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1. GENERAL:

With the exception of some alterations on the transmission line, leading from the mine to the washing plant, activities at the Canisteo Mine from January 1st until July 10th, consisted in pit pumping, policing the mine premises and the washing plant.

The force employed, consisted of two full-time pumpmen; three full-time watchmen and two half-time washing plant watchmen.

The force engaged on the transmission work consisted of electrician Young and two helpers during the months of January and February.

On July 10th preparations were made for ore activities. Some track, equipment and washing plant repairs were undertaken, the work being completed by the end of July and ore operations started August 1st.

Generally speaking, the season's operations were quite satisfactory, although the recovery in treating the Snyder ore was very low and some shifting of equipment was necessary to provide a satisfactory grade of ore. The electric shovel operated the first part of the season in the Snyder area and a Model 88-C Bucyrus steam shovel from the Hill-Trumbull worked in the Bovey. These shovels were switched during the latter part of the season.

Results at the washing plant were, on the whole, very satisfactory. There were the usual adjustments to be made in a new plant, but aside from the difficulty experienced with the Tyler vibrating screens, no delays of consequence were experienced during the season.

Structure drilling was undertaken during the ore season as a guide to advantageous shovel cuts and this work was continued with two structure outfits upon the completion of the ore season to determine the character and best method of mining for 1934.

2. PRODUCTION, SHIPMENTS & INVENTORIES:

a. Production by Grades:

Snyder Crude,	329,946	tons.
Bovey Crude,	222,272	"
TOTAL CRUDE,	552,218	"
Snyder Non-Bessemer Concentrates,	75,914	"
Snyder Bessemer Concentrates,	83,467	"
Bovey Non-Bessemer Concentrates,	73,579	"
Bovey Bessemer Concentrates,	69,366	"
TOTAL CANISTEO MINE,	302,326	"

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2. PRODUCTION, SHIPMENTS & INVENTORIES:

a. Production by Grades: (Continued)

Although ore operations started on August 2nd, capacity production did not begin until August 7th, and were completed October 18th. Three - eight-hour shifts were employed - five days per week.

b. Shipments:

The shipments from the Canisteo Mine during 1933 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 Canisteo property during 1933, but the following lean Non-Wash material was placed in stock:

Paint Rock,	Tons	Fe.	Phos.	Sil.
Snyder Lease,	4,680	38.47	.045	38.90

e. Production by Months:

(1) Crude Ore:

MONTH	SNYDER	BOVEY	TOTAL
August, ----------	137,119	43,010	180,129
September, ----------	125,607	115,783	241,390
October, ----------	67,220	63,479	130,699
TOTAL, 1933 -------	329,946	222,272	552,218

(2) Concentrates:

MONTH	SNYDER	BOVEY	TOTAL
August, ----------	70,428	24,523	94,951
September, ----------	57,879	73,740	131,619
October, ----------	31,074	44,682	75,756
TOTAL, 1933 -------	159,381	142,945	302,326

No direct shipping ore was mined.

f. Ore Statement:

All material considered as ore that was mined during 1933, was shipped from the property.

g. Delays:

The following delays were reported during the year 1933:

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2. PRODUCTION, SHIPMENTS & INVENTORIES: (Continued)

g. Delays: (Continued)

Date:	Time Lost Hours	Minutes	Cause:
August 7th,	5		Coil burned out, East Hummer screen.
August 8th,	1	35	Electrical trouble, Symons crusher.
August 11th,	1	50	Broken shovel cable.
August 14th,		25	Yards plugged with loads.
August 15th,	1	30	Symons crushers plugged - operating one side only.
August 16th,	10		Symons crushers plugged - operating one side only, for 21 hours out of 24.
August 21st,	6	30	Mill operating one side only account Hummer screen trouble.
	3		36" Conveyor plugged.
August 23rd,	1		Pan conveyor motor trouble
	1		Making splice on conveyor
August 24th,		15	Repairing Dorr washer switch
		20	Repairing rock chute
August 25th,		20	Power off
August 28th,		30	Waiting for water
		15	Repairing Dorr washer switch
		30	Splicing crusher belt
August 30th,	4		Hummer screens plugged with wet ore
	1		Car off track
September 1st,	1		Hummer screens plugged with wet ore
	4	30	Broken main conveyor belt
September 4th,	2		Yards plugged with loads
September 5th,		25	Trouble with Hummer screens.
September 7th,	2		Mill operating one side only account of screen trouble.
September 8th,		20	Oiling machinery
		25	36" conveyor belt repairs
	1		Operating one side only - Dorr washer screen repairs.
September 11th,		30	Waiting for water
September 13th,		40	Patching 36" conveyor
September 15th,		30	Repairing chute - Dorr washer
September 16th,		10	Repairing 36" conveyor
		40	Waiting for Great Northern cars
		20	Repairing screens.
September 18th,		15	Waiting for water
	2	45	Classifiers plugged
September 21st,		50	Power off
		20	Priming pumps after shut down account of no power.
	1		Repairing side boards fine ore chutes.

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2. PRODUCTION, SHIPMENTS & INVENTORIES: (Continued)

g. Delays: (Continued)

Date	Time Lost Hours	Minutes	Cause
September 23rd,	5	45	Shovel loading lean ore
		25	Repairing Symons crushers
September 25th,		30	Large boulder in receiving bin
September 26th,	2		Yards plugged with loads
		20	Oiling machinery
		15	Repairing chutes under vibrating screens.
September 28th,	9		Operating one side only for 18 hours account crusher down.
October 2nd,		45	Waiting for water
	1		Plugged rock chutes
		30	Repairing hopper on 36" conveyor
October 3rd,	1	10	Yards plugged with loads
		20	Repairing Hummer screen
October 5th,		45	Repairing 8' pan conveyor
October 6th,	1		Repairing Hummer screen
	1	45	Splicing 36" belt
		15	Yard plugged with loads
October 7th,		20	Repairs to Hummer screens
October 9th,		30	Welding frame on vibrating screen
		30	Waiting for water
October 10th,		30	Repairing rock gun
October 14th,	1		Repairing 36" belt conveyor
October 16th,		50	Waiting for water
Total Delays Ore	88	5	
October 31st,	1	45	Repairing boom motor
November 21st,	1		Changing hoisting cable
November 28th,	1	30	Changing adjustment bolts on trip motor.
December 1st,	1	30	Dipper stick jumped tooth on shipper shaft pinion
	2		Repairing saddle block on shovel
Total Stripping,	7	45	
GRAND TOTAL,	95	50	

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3. ANALYSIS:

a. Mine Analysis of Production & Shipments:

	Tons	Iron	Phos.	Sil.	Mang.	Alu.	Moist.
Snyder Non-Bess. Concts.	75,914	56.09	.070	9.34	.50	.54	9.47
Snyder Bess. Concts.	83,467	57.28	.040	8.94	.29	.46	9.92
Bovey Non-Bess. Concts.	73,579	56.82	.106	10.61	.30	.42	7.98
Bovey Bess. Concts.	69,366	58.75	.049	10.29	.23	.39	7.28
Total - 1933,	302,326	57.20	.066	9.75	.33	.45	8.72

d. Average Analysis of Crude Ore Production:

	Tons	Iron	Phos.	Sil.
Snyder Crude,	329,946	38.04	.047	38.03
Bovey Crude,	222,272	44.60	.069	30.35
Total Crude Ore,	552,218	40.68	.056	34.94

e. Composite Analysis of Season's Shipments:

	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss
Snyder:									
Bess.Concts.	57.15	.040	8.90	.31	.42	.20	.19	.009	8.07
Non-Bess."	56.15	.071	9.40	.49	.50	.22	.18	.010	8.40
Bovey:									
Bess.Concts.	58.60	.050	10.38	.22	.36	.19	.14	.012	4.77
Non-Bess. "	56.90	.104	10.72	.31	.41	.24	.17	.013	6.40

4. ESTIMATE OF ORE RESERVES:

a. Developed Ore:

Assumption:

14 Cu. Ft. per ton for Direct Ore.
16 Cu. Ft. per ton for Wash Ore.
A rock deduction of 10% was applied in this estimate.
The ratio of concentrates was figured at 60%.

	WASH	LOW GRADE WASH	LEAN WASH	MERCH.
Snyder, $SE\frac{1}{4}$-$SE\frac{1}{4}$ Sec.30,	1,936,694	187,000	285,000	-
" $SW\frac{1}{4}$-$SE\frac{1}{4}$ "	995,000	129,000	78,000	-
" $SE\frac{1}{4}$-$SW\frac{1}{4}$ "	485,000	-	-	-
Total, ----------	3,416,694	316,000	363,000	-
No.Bovey $NW\frac{1}{4}$-$SE\frac{1}{4}$ Sec.30,	302,800	35,900	13,500	
" $NE\frac{1}{4}$-$SE\frac{1}{4}$ "	454,555	-	-	229,400
Total, ----------	757,355	35,900	13,500	229,400
So.Bovey $NE\frac{1}{4}$-$NE\frac{1}{4}$ Sec.31,	742,700	78,400	60,900	-
Hemmens $SW\frac{1}{4}$-$SW\frac{1}{4}$ Sec.29,	1,356,500	178,800	148,000	-
Total Wash Concentrates,	6,273,249	609,100	585,400	229,400
Total Low Grade Wash,	609,100			
Total Lean Wash,	585,400			
Total Merch.	229,400			
GRAND TOTAL ORE,	7,697,149			

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4. ESTIMATE OF ORE RESERVES:

a. Developed Ore: (Continued)

The exploratory work undertaken during 1933 was for the purpose of determining the grade of the ore and to guide mining operations and did not effect the known ore reserves. The ore estimate of January 1st, 1934, is, therefore, the same as for the previous year, with the shipments deducted.

c. Estimated Analyses:

	Fe.	Phos.	Sil.	Moist.	Fe.Nat.
Bessemer,	58.00	.045	10.00	9.00	52.78
Non-Bessemer,	58.00	.095	10.00	9.00	52.78

5. LABOR & WAGES:

a. Comments:

(1) Labor:

A number of the mines on the Western end of the Mesaba Range were inactive during 1933 and labor, consequently, was plentiful and of a very desirable character. The force employed at the Canisteo Mine, averaging approximately 250 men, was about equally divided as between former employees of the Hill-Trumbull, Holman-Cliffs and Canisteo Mines.

With the inauguration of the N.R.A. regulations in July, the force at the Canisteo Mine was organized accordingly. We have previously operated our open pit properties and washing plants on a two - 10-hour shift basis, but it was necessary at the Canisteo to adopt a three - 8-hour shift working schedule, effective five days per week.

The Employees' Representation Plan was put into effect, elections were held and the organization completed the fore part of August.

(2) New Construction:

The construction of the transmission line, leading from the mine to the washing plant and the removal of the washing plant sub-station to a location near the shops, was the only work of this nature undertaken during 1933. These transmission line changes were for the purpose of taking all our current for the Canisteo Mine through one meter and thus effect a more satisfactory load factor.

b. Comparative Statement of Wages & Product:

Production (Concentrates)	302,326 tons.
Number of days operated:- 3 - 8-hour shifts per day,	63
Average daily product,	4,799
Average number of men working,	205
Average wage per day,	4.17
Amount paid for labor,	$ 62,700.71

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6. SURFACE:

a. Buildings, Repairs:

Partitions were placed in the ground floor of the washing plant to afford space for an office and sample room.

The quick laboratory was put in shape for service. This structure had only been partially completed before.

It was not necessary to make any repairs to the mine buildings during 1933.

c. Tracks, Roads, Transmission Lines:

(1) Tracks:

A track crew of twenty-two men were engaged July 11th. They put the main line tracks in condition, as well as those leading to the shops, washing plant and in the pit.

A second track was laid on the washing plant high line leading to the receiving pocket.

During the ore season, the track crew was engaged largely on the low tracks and did some general maintenance work.

At the end of the ore season, the stripping tracks were laid in the pit and those on the dump and stockpiles put in shape for service.

No road work was necessary during the year.

A new transmission line was built from the shops to the washing plant. This work, which had been started in December, 1932, was completed by the fore part of March.

7. OPEN PIT:

a. Stripping:

At the conclusion of the ore season on October 18th, the stripping, dump and stockpile tracks were put in shape for service. This work was completed on October 30th, when stripping operations were begun.

