365.07	807.40
Taxes	40.75	41.46	41.35
Personal Injury Expense		192.27	250.98
Tepehone & Telegraph	45.60	68.69	73.59
Papers & Publications		6.00	6.20
Janitor & Cleaning		7.04	-
General - Unclassified	18.11	25.71	74.16
TOTAL	\$ 4,146.08	\$ 11,071.91	\$ 14,143.59

H. AUTOMOBILES

The Ford Sedan and Ford Station wagon owned by the Department, have continued in use all the year. Although now over five years old, they are both giving good service with minimum of repairs. The following table shows the mileage traveled by these cars during 1935, the total mileage and date purchased:

Car	Miles		Date Purchased
	1935	Total	
Sedan	3,962	34,828	July 9, 1930
Station Wagon	1,865	21,657	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

The weekly inspections of the working places in the soft ore mines, by the engineer in charge, continued throughout the year. These inspections were made in company with the mining captain, and were important both for the operating and engineering side. Besides the regular monthly map reports, for the Superintendents, the Messrs. Allen and Moulton prepared for the Superintendents, that part of their reports that covers the underground mining, development, etc. During the year various studies of proposed developments, ventilation, underground water conditions, stock-pile trestles, etc. were made as the occasion required.

ATHENS MINE

The new sump on the 10th Level was designed and lines and elevations given for its excavatio . The proposed new ventilatmon raise from the 10th to the 8th Levels was also studied before deciding on its location. Furthermore, there was much preliminary work in connection with the development of part of Block 4 above the 6th Level, before a plan was finally approved and work commenced. A surface survey was made prior to the construction of the water diversion ditch around the cave to carry as much run off water as possible to keep it from going into the underground workings. In June the 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, Wis. These timbers were placed in the mine in 1926. The summary of this ninth report (1935) is as follows:

Preservative	Number of Timbers Placed	Good	Condition		Removed	
			Partly Decayed	Badly Decayed	Decay	Drushed
Borax	15	-	7	-	5	3
Sodium Fluoride	27	-	-	4	17	6
Zinc Chloride	15	9	-	-	-	6
Untreated	12	-	-	-	12	-

The average life of the untreated timber was 3.8 years.

CLIFFS SHAFT MINE

A complete set of new mounted maps, and four new sets of tracings were made for this mine during the year. This set is comprised of 40 mounted maps and 160 tracings. Although it was started early in March, the work was not completed until November, taking nearly the full time of a draftsman. The old maps were made over twenty five years ago and were not only in very bad condition but were inadequate for the present extensive underground workings. Mr. Chenneour made a study of the heat treating for the detachable bit sharpening. A design of shaft timbering was drawn up for the replacement of the old timbering in "A" shaft, between the 7th and 8th Levels.

GARDNER MACKINAW MINE

Lines were given in the various stopes on the 7th, 8th and 9th Levels that were opened up during the year. A study was made regarding the fault along the north limit of the ore body to determine the best procedure for exploration.

LLOYD MINE

The development of the 5th Level constituted the bulk of the survey work during the year. Lines, and grades, etc. were given as required. The development of the ore body between the 3rd, and 4th Levels at the extreme east end of the mine was also studied, laid out and surveyed. The block caving of the hanging at the east ore body was also sketched and the surface cracks and caves surveyed.

MAAS MINE

There was not any major main level development work during the year at this property, there was, however, considerable time required in connection with planning a general system of mining Race Course and adjacent ore between the 4th and 5th Levels.

NEGAUNEE MINE

The driving of the 13th Level, where lines have been given as necessary, and planning of ventilation raises constituted the most of the work for the property, except for the regular surveys, etc.

TILDEN MINE

The planning and supervision of the opening of the Summit Pit, with the railway incline, loading tracks, stripping, etc. was the chief work during the year. The locating and depth of the churn drill holes at the east and west pits required constant attention and the supervision of charging the holes for the various blasts in the three pits was also done by Mr. Allen. The estimate of additional stripping at the West pit and the surveys for the proposed exploratory drilling was also done by the Department.

J. MISCELLANEOUSSHAFT RUNNERS

During the spring, all the shaft runners in the operating shafts were gauged and the variations from standard reported to the Superintendents.

VENTILATION

The monthly record of intake air on the different levels at the various mines, was continued from January to July inclusive, and was then discontinued. This work was done at the request of the Safety Department. In February and August the volume and direction of air currents through the operating mines were checked and the ventilation maps at the different mine offices posted to date.

STOCKPILES

All the stockpiles at the operating mines were surveyed during September and a general report of ore in stock as of October 1st was prepared for the Cleveland office.

In December the amount of Morris ore in stock at the Lloyd Mine was determined and a joint report made by Mr. Brewer with Mr. R. S. Archibald of Negaunee, fee owner representative

OFFICE HOURS

The office hours during the year were as follows:

	A.M.	P.M.	Saturday
January 1st to February 10	8:00-12:00	1:00-5:00	None
February 11 to December 31	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 |
| April 1st | Local Election Day |
| April 19th | Good Friday |
| May 30th | Memorial Day |
| June 24th | Midsummer Day |
| July 4th | Independence Day |
| September 2nd | Labor Day |
| November 11th | Armistice Day |
| November 28th | Thanksgiving Day |
| December 24th | 1/2 day |
| December 25th | Christmas Day |
| December 31st | 1/2 day. |

Carl Brewer

Chief Mining Engineer

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CLIFFS SHAFT MINE:

In February one of the idler sprockets on the rock picking belt broke. It was replaced with a new sprocket which we had on hand. In September the rock picking belt was found to be so badly worn that it was necessary to rebuild the moving parts. The material was ordered and repairs completed in November.

A new nest of galvanized iron pipe tubes was installed in the #1 Ingersoll-Rand air compressor intercooler on August the 10th to replace the old set, which was leaking very badly.

An axle was broken on the "A" Shaft skip in October. A new axle, a little larger than the broken one, was installed and it is operating satisfactorily.

The material for the new combination skip and cage for "B" Shaft has been ordered. This skip will be built and placed in service as soon as possible after the material has been received.

The decision to adopt electric heat treatment of drill bits seems to have been a wise one. A Westinghouse industrial electric furnace of 26 K.W. capacity, with a temperature range up to approximately 2,000 degrees F., was installed. This has an oven 18" wide, 36" deep and 12" high, with an opening 12" x 16". The control is Leeds & Northrup, fully automatic, with continuous chart record of temperature. The temperature is maintained within 25 degrees of the determined setting. The operation has been entirely satisfactory and in every way appears to have met the conditions desired. The cost of operation is relatively very low.

Modern up to date lighting, with steel enamel shades, was installed throughout the shops in accord with our present standard practice.

Gradual increase and modernization of the use of electricity in the Laboratory has been under way to give us ultimately a completely modern and efficient equipment and lighting throughout.

Very considerable extension in the underground cable distribution for scraper service has been under way with the increased use of scraper outfits. We now have what is probably one of the best and most up-to-date systems of electric distribution for the use of A.C. current scraper operation in any iron mine. The general plan is transmission at 2300 volts through cables from surface to sub-stations conveniently located underground. From these secondary 440 volt cables are carried to junction boxes located as required, the portable cables taking off from these junction boxes to the operating machines. Unusual care is used to maintain permanent and effective grounding for the protection of operators. An inspection of the system made by the Michigan Inspection Bureau brought forth very fine commendation of the method and high class work done. It is very gratifying to have this approval of the type of work our electricians are doing.

A very considerable amount of rail bonding has been done in this mine recently, as this had been somewhat neglected during the depression period.

In general, the electric installation is now in excellent condition.

TILDEN MINE:

Loading was started on April 19th and completed on November 15th.

In September the head shaft on one of the Allis-Chalmers 10" crushers broke. This break was caused by a small piece of drill rod. A shaft salvaged

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TILDEN MINE: (Cont'd)

from the Empire Mine crusher was used to replace the broken one. After operating a short time the oil grooves plugged and burned out the babbitt in the eccentric. Repairs were made without causing any delay to operations.

Considerable repairs are being made to the crushing equipment and electric shovels.

The electric apparatus has been very satisfactory, with very little trouble. The shovel cables have about reached the limit in age for safe operation, and it is expected that one and perhaps two new ones will be required for next season.

ATHENS MINE:

A new Ingersoll-Rand automatic centrifugal pump, with float control, capacity 600 G.P.M. against 125 ft. head, driven by a 25 H.P. General Electric motor, was installed in the Breitung Shaft to hold the surface water below the break in the ledge at the Athens Mine and prevent this water from going into the mine. This pump is operating satisfactorily.

A new nest of galvanized iron pipe tubes was installed in the inter-cooler of the Ingersoll-Rand air compressor in September to replace a set that was leaking badly.

All mechanical equipment operated satisfactorily during the year.

The scraper service underground has been made more reliable and safe by gradual change to circuit breakers and improved portable lighting. These replacing the former standard safety switch.

MAAS MINE:

On January the 19th a cast iron pipe fitting in the third level pump station broke. This caused considerable delay as it was a special fitting. All the water pumped from this mine has to go through this line and we were unable to operate the pumps for 21 hours. Temporary repairs were completed about 6:30 A.M., Sunday the 20th. A new fitting was ordered at once. It was received on February 22nd and installed on February 23rd.