Stripping activities were conducted on a three, 8-hour shift basis, four days per week. The first work undertaken was the removal of the paint-rock along the East side of the North Bovey bay, adjacent to the area where ore operations had been conducted during the season. This work consisted in taking cuts toward the South, following the paint-rock seams until they dipped to such an extent that there was a capping of wash ore. The balance of the work on these paint-rock seams will have to be undertaken in connection with ore operations and the handling of same will be a part of the ore mining cost. Some Bovey paint-rock was also removed from the run-down grade developed by the Oliver Company when they operated the property. Before removing the paint-rock from the old Oliver approach, the tracks were shifted to the East and the old grade will now be abandoned.

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7. OPEN PIT:
(Continued)

a. Stripping: (Continued)

Stripping work on the Bovey land was finished on November 16th and the electric shovel was moved down to the bottom of the pit to handle waste material which had been cast aside in connection with our Snyder ore operations and also some material left by the Oliver Company to the North of the Snyder ore area mined by us during the past season. It was necessary to move this waste material in connection with our 1934 ore operations. Stripping work was discontinued on December 13th.

The material handled from October 18th to December 13th, amounted to: 136,980 yards.

d. Timbering:

Statement of Ties Used:

Amount	Kind	Price	Cost
2,051	Standard 8" x 8" x 8'	.8997	$ 1,845.38

f. Explosives, Drilling & Blasting:

Statement of Explosives Used:

KIND:	QUANTITY	PRICE	AMOUNT
25% - 5 x 16 L.F. Gel.	2,000 Lb.	10.25 C.	205.00
25% - 3 x 10 Quarry Gel.	72,850	10.128	7,378.88
3-1/2 x 10 Dup. Extra "C"	35,800	11.925	4,269.50
35% 1-1/4 x 8 Quarry Gel.	500	10.90	54.50
40% 1-1/8 x 8 Dup. Special Gel.	500	11.25	56.25
60% 1-1/8 x 8 Dup. Special Gel.	250	12.25	30.63
60% 1-1/4 x 8 R.C. Extra,	500	11.75	58.75
60% 1-1/4 x 8 Dup. Special Gel.	500	12.75	63.75
60% 1-1/4 x 8 L. F. Extra,	1,000	12.00	120.00
Hercomite Bag Powder,	2,000	11.50	230.00
Crescent Fuse,	6,900 Ft.	.624	43.06
24' No.6 E.W. Electric Exploders,	250	10.31 C.	25.78
30' No.6 E.W. Electric Exploders,	1,500	13.31	199.68
40' No.6 E.W. Electric Exploders,	600	17.25	103.50
No. 20 Connecting Wire,	100 Lb.	.32	32.00
Duplex Lead Wire,	19.2 Lb.	.26	5.00
No. 2 Cap Crimpers,	4	.75	3.00
GRAND TOTAL,			$ 12,879.28

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7. OPEN PIT:
(Continued)

g. Open Pit Mining & Loading:

On August 1st, the electric shovel began loading wash ore from the Snyder island, taking a cut along the North side and heading Westward. Succeeding cuts were taken to the South and they became shorter and shallower as the work progressed. The original bank on the North side of the island was about 30 feet high, but due to the pitch of the formation and the depth restriction on account of the water level, the bank of ore minable was only 6 feet in height when the last cut to the South was reached.

The electric shovel worked in the Snyder ore until September 10th, when it was transferred to the North Bovey and was replaced by the steam shovel, which had been engaged there. This change was made as it was necessary to conduct a much more flexible operation in the North Bovey area, due to grades and operating conditions.

Practically the entire Snyder ore body, as laid out for mining in 1933, was handled during the season, a small quantity of ore being left at the Western end. The Snyder ore handled during 1933 was of a uniform quality, being of a light sandy, porous structure, yielding a low recovery when treated. The concentrates secured from the treatment of this ore were of a very fair grade, the Silica being lower than is usual with wash ores of a like Iron content.

The Model 88-C steam shovel, started a cut in the North Bovey on August 2nd, loading on the main approach track and working Northward. The first cut was pushed through to the North end of the area, but could not be extended to the limit on account of the very rocky conditions encountered. Subsequent cuts were stopped some distance to the South. This rocky material cannot be washed to advantage in our present plant, but undoubtedly would lend itself to treatment in a jigging or coarse tabling mill.

The steam shovel worked in the upper level of the Bovey area until September 10th, and was then transferred to the Snyder island area in the bottom of the pit and the balance of the ore mined from the Bovey area was handled from a lower elevation by the electric shovel. This shift was made necessary in order to secure a desirable grade of ore. The Snyder ore washed very slowly and in order to get out the tonnage, the Bovey ore had to be pushed during the latter part of the season.

The electric shovel operated from an elevation averaging from 30 to 50 feet lower than the steam shovel when it was engaged in the Bovey area.

The gasoline shovel was utilized throughout the summer to do clean-up work, prepare track grades and load small deposits of ore that could not be handled to advantage with the larger equipment.

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7. OPEN PIT:
(Continued)

g. Open Pit Mining & Loading: (Continued)

The Bovey ore handled during the season yielded a much better recovery and was of higher Iron content. The Snyder ore in the horizon below that mined in 1933 is of much better character and the 1934 Snyder ore should not necessitate sweetening, as regards the Iron and Silica content.

k. Water Level in the Pit:

Pumping operations were maintained on a 24-hour basis throughout the year and the water was held at a constant elevation just below the bottom of the Snyder ore cuts.

Upon the conclusion of ore operations, the gasoline shovel was utilized to dig a drainage ditch across the Snyder bottom to the pump sump. After this work was done the machine was equipped with its clam shell bucket adjustment and longer boom and was engaged in deepening the sump. The elevation of the sump was lowered approximately 15 feet over an area 100 feet long and about 30 feet in width. Work here was discontinued December 6th on account of very severe weather. It is the intention to resume dredging operations in order to affect the desired depth of the sump, during the month of April, 1934.

8. COST OF OPERATION:

a. Comparative Mining Costs:

PRODUCT:	
Concentrates, ----------	302,326 tons
Average Daily Production (Conts.) ------	4,799 "
Tons Per Man Per Day (Concentrates) ----	16.43
Days Operated, ----------	63
Budget - Estimated Cost at Mine --------	$ 1.519
Actual Cost at Mine, ----------	1.333

COST: Total Cost at Mine:	BUDGET ESTIMATE	ACTUAL COST
Open Pit Wash Ore (Concentrates) -----	$ .250	$ .215
General Pit Expense, ----------	.040	.070
Concentrating, ----------	.200	.156
General Mine Expense, ----------	.100	.110
Idle Expense, ----------	.049	---
Cost of Production, ----------	$ .639	$ .551

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8. COST OF OPERATION: (Continued)

a. Comparative Mining Costs: (Continued)

COST:	BUDGET ESTIMATE	ACTUAL COST
Total Cost at Mine:		
Depreciation, Plant & Equipment,	$ .250	$ .250
Depreciation, Movable Equipment,	-	.003
Amortization, Stripping,	.315	.315
Taxes - Ad Valorem,	.152	.155
" - Occupational,	.040	.040
" - Royalty,	.011	.011
Total Cost at Mine,	$ 1.407	$ 1.325
Administrative & General Expense,	.112	.108
GRAND TOTAL, ----------	$ 1.519	$ 1.433

d. Detailed Cost Comparison:

(1) Product:

The mine operated approximately 2-1/2 months and produced 302,326 tons of concentrates, which was in line with our expectations as to the capacity of the plant. Based on this accomplishment and taking into consideration the fact that this was a new mill and had to be tuned up, the annual capacity of the Canisteo Mine can safely be assumed at 800,000 tons of concentrates.

The character of the ore treated during the season of 1933 was of poorer grade than the average wash ore in the property and the expected weight recovery during the life of this operation should be higher by approximately 10%. The low recovery realized during the season of 1933 had a direct bearing on the capacity of the operation and it was necessary to cut down the feed of this low grade ore at the mill.

Considering the character of the ore treated, the average daily output of 4,799 tons was quite gratifying.

The actual cost realized in 1933 was $.086 per ton under the budget estimate, and this reduction was realized in spite of the fact that the Mining Code was put into effect and wages raised subsequent to preparing the estimate.

(2) Wash Ore Costs:

The open pit budget estimated cost for producing the ore (concentrated basis) was $.250 per ton, whereas the actual cost was $.215 per ton. The items under this caption which showed a lower cost than anticipated were: "Drilling & Blasting" - "Steam Shovel Maintenance" - and "Track Expense". In setting up the expected costs - the former operating expense at the Hill-Trumbull and Holman Mines was used as a basis. The track expense was quite a little under expectations.

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8. COST OF OPERATION: (Continued)

d. Detailed Cost Comparison: (Continued)

(3) General Pit Expense:

The cost realized under this caption was $.03 higher than the budget estimate. There were two items, viz: "Pumping & Drainage" and "Structure Drilling" that were responsible for this increase, especially the former. It was necessary to do considerable drainage work in connection with the open pit operations in 1933 that was not anticipated.

(4) Concentrating:

The budget estimate of $.20 was bettered by $.044 per ton and was due entirely to the lower actual washing expense, both in labor and power. The transportation charge was in line with expectations, as well as general expense and maintenance items under this caption.

(5) General Mine Expense:

The actual cost under this heading was $.01 higher than the budget estimate, but it included a proportion of winter and repair expense, which was set up as a separate item in the budget. The Geological and District Office expenses were somewhat higher than anticipated, due in the first instance to charges against the Research Department and in the second, to allocating the District Office very largely against this one operation.

(6) Depletion, Depreciation & Taxes:

The items under this caption were in line with the budget estimate.

9. EXPLORATIONS AND FUTURE EXPLORATIONS:

One of the structure drill outfits was placed in service the middle of August and was engaged during the balance of the ore season putting down holes in the North Bovey area. Some of these holes were necessary as a guide to our 1933 operations and several of them were for the purpose of determining the grade and character of ore to be mined in 1934. A total of eight holes were drilled in the North Bovey and the outfit was then moved to the Hemmens lands, where three deep holes were put down along the West edge of the Hemmens pit. The Hemmens lands were drilled principally for the purpose of ascertaining whether or not operations could be conducted in this area to advantage during the 1934 season. This drilling demonstrated that the character of the Hemmens ore is such that it would be advisable to delay mining operations here until a treating plant is provided for the so-called jigging material.

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9. EXPLORATIONS AND FUTURE EXPLORATIONS:

Upon the conclusion of the ore season, the second "Armstrong" drill, equipped with a structure drill rigging, was put in service and the two machines spent the balance of the year putting holes across the East end of the Snyder pit bottom and in completing exploratory work on the North Bovey for 1934 ore requirements. A total of eleven holes were put down on the North Bovey and thirty-one holes, most of them rather shallow, on the Snyder. At the end of the year - two Snyder holes remained to be drilled.

The drill machines were operated three, 8-hour shifts, five days per week. The progress of the work was interrupted at times by extremely severe weather conditions.

It will be necessary to carry on a fairly extensive drilling program each year in order to determine definitely the character and grade of ore as a guide in preparing our estimates each year. It will require each year approximately the same amount of work in this connection as was undertaken during 1933.

10. TAXES:

The following statement shows the taxes and average rate for the years 1932 and 1933:

	1933	1932	Increase	Decrease
Canisteo Mine,	$ 41,637.85	40,871.74	766.11	
Washing Plant Lands,	2,573.09	2,549.81	23.28	
Personal Property,	2,540.03	2,850.71		310.68
Total,	$ 46,750.97	46,272.26	478.71	
Village Lots,	191.30	187.78	3.52	
GRAND TOTAL,	$ 46,942.27	46,460.04	482.23	
Average Tax Rate,	.761	.747	.014	

11. ACCIDENTS AND PERSONAL INJURY:

There were three lost-time accidents at the Canisteo Mine during the year 1933, as follows:

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11. ACCIDENTS AND PERSONAL INJURY: (Continued)

NAME: Ray G. Wilson DATE: July 11th.
CAUSE: Wilson was engaged in cleaning up the carpenter shop. A casting, bolted to a piece of wood, the entire piece weighing approximately 100 pounds, was being moved out of the shop. In so doing - Wilson sprained his back.
NATURE: Sprain of back, Lumbar region.
TIME LOST: Five days.