We had some trouble with a brake band on the cage hoist as it was a little light for the service. A new and heavier band was installed and it's operation has been satisfactory.

The lug on the power brake on the skip hoist broke on July 17th. Repairs were made at once and operation has been satisfactory.

A new 28" x 46' "Vim" endless belt was put in service on November 3rd on the third level Aldrich quintuplex pump to replace a rubber belt which was completely worn out.

Additional small ventilating fans and additional scrapers have been added. The gradual change in protective equipment for electric apparatus has been under way at this mine as at all others, De-ion circuit breakers being used.

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NEGAUNEE MINE:

A new nest of galvanized iron pipe tubes was installed in the inter-cooler of the Ingersoll-Rand air compressor on August the 18th to replace a set that was leaking.

New steel liners were put in the north skip head sheave to replace a set that was very badly worn.

All mechanical equipment at this mine operated satisfactorily during the year.

A few new protective circuit breakers have been installed for scraper service in line with our present standards.

LLOYD MINE:

The thread on the head shaft of the #6 crusher stripped in April. As the grizzly and chute to the crusher were in very poor condition, it was decided to make the necessary repairs to put the crushing equipment in good condition. A new nut, a little smaller than the old one, was ordered for the crusher, and the thread cut down on the shaft to fit the new nut. This repair saved the cost of purchasing a new shaft. The old grizzly was discarded and a new one built and installed at a greater angle than the old one, which improved the operation of this grizzly and chute considerably. Repairs were completed in April and it's operation has been satisfactory.

The gears on the cage hoist were in very poor condition and it was necessary to change this hoist considerable to put it in good condition. This hoist was changed from double reduction to single reduction by discarding the intermediate shaft, gear and pinion completely. The old drum gear was turned down in place to fit a ring gear (which had been ordered for this job) and the ring gear was pressed onto the spider of the old drum gear. A pinion was put on the old intermediate shaft and this shaft connected direct to the motor. This change was completed in June and is operating nicely.

All other mechanical equipment operated satisfactorily during the year.

Considerable new rail bonding has been done, and this mine completely equipped with De-ion breaker protection for underground scraper service.

SECTION 6 SHAFT:

The mechanical equipment at this shaft operated satisfactorily during the year.

MACKINAW MINE:

All mechanical equipment is in good condition and operation was satisfactory during the year.

SPIES-VIRGIL MINE:

It was necessary to make some repairs to one of the Prescott underground pumps, the suction valves being in very poor condition. The water body was taken to the Ishpeming Shops and the valve seats repaired.

The mechanical equipment operated satisfactorily during the year.

CANISTEO MINE:

At this mine the ore season started May 8th and closed September 19th, with 1,015,369 tons of crude ore going through the washing plant, which produced 605,095 tons of concentrates.

In the pit the drainage system was changed by sinking a drainage shaft in the southeast corner of the pit and installing the old Layne and Bowler pump from the Holman Mine. A new bowl of 2,000 G.P.M. capacity was installed, as past records showed this would care for all incoming water. During the ore season the electric shovel made some sinking cuts, forming a water sump below the ore to be mined during 1935. The old drainage pump house and pumps were removed; a new house, in which was installed one of the old 2,000 G.P.M. pumps, was floated in the new sump and connected to 18" discharge column serving the Layne and Bowler pump.

On account of this Layne and Bowler pump addition a new 2200 volt circuit was run around the Pit, as the old circuit wire was too small for the added load. The new circuit wire and poles were secured from the Holman pit.

At the shop repairs on the shovels, locomotives, cars and drills were completed during the month of April. Locomotives #101, 102 and 103 received a complete overhauling, including new side and flue sheets in the boiler, cylinders and piston valves being re-bored and pistons built up and fitted. Locomotives #104 and 105 received only a check over, as they were not in as bad condition as the first three machines.

Both 4-yard electric shovels needed the caterpillar traction built up; the generators and motors sent to the shop for overhauling and the cable patched. Both shovels worked hard all ore season and then started stripping October 1st, which continued to December 18th, so heavy repairs on caterpillars will be needed again this winter.

From January to April twenty-three 30-yd. cars were overhauled in the shops at the rate of two per week. Dump cylinders were cleaned, wheels changed and journals repacked. It was found that most of the center truck castings had broken, so heavier ones were bought for replacement.