NAME: Lawrence Lafond DATE: August 31st.
CAUSE: Lafond was employed as a motor brakeman on the washing plant haulage system. The track bench on this haulage system is elevated approximately six and one-half feet above the ground level and is made of chunky taconite and rock. A stairway is provided for descending to the ground level. Lafond, instead of using the stairway, attempted to get to the ground over the rocky track bench and fell down, causing the accident.
NATURE: Comminuted fracture lower end of right tibia with joint involvement. Fracture lower 1/3 of fibulae; extensive hematoma at ankle.
TIME LOST: Was still at home at end of year.

NAME: Arthur Fogelberg DATE: September 2nd.
CAUSE: Fogelberg was applying belt dressing to the 36" belt conveyor head pulley with a stick in order to stop the belt from slipping. When sufficient dressing had been applied the belt adhered to the pulley very quickly and his hand was dragged in between the belt and the pulley.
NATURE: Fracture right collar bone; abrasions and cuts of the back, right arm and face.
TIME LOST: Was still at home at end of year.

12. NEW CONSTRUCTION AND PROPOSED NEW CONSTRUCTION:

No new construction work was undertaken at the Canisteo Mine during 1933.

It will be necessary to consider and work up plans for an additional treating plant to handle the so-called jig material. These plans should be perfected and a plant constructed for operation during the season of 1935. The ore program for 1934 will not require such a treating plant and it will not be necessary to handle more than a very small quantity of this material.

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13. EQUIPMENT AND PROPOSED EQUIPMENT:

Two Tyler vibrating screens were purchased and installed at the washing plant during the month of July. These screens did not operate satisfactorily and it was necessary to secure an Allis-Chalmers screen for one side of the plant's operation. The Allis-Chalmers screen proved very satisfactory and it will be necessary to purchase a second one, to replace the other Tyler screen, for our 1934 operation.

Other than the replacing of worn parts in the equipment, no purchases of moment are considered for the year 1934.

14. MAINTENANCE AND REPAIRS:

The only pit equipment repair work undertaken during 1933 was in the nature of maintenance work in the shops while ore and stripping operations were in progress.

It will be necessary to overhaul the pit equipment and the washing plant, prior to a resumption of activities - May 1st. Repair work on the pit equipment will be started January 8th and should require about ten weeks time, with a force of approximately 30 men. The employees will be staggered, so as to effect the maximum force. Repair work on the washing plant will be undertaken when weather conditions in the spring warrant.

Washing Plant Repairs:

Upon the conclusion of the ore season, the washing plant was thoroughly cleaned and drained.

During November and December, the following list of repairs were undertaken: The apron plates in front of the Dorr washer rakes were taken out and this material was used to finish lining the crude ore pocket.

The Tyler vibrating screen was taken out and shipped back to the factory at their request.

The grizzly at the head of the 8-ft. pan conveyor was removed and will be replaced by one of new design. The 18" conveyor belts, leading from the Dorr washers to the concentrating bins, were removed and the necessary changes made to the pulleys to accommodate 24" belts. The rock pockets at the 5-ft. pan conveyor were rebuilt. The West Symons crusher was taken apart and repaired. The chutes under the vibrating screens were overhauled. The Dorr washers were gone over in a general way; the screens cleaned and repaired and the rollers, which had developed flat spots, were removed, to be rebuilt up. The rollers on the 36" conveyor were cleaned and greased.

No further work will be undertaken at the washing plant until April 1st.

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18. NATIONALITY OF EMPLOYEES:

NATIONALITY:	NOL OF MEN
American,	118
Finnish,	15
Austrian,	13
Swedish,	11
Norwegian,	10
Italian,	9
Serbian,	7
Croatian,	6
Slavish,	6
Canadian,	3
Irish,	2
Dane,	1
German,	1
Bulgarian,	3
TOTAL,	205

19. WASHING PLANT OPERATIONS:

A crew of fifteen men started work at the washing plant on July 11th, and were engaged until August 1st in making preparations for the ore season. The following work was accomplished:

Such belting, guards and other equipment as could be used to advantage, were transferred to the Canisteo plant from the Holman washer.

The piping in the mill was completed.

A fill, from the crusher house along the side of the tail track, was provided for the purpose of handling rock sorted out on the 5-ft. pan conveyor. This method of handling the rock rejects eliminated the necessity of building a trestle.

The receiving bin was lined with steel plates.

The motors for driving the crushers and pan conveyors were installed.

A floor was laid in the crusher house and safety guards were installed on the machines.

A concrete floor was laid in the room to be used for the storage of oil and for making minor repairs.

The vibrating screens were installed and the electricians completed the wiring and connected up the motors.

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19. WASHING PLANT OPERATIONS: (Continued)

Chute gates were provided at the loading pockets.

A ditch was dug to carry water pumped from O'Reilly Lake and a 10" pipe line was laid from the end of this ditch to the pumping station.

The quick laboratory was fully equipped and put in shape for operation.

The first ore was put through the mill on August 4th, During the first week only a small tonnage was handled as it was necessary to make numerous adjustments.

Generally speaking, the washing plant operated quite satisfactorily throughout the season, with the exception of the Tyler screens. Extremely good results were obtained with the Dorr washers and no delays occurred here.

The Bowl Classifiers were only put in service intermittently. Very little of the ore treated during 1933 contained fine material that could be saved to advantage.

The method of mixing the concentrates from the various machines was done efficiently and accurate sampling resulted.

The Tyler vibrating screens caused considerable trouble, particularly during the first two weeks. At the start, these machines would not handle the load, but representatives from the factory made adjustments and changed the cloth from 3" square mesh to one of 7/8" x 1-3/4". The construction of these screens was not rugged enough to stand up under the severe service required of them and numerous break-downs resulted. In order to carry the load, the screens had to be tilted at such an angle that the material carried over the screens was not cleaned satisfactorily. The Allis-Chalmers screen, which was installed later in the season, proved to take the load without any strain developing and the over-size carried by the screen was cleaned satisfactorily by the water sprays. The Allis-Chalmers machine worked to the end of the season without any breakage occurring.

The Symons crushers performed very well. One of these machines had to be shut down and cleaned upon two occasions, due to becoming plugged with pieces of wood and slime. This crusher was on the side where the Tyler vibrating screen was operated.

The feed end of the mill operated in a most satisfactory manner. The grizzly proved somewhat too short and of wrong design and by making alterations here at least one, if not two men, can be eliminated.

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19. WASHING PLANT OPERATIONS: (Continued)

One of the control switches gave some trouble, but this will be corrected and the chutes under the 5-ft. pan conveyor will be changed so that we will not have any further plugging here, due to wet, sticky ore.

The water supply proved adequate for the mill's operation and we do not anticipate that it will be necessary to call on any auxiliary supply in the future. Water was pumped from O'Reilly Lake into our storage basin pond for one week. We anticipate that the run-off from melting snows next spring will raise our water level sufficiently in the storage basin to provide us an ample water supply for the 1934 ore operations. The elevation of the water in the basin, referred to Lake Superior level, was 770.09 on May 2nd; - 773.70 after pumping one week from O'Reilly Lake - and at the end of the ore season, 772.75. A reading at the end of the year showed that the water had raised 1.1 ft. since ore operations have been concluded.

On account of the structure and low Iron content of the Snyder ore, the weight recovery realized was well below the average of any ore treated by us at any of our washing plants. The Bovey ore was somewhat better and the average weight recovery here was about in line with that realized at the Hill-Trumbull and Holman plants.

The production of concentrates in 1933 was 302,326 tons. This product was divided as follows:-

Snyder Concentrates,	159,381	tons
Bovey Concentrates,	142,945	"
Total,	302,326	"

The 5-ft. pan conveyor rejects amounted to 20,694 tons, averaging 28.59 Iron.

The analysis of the plant rejects for 1933 were as follows:

	Tons	Iron	Phos.	Sil.
Bovey,	13,218	28.65	.133	54.49
Snyder,	7,476	28.50	.058	55.04
Total,	20,694	28.59	.106	54.69

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19. WASHING PLANT OPERATIONS: (Continued)

The rock removed from the pit and placed on the waste dump during the season of 1933 was as follows:

	TONS	IRON
Bovey,	11,665	27.74
Snyder,	2,340	25.98
Total,	14,005	27.44

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

	TONS	IRON
Bovey,	14,150	31.20
Snyder,	1,050	35.00
Total,	15,200	31.46

The tonnage recovery realized in the treatment of Canisteo ores in 1933 was as follows:

Bovey,	64.31%
Snyder,	48.30%

Based on structure drilling results, the Snyder ore to be handled in 1934 will show considerably better weight recovery. The Snyder ore washed in 1933 had a relatively low Silica content, as compared with other wash ores that we have handled, but the Loss by Ignition was high and the concentrates were quite porous.

The Iron Unit Recovery realized in 1933 amounted to - 83.27% in the case of the Bovey ore and 72.01% for the Snyder.

The analysis of the product from the several machines for the year 1933 follows:

BOVEY MILL MACHINES:

	IRON	PHOS.	SILICA
Dorr Washer Oversize,	56.50	.103	11.98
Dorr Washer Rakes,	57.30	.084	11.46
Dorr Classifiers,	52.80	.036	21.25
Tailings,	20.18	-	-

SNYDER MILL MACHINES:

Dorr Washer Oversize,	56.59	.050	10.05
Dorr Washer Rakes,	55.84	.054	11.04
Dorr Classifiers,	50.67	.033	23.04
Tailings,	19.38	-	-

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19. WASHING PLANT OPERATIONS: (Continued)

On account of the character of the material handled during 1933, the classifiers were only operated a few days during the season and the product for the most part was bipassed to the tailing pond.

22. REPORT OF THE GEOLOGIST FOR THE YEAR ENDING DECEMBER 31, 1933

A. STAFF

The staff of the Geological Department, which on June 1, 1932 was reduced to one man, - Geologist in charge of Department, - continued on the same basis throughout 1933. Table I, below, gives the division of time during the year:

TABLE I

NAME	OCCUPATION	DURATION OF EMPLOYMENT IN 1933	DAYS LOST SICKNESS	DAYS LOST VACATION	% OF WORKING DAYS WORKED
E. L. Derby, Jr.	Geologist	Entire Year	0	0	101.0% #

Represents 21-3/4 hours net overtime after cancelling 33-3/4 hours (4½ days) illness and 29 hours (3-3/4 days) absence on outside business, or a total of 84½ hours, actual overtime worked.

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

TABLE II

Total days worked	276½ days
Sundays	52 "
Full days resulting from Saturday afternoons	26 "
Holidays	10½ "
Total	365 days

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

TABLE III

YEAR	AVERAGE NUMBER OF MEN
1929	4.0
1930	4.0
1931	3.7
1932	1.5
1933	1.0

B. DIVISION OF WORK AMONG THE MEMBERS OF THE DEPARTMENT

A division of the time between the various mines and miscellaneous items is shown in Table IV, below:

TABLE IV

ITEMS	HOURS WORKED	PERCENT
MINES:		
Athens	13	0.6%
Canisteo Cliffs	57¾	2.7
Cliffs Shaft	121	5.6
Drew	96	4.4
Erickson-Ravenna Leases	31	1.4
Jackson-Cambria	17½	0.8
Lloyd	60	2.8
Maas	197¼	9.1
Mackinaw	25	1.2
Morris	53¼	2.5
Negaunee	10	0.5
Sherwood	706½	32.6
Tilden	7	0.3
Virgil	41½	1.9
TOTAL MINES	1,436¾	66.4%
MISCELLANEOUS:		
Annual Report	73¼	3.4
American Inst.Mng.& Met.Engrs.Mt.	7¼	0.3
Beneficiation of Iron Ores	14	0.6
Dust Count	15¾	0.7
Examination W.G.Mather's Lands	58	2.7
General Departmental	257	11.9
Gold Leases	8	0.4
International Geological Congress	89	4.1
Investigating Mineral Land Offers	71¼	3.3
" Outside Explorations.	2	0.1
Michigan Mineral Land Company	47	2.2
Mineral Classification(For Land Dept)	7	0.3
Taxes (Michigan Properties)	4	0.2
Taxes (Minnesota Properties)	74	3.4
TOTAL MISCELLANEOUS	727½	33.6%
GRAND TOTAL	2,164¼	100.0%

E. L. Derby, Jr. Approximately twelve percent of my time during the year was taken up with office routine work, and the numerous miscellaneous duties peculiar to the Geological Department. I was without any regular assistance during the entire year. The largest single increment of my time,-approximately a third,- was taken up with the underground drilling which this Company did for the Republic Steel Corporation on the Sherwood lease, adjacent to our Virgil Mine at Iron River. This work started April 1st and was completed September 1st. It required the greater part of my time supervising it and calculating the results of sulphur tests made on the drill water to determine the percentage of soluble sulphur in the ore body. I mapped the geology of the underground development work in the Sherwood property which was carried on by us through the Virgil Mine. I also made underground geological surveys at the Cliffs Shaft and Maas Mines and supervised the structure drilling in the Canisteo-Cliffs and Drew Mine open pits of our Mesaba Range operations.