At the washing plant some radical changes were made. A false timber back was added to the crude ore concrete bin, which shortened the bottom opening to 8-ft. pan conveyor from 18 ft. to 8 ft. long and stopped the heavy wear on the pans. The old style grizzly was changed to an overhang type - called the McClure grizzly bar screen. The new one proved to be too light for the larger chunks and will have to be strengthened during this winter.

Due to the nature of the ore, it was decided to replace one Dorr washer with a 25-ft. log, and change the present bowl classifier 4-ft. wide rake section with one 8 ft. wide. The log and bowl rake were secured from the Holman Plant. Extensive tests were carried on during the ore season - comparing the 25-ft. log with the Dorr washer. These tests form a separate report, but show there was little choice between the two methods, until the old electric vibrator screen at

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CANISTEO MINE: (Cont'd)

25-ft. log discharge was replaced with an Allis-Chalmers 4'x6' Aero Vib screen, which has a positive throw. This addition proved the 25-ft. log and 8-ft. rake bowl the better combination, so the second Dorr washer is being replaced by another 25-ft. log from the Holman Plant this winter.

Water for washing ore was secured by sinking a well to the east of the plant and installing a 250 G.P.M. Fairbanks-Morse deep-well pump, driven by an 1800 R.P.M. 10 H.P. motor. This pump has run continuously since April 1st, but it was necessary for the Danbe Mine to supply 3,000 G.P.M. for ten days in order to get enough water to finish the season. With five more months to store water from this well, it is estimated sufficient make-up can be secured for next season.

Delays for the season are classed under the various headings:

1. Loaded train derailed.
2. Broken door on D.M.&N. loaded ore car plugged track.
3. Broken impeller on pump caused water shortage in mill.
4. Waiting for Great Northern empties.
5. Bad storm in August tied up pit for one-half day.
6. Sticky ore stopped conveyor belt.
7. Car overturned in crude ore bin, due to broken hold-back cable.

These delays caused no weekly reduction in ore concentrates, as a five-day week allows one day to make up lost time.

In the Shops it was necessary to replace the 150-ton wheel press with the 200-ton machine from the Hill-Trumbull Mine. The 16" lathe needed heavy repairs, and rather than spend money on it a similar lathe was brought over from the Hill-Trumbull shops.

HILL-TRUMBULL MINE:

The washing plant was painted aluminum color during the summer.

Shop machinery was moved to the Canisteco Mine, as outlined in Canisteco report.

HOLMAN-CLIFFS MINE:

No change from last year, with exception of machinery moved to Canisteco, as outlined in report for that mine.

ELECTRICAL DEPARTMENT:

The general business revival which has been taking place during the year just closed has been reflected in a very gratifying way in the operation of The Cliffs Power & Light Co. The total amount of electric current generated exceeded 63,000,000 K.W.H., with total net sales of over 54,000,000 K.W.H. In the amount generated this exceeded any year in the history of the company with the exception of 1930. In the production and delivery of this considerable volume of power we observed the growing tendency of more critical demand on the part of the consumers as electric power is utilized to a greater extent in place of man power. This

ELECTRICAL DEPARTMENT: (Cont'd)

condition, of course, in the event of interruption or defective service, is immediately reflected in the industry by a greater loss of product than when more man power was utilized. Our net average rates for power have shown a gradual decrease, but our gross revenue exceeds in amount any year in the history of the company with the exception of 1929 and 1930. Due to the more definite application of the peak demand feature in our service contracts our station peaks have been very materially reduced and our service as a whole improved. This was very happily illustrated in the latter part of the year, when we supplied current for the operation of the Munising Paper Mill on the order of 3,000 H.P. for several days, whereby we lost the effect of any stabilizing of peak demand requirements by virtue of the connection, and carried the total load exclusively on our own system. No difficulty arose and the service was just as good as when we were under normal operation with the Paper Mill in parallel.

Early in the year the necessary lines and substations were provided and connections made for service at the old Ropes Gold Mine property, now being operated by the C. & H. Company, and also an off-peak service for the Marquette plant of the Piqua-Munising Wood Products Co. The gold mine has proven to be a very satisfactory customer. The service at the Piqua plant has yielded sufficient to justify the expenditure, and at the same time has provided what must have been an unusually satisfactory arrangement for them.

The service contract with Republic Township was renewed for a term of five years, and the present operating arrangement in this area is entirely satisfactory to all concerned. During the year we made approximately 11 miles of rural line development for them, advancing the necessary funds to cover the expense. This was worked out under a plan whereby we should be reimbursed for the expenditure, together with interest and a nominal profit, during the life of our present contract with the Township. Viewed in a political way, this development was highly satisfactory.

The principal capital expenditures made during the year were under E. & A's #23 and #24, which provided for rehabilitating the North Lake Substation and some other corrections which were necessary due to obsolescence of existing apparatus. This was fully completed and was an essential and very desirable expenditure.