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

In January, I revised to date the reserve ore estimates of our active Michigan Mines as a part of the Annual Report to the Michigan State Tax Commission. I wrote a report covering my recommendations in regard to a revised appraisal of the mineral estate of the Michigan Mineral Land Company with special reference to a report to Mr. S. L. Mather, President, by Mr. R. C. Allen, Director.

In February, I prepared a revised operating estimate of the ore reserves of the Lloyd Mine, in anticipation of an examination of the property by mining officials of the International Harvester Company, with the idea of interesting their company in a substantial share of the ore in this property. The examination was not made.

I joined with Messrs. Jackson and Brewer, and the Superintendents, in conferring with Mr. F. G. Pardee, Michigan State Appraiser of Mines, on the reserve ore estimates filed with the State Tax Commission.

In March, I examined all our records covering the mineral value of the lands in the Upper Peninsula of Michigan owned personally by Mr. W. G. Mather and prepared a special report on the subject. I joined with Messrs. Elliott and Meyers and with Messrs. J. E. Nelson and E. W. R. Butcher of the Republic Steel Corporation, in planning a campaign of exploration and underground drilling on the -930' level in the Sherwood mine from the 6th Level of the Virgil Mine.

In April, approximately one half of my time was taken up with the exploring and drilling activities on the -930' level at the Sherwood Mine, which were started the first of the month for the account of the Republic Steel Corporation. The drilling, in particular, required very close supervision because it was necessary to sample all drill water,accurately, for soluble sulphur dissolved from the ore during the process of drilling. The calculations necessary in determining the final corrected analysis of total sulphur in the drill samples were voluminous and required much time.

I examined our files and correlated all the data contained therein covering the mineral possibilities of the lands of the American Iron Mining Company at the request of Mr. W. G. Mather, to be used at the annual meeting of the American Company on May 18th. I prepared a special report on this subject. I examined a report by Prof. J. L. Adler of the Michigan College of Mining & Technology, which he had prepared on the strategraphy of the Marquette Range, as a result of the field work he and several assistants did during the summers of 1929 and 1930. I prepared a criticism of this report at Prof. Adler's request prior to its final publication.

In May, 85% of my time was taken up with the exploration work at the Sherwood Mine. The drilling and calculation of drill sample results accounted for most of this time. Two drills, each working six double shifts per week, made progress rapid with a corresponding large number of samples. I also attended the public hearing given by the Michigan State Tax Commission at Ishpeming, May 20th.

In June, 68% of my time, - most of it in connection with the drilling, - was taken up with the exploratory work at the Sherwood Mine. I spent some time going over correspondence and miscellaneous reports relative to Land Offer No. 1884 covering a deposit of Chromite located about 21 miles south of Collins, Ontario and a similar distance west of Lake Nipigon.

I made a classification of the mineral values of the Company's lands in the vicinity of the Iron Ranges in Michigan, which are under the supervision of the Land Department. Mr. Elliott authorized me to assist President W. O. Hotchkiss of the Michigan College of Mining & Technology, in planning and carrying out an excursion over the Marquette Iron Range for geologists from all over the world who were first to attend the International Geological Congress at Washington, D. C., the latter part of July and I started to work up the necessary data for numerous talks to these visitors while they were on the Range.

In July, 41% of my time was taken up by the Sherwood exploration. Another 34% was required to complete the preparation of illustrative geological cross-sections and other data in connection with the excursion of members of the International Geological Congress, August 1st, on the Marquette Range. I also made a field examination and report of the work being done by Lundin & Bjork on the Gold property leased from this Company just East of the old Ropes Gold Mine.

In August, 56% of my time was taken up by the Sherwood exploration. August 1st witnessed the Marquette Range field trip of 39 members of the Lake Superior Excursion of the International Geological Congress. I assisted Dr. Hotchkiss in conducting this party over the Range, arranging for their luncheon and dinner at The Mather Inn, and for the automobiles to convey them. In the evening, at the Inn, I gave them a talk on the economic geology of the Range, illustrated by several large scale cross-sections which I had prepared especially for the occasion.

I spent several days in Minnesota in connection with our Mesaba Range operations. One day, I conferred with Professors Lambert and Heilig, engineers for the Minnesota State Tax Commission, at their office in the School of Mines, University of Minnesota, at Minneapolis. At this time I went over with them the estimates they have set up on underground wash ore at our various Mesaba-Cliffs West End properties. This type of ore is now valued at 1¢ per ton in the ground. The two following days I spent at our Hibbing office and at the Oliver office in Coleraine, getting additional data on underground wash ores.

In September, 46% of my time was taken up in connection with the Sherwood exploration. The drilling was completed on August 31st but the work of calculating and compiling the final results, and preparing a complete report on the entire program was considerable. In this connection, I attended a conference of Republic Steel Corporation officials at their office in Youngstown, Ohio, on September 20th. Following this, I went to our Cleveland office where I spent part of a day going over the results of this work with Messrs. W. G. and S. L. Mather and Mr. Geffine.

I spent four days on the Mesaba Range with headquarters at our Hibbing office, early in September, going over proposed revised Tax Commission ore reserve estimates of several of our West End properties. I also planned a series of structure drill holes at the Drew Mine and let a contract for the work at attractively low figures to the Schultze Brothers of Grand Rapids, Minnesota. I collected a quantity of high sulphur Mackinaw stockpile ore for laboratory experimental work on leaching the soluble sulphur content later in the season.

In October, I examined the old maps and other data of the Maitland Mine, an underground property located in the SW¼ of the NW¼ of Section 30, 47-26, about a mile Northwest of the Village of Palmer, and covered by our Land Offer No. 1890. I prepared a detailed report of this examination. I also accompanied Mr. Elliott on an underground examination of the Hartford-Cambria Mine workings in the vicinity of the Jackson boundary, which was covered in a special report by Mr. Elliott. The Republic Steel Corporation desires to lease a part of the continuation of their ore body on the Jackson property but Mr. Elliott advised against it.

I attended a Director's meeting of the Michigan Mineral Land Company, held at the office of the Inland Steel Company in Chicago, on October 19th, in connection with revising the list of mineral lands to be held or protected against tax delinquencies. I also spent four days on the Mesaba Range in connection with the structure drilling at the Drew Mine and also similar work at the Canisteo-Cliffs pit to sample the areas from which next year's production will be mined. Mr. Elliott accompanied me on this trip.

In November, I went over the list of lands of the Michigan Mineral Land Company on which taxes are being paid and particularly those descriptions where only the mineral rights are owned and tax titles have been purchased in the past. I prepared a special report recommending that we discontinue paying taxes on certain of these descriptions. I spent several days on the Mesaba Range laying out several new holes for the contractors doing the structure drilling at the Drew Mine, and in classifying the samples from both this drilling and similar work at the Canisteo-Cliffs pit, some of which I had not time to do since the drilling was done late last year.

In December, I assisted Mr. Elliott in planning the location for a large diameter churn drill hole to test the depth, character and moisture content of the surface material and the thickness of rock capping immediately over the extensive Maas Mine workings above the Southwestern end of the 4th Level.

I attended the Annual meeting of the Minnesota Section of the American Institute of Mining & Metallurgical Engineers held in the University of Minnesota in Minneapolis, on December 11th. Following this, I spent three days on the Mesaba Range classifying samples for the structure drilling at the Drew and Canisteo-Cliffs properties. Drilling at the Drew was discontinued for the present early in the month, due to unusually severe weather conditions. I collaborated in a detailed report of this work prepared by Mr. Barber. I also spent some time familiarizing myself with the technic of the preparation of cells or slides and the microscopic work in counting the dust particles, both in the light and dark fields, that are present in specimens of air collected from various working places and air ways in our operating mines. It is Mr. Elliott's thought that I should be prepared to assist Mr. Conibear in the supervision of this work as opportunity permits, - more especially the microscopic work.

C. SURFACE GEOLOGICAL SURVEYS

There were no surface geological surveys made by the Geological Department during the year.

D. UNDERGROUND GEOLOGICAL SURVEYS

D-1. ATHENS MINE

The Athens Mine worked four days per week, single shift, and with half a crew alternate weeks, from January 1st to April 8th and six days per week, single shift, and with half a crew alternate weeks (Thursday to Wednesday) beginning November 15th. Geological data was recorded periodically by Mr. R. J. Chenneour, engineer at the property.

The product came entirely from between the 4th and 8th Levels with most of it from between the 6th and 8th Levels. Development work continued above the 6th Level, South of the fault dike, on the -405', -415', -430' and -440' sub-levels. The ore in this part of the deposit has developed an horizontal area of considerable size due to the local flattening of the hanging wall. Raise No. 609, which was put up from the 6th Level a distance of 108' during 1932, was continued through to the 4th Level, principally for ventilation purposes. It wasin ore to a height of 151' and then in hanging jasper the rest of the distance to the 4th Level.

The ore mined from the 4th Level came from the South end of the old cross-cut at the Southwest end of the level. It was the top of the ore riser mined on the -405' to -440' subs. On the North side of the fault dike, and particularly on the -735' sub-level, stringers of decomposed dike or slate

(not yet distinguishable) have been uncovered interbedded with the ore and contaminating it sufficiently to somewhat reduce the recoverable ore in this vicinity. A suggestion of this condition prevailed when this area of ore was first opened up at the 8th Level elevation.

D-2. CLIFFS SHAFT MINE

At the Cliffs Shaft Mine the day shift men worked two days per week (Mondays and Wednesdays) mining, tramming and hoisting ore from January 1st to April 8th. During the same time the old night shift men worked two days per week, day shift, (Tuesdays and Thursdays) tramming and dumping rock into old stopes. Beginning November 15th, the same relative schedule was followed except that each man worked three days per week, - those on ore Mondays, Wednesdays and Fridays, - those on rock, Tuesdays, Thursdays and Saturdays. I made only one geological survey because the progress of development work has been very slow on the reduced scale of operation.

In "A" Shaft, the production continued to come 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. Development drifts to get under known ore bodies, or to open up their downward extensions, were cut on the 8th, 9th, 10th, 11th and 12th Levels. Stoping was commenced in the ore body on the 10th Level, Bancroft Lease, on the 1800 East coordinate which was first encountered in drill hole #421. The drift to this ore was driven in 1931 and 1932. On the 15th Level, the drift being driven North on the line of drill hole #422, on the East side of the Bancroft Lease, was extended about 50'. It had been following along in footwall greenstone but close to the upper contact and finally cut into ore in the back of the drift. A raise will be put up at once to outline this ore and determine if it is a part of the main Bancroft vein.

In "B" Shaft, the production continued to come entirely from floors, raises and stopes in the ore areas already developed on the various levels. No. 33 contract was raising from the 6th Level to encounter ore in an old incline drill hole put down from the 3rd Level. A rock drift, which was extended Northeasterly from the Northeast side of the 8th Level, failed to encounter the anticipated North vein ore and was discontinued until a raise can be put up. The drift from the Southwest end of the 10th Level was extended about 50' Southwesterly toward the ore body in the West half of Section 9, which was discovered many years ago by drilling from surface. On the 15th Level, the drift going Northeasterly toward the Section 3 ore body was extended only about 40', as the work was stopped temporarily in March. It is anticipated, however, that this drifting will be resumed shortly.

D-3. GARDNER MACKINAW MINE

All work at this mine was confined to the Mackinaw Lease. The schedule of operation was similar to the Athens Mine, each man working two days per week from January 1st to April 8th and three days per week after November 15th.