Our contract with The Munising Paper Company was terminated at the close of the year and new contract prepared for execution, resulting in more favorable terms to us than the previous one.

In July, due to a breakdown at the Paper Mill, we took up, without previous notice, approximately 4,000 H.P. load. This must have been of great value to them, and was not a serious inconvenience to us during the few days when they were making repairs.

The connection with Marquette City has proven to be very satisfactory. They have drawn upon us for additional power in a considerable amount as seemed necessary throughout the year.

Our load at the Cliffs Dow Chemical Plant has shown a continual increase throughout the year, and we have had tentative negotiations with them relative to future developments which they may be required to undertake. These are only in the preliminary stage as yet.

An authorization was received and a new 500 K.V.A. transformer was ordered as a reserve for the Indiana Lime & Stone Co. substation. It was very gratifying to us to receive a letter of commendation from their Vice President,

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ELECTRICAL DEPARTMENT: (Cont'd)

indicating entire satisfaction with the service which we have provided under their original five-year contract, and voluntarily indicating a desire for renewal without change in terms.

Three new replacement trucks were purchased in November, and three or four additional will be required in the near future due to the wearing out of the old transportation equipment.

At the present time it appears that the most important expenditure which will be required during the coming season will be equipment for changes at the Au Train Plant to make a tie-in with the 66,000 volt transmission line. The present arrangement of service from the Au Train Plant to Munising over the 30,000 volt line does not seem justified because of the age of this line (25 years). It will be necessary to either abandon this circuit or replace it. It does not seem justified that we should maintain the two circuits paralleling each other.

During the year we had a few leaks in the Carp and McClure wood pipe lines, and a number of transformer and circuit breaker bushing failures. None of these caused interruption of any moment to any of our operations, and the plant as a whole is in good operating shape. We look forward to a very satisfactory business condition in the plant operations the coming year.

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Electrical Department: (Cont'd)

Summary of Operating Conditions - 1935.

Month	-	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.			
Precipitation	-	1.97	0.91	1.52	1.38	1.38	3.71	5.82	2.40	2.55	2.49	2.04	1.13			
Total Precipitation at Ishpeming during 1935	-	27.10"														
Average	"	"	"	Marquette										-	32.88	(46 year record)

CARP RIVER PLANT:

Drainage area above Intake Dam,	66.66 sq. miles
Cubic Feet Precipitation in 1935,	4,196,208,800
Kilowatt Hours generated in 1935,	14,358,100
Cubic feet water utilized (90 cu. ft. = 1 KWH.)	1,292,229,000
" " " in Carp Storage Basin Jan. 1, 1935,	416,495,300
" " " " " " " " Dec. 31, "	303,166,100
" " " used from Storage,	113,329,200
" " " wasted over Intake Dam in 1935,	484,560,000
Total run-off for year 1935, (cubic feet)	1,663,459,800
Run-off per square mile of drainage area,	24,954,390

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

	<u>1923</u>	<u>1924</u>	<u>1925</u>	<u>1926</u>	<u>1927</u>	<u>1928</u>	<u>1929</u>	<u>1930</u>	<u>1931</u>	<u>1932</u>
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

	<u>1933</u>	<u>1934</u>	<u>1935</u>
Total Precipitation,	32.72	32.87	27.10
Sec.ft.per sq.mi. run-off,	1.14	1.00	.79

McCLURE PLANT:

Drainage area above Intake Dam,	140.52 sq. miles
Cu. ft. Precipitation in 1935, (Hoist Plant - 29.96")	9,780,362,500
Kilowatt Hours generated at McClure Plant in 1935,	31,643,900
Cubic feet water utilized, (125 cu. ft. = 1 KWH.)	3,955,487,500
" " " wasted over Intake Dam in 1935,	1,157,364,000
" " " in Hoist Storage Basin Jan. 1, 1935,	1,811,643,100
" " " " " " " " Dec. 31, "	864,911,100
" " " taken from Storage in 1935,	946,732,000
" " " in Silver Lake Jan. 1, 1935,	746,194,000
" " " " " " " " Dec. 31, "	491,875,500
" " " taken from Silver Lake in 1935,	254,318,500
Total run-off for year 1935, (cubic feet)	3,993,621,900
Run-off per square mile of drainage area,	28,420,300

	<u>1920</u>	<u>1921</u>	<u>1922</u>	<u>1923</u>	<u>1924</u>	<u>1925</u>	<u>1926</u>	<u>1927</u>	<u>1928</u>
Precipitation - Hoist Plant -	35.10	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

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