The only production came from development work. This consisted of stripping the incline raise, which had been put up on the line of the incline shaft from the 8th to the 7th Levels in 1932, and in sinking this shaft from the 8th level for a distance of 177' on a 50° inclination. All but the bottom 20' was in ore, the last 20' being in footwall jasper with interbedded seams of black graphitic slate. At about 140' on the incline below the 8th Level, in this shaft, a cross-cut was extended for a distance of 54', all in ore, without encountering the hanging wall, - a very encouraging width. The 9th Level timbers were set at 165',on the incline, below the 8th Level.

D-4. LLOYD MINE

The activity at the Lloyd Mine was all confined to the work in the shaft and it was carried on three shifts per day and six days per week from January 1st to April 8th and after November 15th. Each man worked a full week every third week till April 8th and on a half time basis after November 15th (three shifts each week).

An 8' x 12' raise was put up on the line of the shaft and holed into it, starting from the 6th Level and is now being stripped to full size (13' x 17'). The 5th Level plat and pocket has also been cut out one third of the way down from the 4th to the 6th Levels or 134' below the 4th Level.

D-5. MAASMINE

The Maas Mine worked the same schedule as the Athens Mine until April 8th. Following this a development program to continue opening up the new 5th Level was carried on throughout the balance of the year. From July 1st on, a few contracts, - starting with six and gradually increasing to sixteen, - were put to work on Bessemer ore production. After November 15th, the same schedule of operation was followed as at the other soft ore mines. I made several geological surveys of the 5th Level development and Mr.Moulton, engineer at the property, recorded geologic data, periodically, from the rest of the mine.

The principal production continued to come from three localities: above the 3rd level in the new riser of ore from the 4th Level on the Race Course; between the 2nd and 3rd levels on the footwall side of the deposit; and above the 4th Level under the hanging just South of the Race Course. All the Bessemer production came from the last mentioned locality.

On the 4th Level, the cross-cut Southeasterly from the main North-South rock drift was holed through to No. 3 cross-cut East. Also, on this level, the West ends of the two Southwest drifts South of the Race Course were connected by a cross-cut, - partly in ore and the balance in jasper and two dikes. On the 5th Level, parallel Southeast, cross-cuts Nos. 4, 5 and 6 were opened up and the South ends of Nos. 4 and 5 connected by a Southwesterly drift which had almost holed into No. 6 cross-cut at the end of the year. Also the footwall drift at the North end of these cross-cuts was driven Westerly to the West boundary of the Race Course and was in ore from No. 6 cross-cut to its end. Eleven raises were put up, ten of them holing into the 4th Level, the other, No. 5428 being stopped temporarily.

D-6. MORRIS MINE

Although the Morris Mine is operated under lease by the Inland Steel Company, it is my intention to make periodical underground surveys and keep our geological maps and cross-sections posted to date. Owing to the depletion of personnel in the Department, however, this has been impossible the past year. Mr. Trosvig, formerly engineer at the property under our employ, is now employed by the Inland Company in the same capacity and he has kept the geology surveyed and posted on the Inland's set of maps and sections.

The mine was operated continuously through the year on the basis of from 12 to 14 day shifts per month. Three men are employed in each contract but only two on any one shift so that each man worked one third time, or from eight to ten shifts per month. Since about November 15th, each man has had the full twelve to fourteen shifts.

Production the past year has all come from No. 9 lease and the Cleveland-Cliffs fee land East and South of this lease. Approximately 75% of the product has come from the sub-level stopes and the balance from sub-level slicing and caving. The top-most working was the 220' sub, about 140' above the 7th Level, and the lowest working the 10' sub, about 145' below the 7th Level. Development work on the -40' sub, however, has been carried on and five raises from the 8th Level holed into. Also a 35° inclined raise was put up from the East end of this sub to the 7th Level to handle timber.

The known ore bodies were more completely outlined, of course, as mining in them progressed. In No.21 deposit, however, which is the most Northeasterly ore body, an appreciable extension has been developed, both horizontally and vertically. The horizontal extension was developed on the 170' sub and the vertical extension by a North drift on the 110' sub which cut 39' of extremely high grade ore right across the formation. It now seems very probable that this ore will extend well below the 7th Level, particularly on the pitch, and be found at this elevation a short distance North of the present Northernmost ore drift. I shall watch this development with an unusual interest because of our earlier prediction of such a possibility.

D-7. NEGAUNEE MINE

The Negaunee Mine followed the same schedule of operation as the Athens Mine, being closed but kept pumped between April 8th and November 15th. The Geological features were surveyed and mapped periodically, by Mr. Moulton, engineer at the property.

The production came, principally, from three sub-levels, - the 2nd sub below the 10th Level in the North and South footwall areas, and the 1st and 2nd subs below the 11th level adjacent to the Maas boundary. The new transfer drift in the footwall on the 360' elevation, started in 1932, was completed and three raises holed to the 11th Level from it. The top 20' of each raise was in ore.

D-8. TILDEN MINE

The Tilden Mine worked irregularly during the shipping season and produced a total of 94,104 tons of silicious ore. Of this, 25,924 tons were mined from the East Pit and 68,180 tons from the West Pit. The East Pit is a new operation, having been partially stripped in 1932. It is located about half a mile East of the West Pit and produces an ore much lower in phosphorus but also somewhat lower in iron and higher in silica. No extensive geological mapping was necessary,

D-9. VIRGIL MINE

The Virgil Mine operated six day shifts per week from January 1st to April 28th but each man worked only two days per week. The Mine has not produced since April 28th but has been kept pumped. I have kept the geology mapped periodically and the geological maps and cross-sections posted.

A small amount of ore was produced from stoping in the main ore body above the 6th Level but most of the production came from the development and stopes in the 8th Level ore body between the 6th and 8th Levels.

Drifting and cross-cutting at the 6th Level elevation on the Sherwood property, their -930' level, and which was commenced the early part of 1931 was resumed. A cross-cut driven due South 200' West of the Virgil boundary developed ore to a width of 160' but it was quite high in sulphur. A small sub-level, 21' above the level, was opened in the North ore in its extension onto the Sherwood from theVirgil and the hanging wall contact outlined. Four drill stations were cut from which five inclined diamond drill holes were drilled. The main footwall drift was extended Southwesterly to a point 600' West of the Virgil boundary for the purpose of cutting two of these stations. The other two stations were located 200' West of the boundary, one in the North-South cross-cut, the other along side the main drift. I surveyed and mapped all of the geology and had direct charge of the drilling for the Republic Steel Corporation. The work was all done by our own men with our own equipment and was completed on September 1st.

E. OPTIONS AND LEASES

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

The lease on the Dean-Itasca Mine, Mesaba Range, was surrendered, effective February 3, 1933.

A lease on the Ravanna-Prickett Mine, in the Crystal Falls District, was acquired from the Hollister Mining Company, a subsidiary of the M. A. Hanna Company, in exchange for our Erickson lease at Iron River. The lease on the Prickett forties of the Ravenna-Prickett was subsequently surrendered.

F. EXPLORATIONS AND COSTS

Drilling explorations were carried on during 1933 in the following districts and mines:

F-1. FROM SURFACE

DISTRICT	RANGE
Buhl	Mesaba
Negaunee	Marquette

F-2. FROM UNDERGROUND

MINE	DISTRICT
Sherwood	Iron River

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 $2.54 per foot, excluding certain items which are not actual drilling expense but which are charged to the explorations. By including these items, the average cost was $3.08 per foot. The average cost of underground drilling in the same way was $3.17 and $4.12 per foot, respectively.

Table VI, also shown below, gives a comparative cost per foot of drilling for the past five years;

TABLE V

SUMMARY OF DRILLING FOR 1933

	DESCRIPTION SEC.	T.	R.	STAND-PIPING FT.	CHURN DRILLING FT.	DIAMOND DRILLING FT.	TOTAL DRILLING FT.	FIRST CLASS ORE FT.	SECOND CLASS ORE FT.	LEAN ORE FT.	TOTAL COST "A"	COST PR. FT. "A"	TOTAL COST "B"	COST PR. FT. "B"
SURFACE DRILLING														
Drew Mine	13,	58 - 20,	Minn.	494½	668½	-	1,163	196*			$3,486.15	$ 3.00	$ 2,788.37	$2.40
Maas Mine	6,	47 - 26,	Mich.	123	-	-	123				481.02	3.91	481.02	3.91
TOTAL SURFACE DRILLING				617½	668½	-	1,286	196*			$3,967.17	$ 3.08	$ 3,269.39	$2.54
UNDERGROUND DRILLING														
Sherwood Mine	23,	43 - 35,	Mich.	-	-	3,653	3,653	1,190	-	130	$15,066.64	$ 4.12	$11,586.88	$3.17
TOTAL UNDERGROUND DRILLING						3,653	3,653	1,190		130	$15,066.64	$ 4.12	$11,586.88	$3.17
GRAND TOTAL DRILLING				617½	668½	3,653	4,939				$19,033.81	$ 3.85	$14,856.27	$3.01

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

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

The drilling at the Drew Mine was done under contract by J.S.Schultze of Grand Rapids, Minn.

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"
1929	13,190	$ 3.75	$ 3.36
1930	14,656	4.15	3.61
1931	8,031	3.59	3.05
1932	63	11.44	3.75
1933	4,939	3.85	3.01

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F-3. DIAMOND DRILL CARBON

We had on hand, January 1, 1933, a total of 380.90 karats of diamond drill carbon which inventoried at $46,556.06. We consumed, in 1933, a total of 12.10 karats in our drilling (all at the Sherwood Mine) at a cost of $1,756.44. This left on hand, December 31, 1933, a total of 368.80 karats which inventoried at $44,799.62.

F-4. DRILL SECTIONS

Due to the depletion of the force of the Geological Department, it has been impossible to make cross-section tracings showing in detail the results of the drilling done during the year 1933. It is customary to file photographic white prints of these tracings with the mine maps and cross-sections in the Annual Report books and I trust this work can be made up and filed at a later date so that our files may remain complete.

G. SURFACE EXPLORATIONS

G-1. DREW MINE, SECTION 13,56-24, MINNESOTA

A series of fifteen structure drill holes were put down near the East boundary of two of the Syme forties which are held under lease by the Dohm Mining Company. These forties are the NE¼ of the SW¼ and the SE¼ of the SW¼ both in Section 13,56-24. The Drew Mine ore body, most of which lies on the NW¼ of the SE¼ of Section 13, extends over onto the NE¼ of the SW¼ of the Syme lease.

Holes 1001 to 1008, inclusive, were drilled along a general North-South direction on the NE¼ of the SW¼ just West of the Pit and quite accurately outlined the West limit of ore. Holes 1009 to 1013, inclusive, were located on the SE¼ of the SW¼, and on the Southerly continuation of the same line, to explore for a possible Southerly extension of the Drew ore body of such size that the open pit might be extended in this direction. Holes 1014 and 1015 were only standpipes to ledge. The results of Holes 1009 to 1013, inclusive, were so discouraging that it was decided not to complete 1014 and 1015 and the work was stopped.

The Drew ore is a wash ore and although a limited Southerly extension was found by drilling Holes 1009 to 1013, there wasn't enough to warrant the necessary stripping. It had been planned to drill several structure holes somewhat farther south to more completely explore the ground between the Drew ore body and the Hartley-Burt deposit to the South but this plan was abandoned, temporarily at least, by the severe winter weather conditions prevailing at the time.

This drilling, which was commenced on September 16th, was done under contract by the Schultze Brothers of Grand Rapids, Minn., using two outfits. To speed up the work, however, several of the standpipes through the surface to the ledge were sunk ahead of the drilling with our own Armstrong drill equipment and crew. A total of 1163' was drilled, including standpipes 1014 and 1015, or 1088' not including them. All work was stopped early in December.

G-2. MAAS MINE, SECTION 6,47-26, MICHIGAN

Work was started on December 20th to sink a 6" churn drill hole through the surface and jasper capping directly over the area in the Maas Mine Southeast of the Race Course, where most of the mining above the 4th Level has been done. Although 160' of ore in vertical thickness has been mined, and a corresponding mat established over the present sub levels in this area, no caving of cap-rock has reached the surface. The object of this hole, therefore, is two-fold. First, it will determine if there is a pot-hole in the ledge at this point holding surface ground water which, on caving, might flood the mine workings with water and sand. Second, it will determine how much of the cap-rock has been broken on top of the mat and if there is a large open cave over this mat which would be a menace to the lives of the men underground should the remaining block of cap-rock drop en masse.

The hole was still in surface material at a depth of 123' on the last of the year. An 8" standpipe is being sunk through the surface which is mainly sand with occasional seams of gravel and clay. Fortunately, we have found that the ground is well drained of any surface water. In order that there be no danger of loss of life of any of the drill crew in case a cave should occur during this drilling, a large steel cable has been stretched across the area and firmly anchored at each end on safe ground. The drill men wear safety belts which, at all times, are attached to this cable by means of lengths of rope from trolley wheels on this cable.

H. UNDERGROUND EXPLORATIONS

H-1. SHERWOOD MINE

Early in March, when it seemed likely that the Virgil Mine would soon close for an indefinite period, the pumps removed and the workings allowed to fill with water, the Republic Steel Corporation, owners of a lease on the adjoining Sherwood property, decided to resume exploratory work on its property by means of both drifting and diamond drilling. A single drift along the formation was driven into the property from the Virgil 6th Level (Republic's -930' Level), and a cross-cut started in 1931. Both these openings were now extended and stations for five diamond drill holes cut, the thought being that by drilling these holes a very good idea would thus be gained of the shape and size of the ore body and, equally important, its analysis.

Five holes, Nos. 13 to 17, inclusive, were drilled by us for the Republic under contract, starting April 1st and stopping August 31st. Three of the holes, Nos. 14, 15 and 17, were drilled in a North-South plane directly cross-cutting the ore, - 14 and 17 being 200' West of the Virgil-Sherwood boundary and hole 15, 600' West. Holes 13 and 16 were drilled Southwesterly more nearly with the strike and pitch yet cross-cutting the ore at a slight angle. All holes were inclined, - the angles varying from -17° to -60°. Two drills were used and worked double shift six days per week.

It was known that the ore in this vicinity carries varying amounts of sulphur in a soluble form, - that is, as gypsum or calcium sulphate. In order to accurately sample the ore, it was necessary to sample the drill water, both in coming and out going, whenever the drill was in ore and the final analyses corrected by the amount of sulphur so removed from the drill cuttings. This process entails a great deal of extra work and computing of data, particularly when further complicated by large and varying amounts of underground water which was encountered in the ground drilled.

A total of 3653' was drilled of which 1190' was first class ore and 130' was lean ore. The original drilling on this property, which discovered the ore body, was done from surface in 1912 and 1913 before much was known about the presence of gypsum in the ore and its loss by solution in the drill water. Consequently, it was not surprising that the present drilling demonstrated the ore body to contain areas of quite high sulphur content and the body as a whole, higher in sulphur than indicated by the original drilling. The same was true of the phosphorus content. An explanation of this discrepancy, however, involves the methods used by chemists in analyzing for phosphorus. I assume that the samples from the early drilling were not fused before dissolving out the phosphorus some of which, in the Iron River District, is in the insoluble state.

The results of the present exploration, combining the drifts, crosscut and a small sub level development with the drilling, did not alter the tonnage of ore materially, as expressed by its iron content, but it did develop areas of off grade ore, due to higher sulphur and phosphorus contents, which reduced the tonnage of standard Iron River District ore a corresponding amount. These factors may alter the method of mining appreciably if it is found necessary to mine the off-grade areas separately in order to effect an arbitrary mixing. I do not have Republic's revised estimate of tonnages and grades.

I. EXPLORATIONS AND NEW DEVELOPMENTS BY OTHER COMPANIES

Due to the continued economic stress throughout 1933, very little exploring and drilling were done by the various iron ore companies in the Lake Superior District. In fact, a number of attractive leases were surrendered to the fee owners. Exceptions to this that came to my attention are as follows:

I-1. MARQUETTE RANGE

The Inland Steel Company, at its Greenwood Mine exploration, continued to develop the hard ore on and above the 1100' level. A diamond drill, rented from us, was used much of the time to augment the drifting, raising and cross-cutting.

The ore continues to be spotty, occurring in a narrow, irregular seams of limited extent. A total of 5,054 tons of ore was shipped from the property in 1932, its first year of production, and 21,876 in 1933. Mr. Wearne, General Supt., for the Inland Company, in a general statement to me, said the property was still an exploration, had shipped more the past year than the year before and had in sight more ore than had been shipped. This of course, is saying relatively little in the face of the length of time elapsed, the amount of exploring done and the amount of money expended. Mr. Randall, I am told, continues to be optimistic as to the ultimate outcome.

J. EXAMINATION OF MINERAL LAND OFFERS

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

NUMBER	DESCRIPTION	REMARKS
1881	S½-NW¼, Sec. 10,47-27, South of Cliffs Shaft Mine	Pending
1882	Manganese property in Northern Virginia	Declined
1883	Part of the old Michigan Gold Mine property	"
1884	Chrome ore deposit near Collins, Ontario	"
1886	Chrome ore deposit in Australia	"
1887	Red iron ore, 30 miles from Chattanooga, Tenn.	"
1888	Various forties in Secs.32 & 33,42-28,Mich.	"
1890	Maitland Mine, near Palmer, Mich.	Pending
1891	Chrome ore deposit in Montana	Declined
1892	Iron ore deposit in Cuba	"
1893	NE¼-SE¼, Sec. 14,58-20, Minn.	"
1894	Gold ore in Georgia	"

K. EXPENSE STATEMENTS

Tables VII and VIII, which follow, show a detailed statement of charges to Geological expense for the year 1933 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 YEAR 1933

Salaries	$ 4,544.62
Travel & Entertainment	482.32
Operating Automobiles	337.74
Supplies & Office Expense	218.02
Unclassified	8.35
Total	$ 5,591.05

TABLE VIII

COMPARATIVE STATEMENT OF CHARGES TO GEOLOGICAL DEPARTMENT FOR LAST THREE YEARS

	1933	1932	1931
Salaries.....	$ 4,544.62	$ 5,469.83	$12,994.58
Travel & Entertainment...	482.32	633.34	2,244.77
Operating Automobiles....	337.74	560.37	451.81
Supplies & Office Expense.	218.02	188.73	1,094.39
Unclassified.....	8.35	67.67	119.86
	$ 5,591.05	$ 6,919.94	$16,905.41

L. RESEARCH DEPARTMENT

The Research Department, formerly maintained as a part of our organization on the Mesaba Range, was discontinued February 1, 1932. We had an arrangement, however, with Mr. E. C. Congdon of Duluth, by which this Company would pay a part of Mr. McMorris' salary to complete the tests on the tabling of coarse material which he had started at the University Experiment Station in Minneapolis on samples taken from the Canisteo Cliffs pit. These tests were completed and the report submitted to Mr. Congdon and this Company the forepart of the year.

Mr. McMorris, as a result of these tests, reached the conclusion that the new type of concentrating table, which has been designed especially to treat coarse material, has the following advantages over jigs of like capacity:

1. Less first cost
2. Lower operating cost
3. Lower maintenance
4. Much more flexible control
5. As good, if not a better product.

Respectfully submitted,

E. L. Derby, Jr.

ELD:DP

Geologist

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CLIFFS SHAFT MINE:

On March 2nd the timber supporting the skip rope angle sheave at "A" Shaft broke. All of the old timber framework was torn out and replaced with steel supports. A new 8 ft. steel lined sheave, with standard 6" bearings and Agathon steel axle, was installed to replace the old sheave. This repair and change was completed on March the 7th and we should have no more trouble with the sheave or support.

On March 23rd we changed the discharge opening in "A" Shaft pocket 12" higher. They were having some trouble getting the largest pieces through the opening and into the tram car. After this change was made they had no more trouble. This opening is now larger than the skip box, so that any piece of ore that will go into the skip will have plenty of clearance to pass through the pocket.

This mine was shut down on April 8th and started to re-open on November 7th. Pumping was continued during the closed period.

The #8 crusher was repaired and put in good operating condition during the month of October.

In September and October the pocket at "B"Shaft was rebuilt. It was necessary to dismantle this pocket completely as all the timber was in such condition that it would not hold a bolt or spike. This pocket is now a duplicate of the one at "A" Shaft, and the same type fingers were used to control the opening and loading of the car.

Work was started on the installation of a 5' x 13' rock picking belt. This installation has not yet been completed as there are several changes to be made to the ore and rock chutes. A tram plant (from Republic Mine) is being installed to handle the rock from the picking belt.

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

TILDEN MINE:

Loading was started in June and completed in October.

We had a little trouble with the eccentric on one of the 10" crushers. A brake rim on the crowding machine on the #29 electric shovel broke. This rim was replaced with a new one which we had in stock.

Repair work is going along as well as can be expected, as we are working only about four men three days per week, and there is considerable work yet to be done on the equipment at this mine.

ATHENS MINE:

This mine was closed on April 8th and re-opened about November 7th.

A few repairs were made to #2 Prescott underground pump. The packing boxes were bored deeper and new throat rings installed.

The mechanical equipment operated satisfactorily during the year.

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MAAS MINE:

The Aldrich triplex pump was moved from the 4th to the 5th level new pump station. This pump is now handling the water from the 5th to the 3rd level.

The $5\frac{3}{4}$" x 36" Prescott pump on the 3rd level was given a complete overhauling. The plungers on this pump were changed to $6\frac{1}{4}$" x 36". The packing boxes were bored out to fit the new plungers and were also bored deeper to take more packing. Four new porcelain plungers were installed. On the power end a new crankshaft was made to fit a gear that had been bought for a pump at the Morris Mine, and this new gear, pinion, pinion shaft and large flexible coupling installed. One of the 500 H.P. hoist motors from the Republic Mine was installed to replace the 325 H.P. motor bought with the pump. It was also necessary to cut out the concrete from under the pump, re-align and grout it in. Connecting rod and crankshaft bearings were re-babbitted, crossheads repaired and one connecting rod straightened. This pump is now in first class condition.

The drive pulley on the Aldrich quintuplex pump on the 3rd level became loose. This was repaired by boring out the hub of the pulley and fitting a new drive shaft.

The brake band on the skip hoist broke on August 23rd, but did not cause any delay. It was repaired and is in good condition.

On October 15th the pedestals broke on the toggle shaft of the power brake on the skip hoist. It was necessary to get new castings to make the repair, this being done on Saturday and Sunday, November 18th and 19th.

The 3rd level centrifugal pump motor burned out and is now in the Shops for repair.

All other mechanical equipment operated satisfactorily during the year.

NEGAUNEE MINE:

On March the 2nd the brake lever on the cage hoist broke. As it was unsafe to operate the hoist in this condition, the men were sent home at noon and the necessary repairs were made to the brake.

On March 6th a kink developed in the north skip rope about 50 ft. from the skip. This rope was inspected on March 7th and it was found to be safe to operate, and is still in operation.

On the Ingersoll-Rand compressor a crack developed in the low pressure frame. This crack does not interfere with the operation of the compressor.

A pinion on the 11th level Aldrich triplex pump stripped. We had a new pinion made at the Lake Shore Engine Works to replace the old one. The shaft was bent and was taken to the General Shops and straightened.

All other mechanical equipment operated satisfactorily during the year.

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LLOYD MINE:

In February an Ingersoll-Rand compressor formerly used at the South Jackson Pit was installed at this mine. This compressor has a capacity of 600 cu. ft. per minute and is driven by a 100 H.P. motor. It is being used to sink the shaft.

A Sullivan 1385 cu. ft. Compressor from the Boeing Mine is now being installed. The two compressors give us a total capacity of 1,985 cu. ft. per minute, which should be ample to take care of the air requirements when the mine is in full production.

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

MORRIS MINE:

This mine was taken over by the Inland Steel Co. at 7:00 A.M. on January the 16th

MACKINAW MINE:

The mechanical equipment operated satisfactorily during the year. There were no changes or additions to the equipment.

SPIES-VIRGIL MINE:

In February the heating boiler was repaired and 23 new tubes installed.

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

ALEXANDRIA MINE:

A watchman was employed at this mine until July 1st, when its management was taken over by the Republic Steel Corporation, who placed it in active operation and shipped the ore in stockpile.

CANISTEO MINE:

It was decided about July 1st to complete the washing plant, ready to wash ore. By robbing the Holman washing plant of necessary conveyor belts, etc., very little new equipment had to be purchased. Two type "400" Hummer screens were bought from The TylerCompany, Cleveland, Ohio, for coarse screening off the 36" conveyor belt. They proved to be entirely too light for this service and were continually breaking down. To get the estimated tonnage it was necessary to replace one with an Allis-Chalmers heavy duty 4' x 10' screen, driven by a 5 H.P. motor. After the shipping season was over, the Hummer screenswere returned to the factory at Cleveland.

The mill was started August 2nd, but did not get into production until August 7th. It was operated on a schedule of six 24-hour days a week and produced

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CANISTEO MINE: (Cont'd)

302,326 tons of concentrates by October 18th, the last day of operation. The ore grade was above average and it was unnecessary to crush the crude to 1/2" size, as the plant was originally designed. In fact, the crushers were opened until at least 50% of the product was passing over the trommel screen and overloaded the 18" conveyor belts, to the concentrat bin. If all crude ore in the Pit is similar to that washed, the old 25-ft. log would have been satisfactory for this operation. However, a leaner grade, requiring finer reduction, is anticipated before the Pit is worked out.

Make up water for washing ore was secured by running 2,600 ft. of 10" line to connect with Pickands, Mather & Company's Danube washing plant pump station on O'Reilly Lake and pay that company to pump the needed water. Sufficient was pumped in ten days to last for the season's operation.

With the exception of the vibrating screens, the washing plant gave little trouble. The old 36" conveyor belt from the Holman Mine was badly worn and 100 feet of it had to be replaced with new belt. The weightometer was supposed to duplicate the Holman washing plant machine, but the first few days operation proved it was too light for the load. On taking this up with the Merrick Scale Mfg. Co. it was found the scales were built for 72 lbs. per running foot instead of 112 lbs., as used at the Holman. By changing two small gears, the capacity was raised to.94 lbs. per foot, which is satisfactory for the present load.

A bad wreck occurred in the Pit when the front car of a loaded train, coming out of the Pit, hit the tender of locomotive #102, which was on the wrong track due to a disobedience of orders. No one was hurt, but the 30-yd. dump car, tender and locomotive needed extensive repairs. The 120-B electric shovel had so much traveling to do in the Pit that it was necessary to replace its caterpillars with a set from the Hill-Trumbull shovel and use 600 lbs. of welding rod to build up the old caterpillar pads and sprocket driving wheels.

Water flowage into the Pit changed very little during the year. A 2,000 G.P.M. pump was sufficient to keep the water down at all times. It is planned to remove the 7,000 G.P.M. pump and use two 2,000 G.P.M. pumps on the scow. These can be moved from the Holman washing plant.

The 22,000 volt transmission line, built during the winter, gave no trouble for the season, and on full production would have paid for itself this year.

HILL-TRUMBULL MINE:

It was necessary to use 1,000 G.P.M. pump to supply water to the tailings pond for four months beginning in April, but by August the sweet clover had made such growth that the sand was protected from the wind and caused no trouble for the rest of the year.

The mine was idle all season.

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HOLMAN-CLIFFS MINE:

This mine was idle during the year.

All equipment that could be used to start the Canisteo washing plant was taken from the Holman concentrator, with the expectation of replacing it later. The Pit water is now up to its original level, but with the tracks undisturbed de-watering can start on short notice.

WADE MINE:

All equipment worth taking away was removed during the year. What could not be used on this range was shipped to Ishpeming. All the Location houses were sold, and the only mine buildings left were the shaft house, dry, machine and power house. The lease was turned back to the former owners.

DREW MINE:

On the death of John Dohm in February, the operation of this mine was taken over. Considerable stripping was necessary in the Pit to open up the ore body and the loading pocket had to be rebuilt before the mine could operate.

Some improvements were necessary in the washing plant before it started August 27th. It continued on a variable schedule to October 27th, and considerable cold weather was encountered. The mine washed 52,047 tons of concentrate for the season.

The larger items of equipment at this property are:

1 - 5'x5' drum electric hoist, driven by 200 H.P. General Electric motor - Transferred from Helmer Mine.

1 - 50-B Bucyrus electric shovel #10913, complete with 2-yd. bucket. Also a drag line equipment for this machine, with 50 ft. boom and 2-yd. Sauerman scraper bucket.

2 - 16" x 21" cyl. Porter standard gauge locomotives Nos. 1 and 2 - Purchased second-hand from Virginia & Rainy Lake Lumber Co.
Weight about 45 tons. Type 2-6-0 machines.

1 - Washing Plant, consisting of 8 ft. x 16 ft. Dorr washer, with Link-Belt variable feed and 18" belt conveyor carrying concentrate to railroad car pocket. This plant has a capacity, in good ore, of 75 tons per hour.

1 - 12" x 10" "ERL" Ingersoll-Rand air compressor, driven by a 60 H.P. General Electric motor.

ARMOUR NO. 2 MINE:

Five cars of equipment from this mine were loaded and shipped to Ishpeming during January. This consisted of the two hoists, pump, underground locomotives, shop and dry equipment. The air compressor and motor-generator set were sold to the Inland Steel Company. Sixteen tons of 35 lb. rail, three cages and four skips were stored at Armour No. 1.

All buildings that could not be sold were left to the owners.

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ELECTRICAL DEPARTMENT:

Through the year 1933 all operations of The Cliffs Power & Light Co. and The Cliffs Electric Co. have been carried on with a view to keeping cash expenditures at as low a.minimum as was consistent with reasonable maintenance and reliable service.

It has seemed expedient to allow our average revenue to decrease slightly per unit sold in order to help, in a measure, those industries depending upon our power for their continued operation under the adverse conditions which have prevailed.

An analysis of the reports from the Department of Commerce show that we are aligned with the Utility Industry as to rates and service, as far as applicable. The average rate for wholesale power in Michigan is 1.4 ¢ per K.W.H., with average annual consumption of 412,891 per customer. This is very close to our average. For commercial service the average rate is 3.9 ¢ per K.W.H. and the average annual consumption 4,138 K.W.H. We are probably slightly above this on account of the relatively small population in this area. For domestic service at 4.4 ¢ and 692 K.W.H. we are also probably slightly higher for similar reason. The farm service at 4.6 ¢ and 725 K.W.H. is appreciably lower in rate and higher in consumption because of the very difficult farm conditions here and lack of practical application for appreciable use.

The collections for service have been rather better than we anticipated and probably better than we had reason to expect.

The physical condition of our Plants, as a whole, is very good, both in power plant equipment and also transmission lines. Some of our feeders are not quite up to standard due to normal deterioration.

No brush trimming along rights-of-way was done during 1933, and for 1934 we must expect a marked increase in maintenance for this work.

One transformers at the Maas Substation burned out and was repaired.

On account of increased use of current and to improve the regulation at the Pioneer Furnace this line was changed from 6,600 volts to 11,200.volts. It is quite satisfactory at present. If their load is stable and indicates any increase it will be necessary to provide a new circuit for this service.

A short feeder was built to the Michigan Gold Mine. They made an advance payment approximately sufficient to cover our expenditure for this extension. This operation is speculative and may develop into a reasonably good customer. In order to encourage such development it seems a wise extension.

On account of the inability of Republic Township to meet their power bills, and by their request, we took over the operation their distribution system. During the first month our collections were nearly three times the amount they collected the previous month, and the next two months about twice the amount. The arrangement seems to be satisfactory to them and we should make a little profit, also have some assurance of the payment of our bills against them. An application for C.W.A. funds to improve their light and water systems was made and has been approved.

From present indications there will be more than sufficient run-off in the Spring to fill our storage basins and assure us of a plentiful supply of water to carry our load during the year. As a matter of fact, the Au Train Storage Basin is full at the present time and the Hoist basin is close to the top.

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

X

Electrical Department: (Cont'd)

Summary of Operating Conditions - 1 9 3 3 .

Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Precipitation -	1.52	2.38	1.72	3.85	2.03	1.68	2.18	0.99	5.16	3.23	2.12	1.86

Total Precipitation at Ishpeming during 1933 - 32.72"
Average " " Marquette - 32.8" (46 year record)

CARP RIVER PLANT:

Drainage area above Intake Dam,	66.66 sq. miles
Cubic feet Precipitation in 1933,	5,065,927,900
Kilowatt Hours generated in 1933,	10,751,500
Cubic feet water utilized (90 cu. ft. = 1 KWH.)	967,635,000
" " " in Carp Storage Basin Jan. 1,1933	266,608,300
" " " " " " " Dec. 31, "	306,821,900
" " " stored in 1933,	40,213,600
" " " wasted over Intake Dam in 1933,	1,394,064,000
Total run-off for the year 1933,	2,401,912,600
Run-off per square mile of drainage area,	36,032,290

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

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

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

McCLURE PLANT:

Drainage area above Intake Dam,	140.52 sq. miles
Cu. ft. Precipitation in 1933, (Hoist Plant - 35.07")	11,439,020,500
Kilowatt Hours generated at McClure Plant in 1933,	20,744,600
Cubic feet water utilized, (125 cu. ft. = 1 KWH.)	2,593,075,000
" " " wasted over Intake Dam in 1933,	3,278,088,000
" " " in Hoist Storage Basin Jan. 1,1933,	1,711,294,700
" " " " " " " Dec. 31, "	1,871,453,800
" " " stored " " " in 1933,	160,159,100
" " " in Silver Lake on Jan. 1,1933,	666,284,000
" " " " " " Dec. 31, "	395,878,700
" " " used from Silver Lake in 1933,	270,405,300
Total run-off for the year 1933,	5,760,916,800
Run-off per square mile of drainage area,	41,076,000

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

	1931	1932	1933
Sec. ft. per sq. mi. run-off	1.10	1.23	1.30

THE CLIFFS POWER & LIGHT CO.

SUMMARY OF OPERATIONS - 1933.

	KILOWATT HOURS GENERATED & PURCHASED								Used by Auxiliaries	Delivered to Line	KWH. Sold	Transmission Losses	
	McClure	Carp	Hoist	Au Train	Republic	Escanaba	Purchased	TOTAL				K.W.H.	%
Jan.	1,971,300	775,700	316,000	124,750	115,000	238,000	0	3,540,750	10,436	3,530,314	2,950,974	579,340	16.41
Feb.	1 535 200	941 600	334 000	132 460	94 400	242 000	0	3 279 660	10 002	3 269 658	2 787 979	481 679	14.73
March	1 384 500	1 019 000	330 000	128 280	97 500	231 000	0	3 190 280	10 218	3 180 062	2 627 033	553 029	17.39
April	1 190 600	965 600	319 000	109 530	93 900	237 000	0	2 915 630	9 898	2 905 732	2 439 106	466 626	16.05
May	1 380 700	876 200	310 000	64 710	87 300	244 000	0	2 962 910	9 831	2 953 079	2 394 389	558 690	18.9
June	1 665 800	794 900	316 000	113 260	66 000	241 000	0	3 196 960	9 526	3 187 434	2 642 857	544 577	17.08
July	1 945 200	652 900	573 000	108 540	49 600	212 000	0	3 541 240	11 627	3 529 613	2 977 062	552 551	15.65
Aug.	2 112 100	398 700	754 000	113 600	40 900	154 000	0	3 573 300	11 739	3 561 561	2 971 148	590 413	16.57
Sept.	2 121 400	1 008 300	725 000	150 400	24 200	152 000	0	4 181 300	11 606	4 169 694	3 477 447	692 247	16.60
Oct.	1 757 300	1 091 200	592 000	181 380	62 900	235 000	0	3 919 780	12 629	3 907 151	3 342 476	564 675	14.45
Nov.	1 751 600	1 137 400	583 000	124 790	100 000	252 000	0	3 948 790	12 234	3 936 556	3 361 542	575 014	14.60
Dec.	1 928 900	1 090 400	576 000	101 370	125 700	237 000	0	4 059 370	12 181	4 047 189	3 380 123	667 066	16.48
TOTAL	20,744,600	10,751,900	5,728,000	1,453,070	957 400	2,675,000	0	42,309,970	131,927	42,178,043	35,352,136	6,825.907	16.18

MECHANICAL DEPARTMENT
ANNUAL REPORT
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Electrical Department: (Cont'd)

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

	INSTALLED TO JAN. 1, 1933	INSTALLED IN1933	TAKEN OUT IN 1933	CONNECTED JAN. 1,1934 TOTALS
ANGELINE MINE:				
Hoist	250 HP.			250 HP.
CLIFFS SHAFT MINE:				
Shop	25			
No. 8 Crusher	125			
Screens	15			
Top Tram	100			
Hoist for "A" Shaft	750			
Underground Plunger Pump #1	180			
" Centrifugal Pump	250			
Allis-Chalmers Compressor	175			
Hoist for "B" Shaft	750			
Underground Plunger Pump #2	200			
Laboratory Crusher	5			
Coal Crushing Plant Exhaust Fan (to Tilden)	1/2		1/2	
Cooling Water Pump for Compressors	10			
Ingersoll-Rand Compressor #1	400			
" " " #2	400			
Lower Tram #2	50			
Heating Plant Condensing Water Pump	2	5	2	
Underground Haulage Set #2	215			
Small Hoist in Crusher Building (stored)	15		15	
Jaw Crusher - New Crushing Plant	75			
Magnetic Separator - " "	1½			
Underground Scrapers - 50 - 25 HP. motors	1,250			
Lower Tram #3	30			
Battery Charging Set, 2nd level "A" Shaft	7½			
Grinder in Drill Sharpening Shop	7½			
Rotary Screen	10			
Boiler Feed Pump at Central Office	3/4			
Undg. Haulage Set #1 (from Gen. Storehouse)	150			
Carpenter Shop	25			
Return Water Pump at Central Office	1			5,213¼
BROWNSTONE SUBSTATION:				
Test Set	1/2			
Oil Filter Press	1/4			
Battery Charging Motor-Generator Set	3			
Commutator Grinder	1			
Synchronous Condenser	80			
M.G. Set on Voltage Regulator Control	1/4			
Large Oil Filter Press	2			
Drill	1			88
fwd.	5,563¾ HP.	5 HP.	17½ HP.	5,551¼ HP.

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

Electrical Department: (Cont'd)

	INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	CONNECTED JAN. 1,1934 TOTALS
brt. fwd.	5,563¾ HP.	5 HP.	17½ HP.	5,551¼ HP.
HARD ORE SHOPS:				
Machine Shop	10			
Carpenter Shop	25			
Blacksmith Shop Punch	3			
Armature Banding Machine	2			
" " "	1/2			
" " "	1/8			
Lathe Grinder	1			
Portable Drill - small (Stanley)	1/4			
" " - large	1/4			
Commutator Slotter	1/8			
Air Compressor	10½			
Water Supply Pump	7½			
Blacksmith Shop Blower	1/4			
Hacksaw	1/2			
Small Grinder	1/4			
Portable Drill (Stanley)	1			
Carpenter Shop Saw	25			
Water Pump (S,R.Elliott)		2		
Motor-Generator Set		15		
				104¼
ISHPEMING HOSPITAL:				
Passenger Elevator	7½			
Dumb Waiter	3			
Large Washer	2			
Small "	1			
Extractor	2			
Vacuum Cleaner	3			
Water Supply Pump	1			
Xray Machine	1/4			
Hot Water Circulating Pump	1/2			
" " Return - high pressure	5			
" " " - low "	1½			
Vacuum Pump	3			
				29¾
fwd.	5,680¾ HP.	22 HP.	17½ HP.	5,685¼ HP.

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

Electrical Department: (Cont'd)

	INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	CONNECTED JAN. 1,1934 TOTALS
brt. fwd.	5,680¾ HP.	22 HP.	17½ HP.	5,685¼ HP.
TILDEN MINE:				
Compressor	150			
Centrifugal Pump	275			
Scraper on Coal Dock	15			
#29 Shovel - Motor-Generator Set	110			
" - Air Compressor	4½			
" - Oil Pump	1/4			
" - Trip Motor	2			
" - Exciter Motor	10			
Cyclone Drill	10			
" Drills - 4 - 15 HP.	60			
Car Dumper	30			
Large Crusher	250			
Car Puller	10			
Sample Crusher	3			
Belt Conveyor	50			
Secondary Crushers - 2 - 100 HP.	200			
Small Hoist over Crusher	3			
#31 Shovel - Motor-Generator Set	110			
" - Exciter Motor	7½			
" - Trip "	1½			
" - Air Compressor	5¾			
Drill Sharpener	15			
Pump for Drills	15			
Synchronous Condenser from P.C.P.Plant	625			
Shop Motor	5			
" " #2	3			
Scraper (stored at Tilden)	50		50	
Armstrong Drill (sent to Maas Mine)	15		15	
Blower Fan	1/2			
Fan in Crusher Building		1/2		1,971¼
ATHENS MINE:				
Cage Hoist	400			
Nordberg Compressor	325			
Compressor Cooling Water Pump	3			
Auxiliary Compressor for Hoist Brakes	5			
Underground Ventilating Fan #1	15			
Sinking Pump - 2400' station	50			
Skip Hoist Set	850			
" " " Oil Pump	1			
Shop	10			
Underground Haulage Converter	150			
Skip Pit Pump	2			
Laboratory Crusher	5			
Underground Plunger Pumps - 2 - 400 HP.	800			
Ore Tram 2 - 50 HP.	100			
Carpenter Shop	20			
Ore Crusher	25			
Batter Charging Motor-Generator Set (burned out)	1/4		1/4	
Underground Ventilating Fan #2	50			
Ingersoll-Rand Compressor	450			
Rock Tram	50			
Underground Haulage Converter #2	150			
Nordberg Compressor Oil Pump	1/4			3,461¼
fwd.	11,178 HP.	22½ HP.	82¾ HP.	11,117¾ HP.

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

Electrical Department: (Cont'd)

		INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	CONNECTED JAN. 1,1934 TOTALS
	brt. fwd.	11,178 HP.	22½ HP.	82¾ HP.	11,117¾ HP.
MAAS MINE:					
Turbine Auxiliaries	(Circulation Pump	40			
	(Injection "	25			
	(Exciter	33			
Underground Haulage Set		215			
Shop		10			
3rd level Centrifugal Pump		350			
" " Plunger Pump #1	(stored)	325	500	325	
Compressor Cooling Water Pump		5		5	
Ore Tram	2 - 50 HP. motors	100			
Coal Crushing Plant		15			
3rd level Plunger Pump #2		250			
Ingersoll-Rand Compressors -	2 - 400 HP.	800			
Skip Hoist		700			
Cage "		400			
Boiler Room Fan	(to Tilden Mine)	1/2		1/2	
Skip Hoist Rheostat Pump		3			
Carpenter Shop Saw		15			
Auxiliary Compressor for Hoist Brakes		7½			
4th level Pump	(stored in Negaunee Barn)	50		50	
Cooling Water Pump		5			
4th level Triplex Pump	(stored in Ishpeming ")	50		50	
" " Centr. "	" " " "	40		40	
Saw Gumming Outfit in Carpenter Shop		2			
Underground Haulage Set #2	(from Neg. Mine)	215			
Return Water Pump in Heating Plant		2		2	
5th level Aldrich Pump	(from Boeing Mine)	100			
3rd " Centr. "	(" Francis ")	400			
" " " "	- primer	50			
5th " Prescott "	(from Lake Mine)		75		
" " Centr. "	(" Princeton)		125		
Armstrong Drill	(" Tilden)		15		
					4,450½
NEGAUNEE MINE:					
Underground Haulage Set #1		300			
"Ilgner" Hoist Set		450			
Ore Tram	2 - 50 HP.	100			
Laboratory Crusher	(to Cliffs Shaft)	5		5	
Auxiliary Compressor for Hoist Brakes		3			
10th level Plunger Pumps -	2 - 300 HP.	600			
" " Centrifugal Pump		350			
" " Suction Pumps	2 - 15 HP.	30			
Compressor Cooling Water Pump		3			
Nordberg Air Compressor		325			
Shop		15			
Ore Crusher		25			
Ingersoll-Rand Compressor		400			
13th level Plunger Pump		15			
11th " " Pumps	2 - 75 HP.	150			
Exciters for 10th level Pump Motors	(2)	40			
Signal System Motor-Generator Set		1/2			
Timber Hoist - #2 Shaft		25			
Ventilating Fan " "		150			
Gravel Hoist		15			
Saw in Carpenter Shop		15			
Skip Pit Pump		3	5	3	
Underground Haulage Set #2		220			
	fwd.	15,386 HP.	737½	555¼	15,568¼ HP.

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

Electrical Department: (Cont'd)

	INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	CONNECTED JAN. 1,1934 TOTALS
brt. fwd.	15,386 HP.	737½ HP.	555¼ HP.	15,568¼ HP.
NEGAUNEE MINE: brt. fwd.	3,239½	5	8	
New Flywheel Set for Hoists	800			
Oil Pump on #2 Flywheel Set	1			
" " " " "	1			
" " " Nordberg Compressor	1			
Hot Well Pump	2			
				4,041½
MAAS CRUSHING PLANT:				
Jaw Crusher	100			
Belt Conveyor	50			
Pan Conveyor Motor-Generator Set	50			
				200
SOUTH JACKSON CRUSHING PLANT:				
Hoist (stored in Negaunee Barn)	75		75	
Crusher " " " "	150		150	
				0
BARNES-HECKER MINE:				
Skip Hoist	400			
				400
LLOYD MINE:				
Skip Hoist	400			
Cage "	400			
Top Tram	40			
Ore Crusher	25			
Water Supply Pump installed underground	50			
Concrete Mixer	5			
Top Tram	50			
Compressor (from So. Jackson)		100		
" (" Boeing)		225		
Underground Haulage Converter (from Inland Steel)		120		
Timber Yard Saw		7½		
				1,422½
MORRIS MINE:				
Ingersoll-Rand Compressor #2	500			
Underground Haulage Set #2 (Sold to Inland Steel)	215		215	
				500
SECTION 6 SHAFT:				
Hoist	200			
				200
GWINN CRUSHING PLANT:				
Crusher	85			
Pan Conveyor	50			
Belt Conveyor (from Mackinaw)	40	50	40	
Compressor	15			
" Cooling Water Pump	3			
				203
FRANCIS MINE STOCKPILE:				
Triplex Pump	7½			
				7½
GARDNER MINE:				
Hoist	400			
Top Tram	50			
Laboratory Crusher	3			
				453
MACKINAW MINE:				
Hoist	400			
fwd.	22,794 HP.	1,245	1,043¼	22,995¾ HP.

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

Electrical Department: (Cont'd)

		INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	CONNECTED JAN. 1,1934 TOTALS
	brt. fwd.	22,794 HP.	1,245 HP.	1,043¼ HP.	22,995¾ HP.
MACKINAW MINE:	brt. fwd.	400			
Shop		7½			
Ore Tram		50			
Underground Haulage Set		150			
Air Compressor		325			
Compressor Cooling Water Pump		7½			
4th level Quintuplex Pump		350			
" " Triplex "		75			
5th " Pump (Automatic)	from Stephenson	30			
Winze Hoist	" Morris	200			
4th level Centrifugal Pump		400			
" "		20			
Underground Hoist	(to Gwinn Crushing Plant)	50		50	
					2,015
PRINCETON MINE #2:					
Hoist		200			
Top Tram		50			
Stockpile Loader		25			
					275
PRINCETON MINE #3:					
Hoist		75			
					75
PRINCETON CENTRAL POWER PLANT:					
Turbine Auxiliaries	(Circulating Pump	50			
	(Injection "	40			
	(Exciter	33			
Boiler Room Fan		50			
Coal Handling Machinery		10			
" " "		5			
					188
PRINCETON CENTRAL SHOPS:					
Shop Motor		25			
					25
PRINCETON CENTRAL PUMP STATION:					
Centrifugal Pump		100			
Automatic Pump		30			
					130
REPUBLIC MINE:					
#9 Shaft Hoist Motors	(1 to Maas & 1 to Lloyd)	1,000		1,000	
" " Ore Tram	(1 to Cl.Shaft, 1 Stored)	100		100	
					0
CARP PLANT:					
Auxiliaries	2 - 15 HP. pump motors	30			
Water Supply Pump		1			
Air Compressor		5			
					36
HOIST PLANT:					
Exciter Motor-Generator Set		20			
Oil Pump		3			
Air Compressor		5			
Small Supply Hoist Motor		3			
					31
	fwd.	26,719 HP.	1,245 HP.	2,193¼ HP.	25,770¾ HP.

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

Electrical Department: (Cont'd)

	INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	CONNECTED JAN. 1,1934 TOTALS
brt. fwd.	26,719 HP.	1,245 HP.	2,193¼ HP.	25,770¾ HP.
McCLURE PLANT:				
Water Supply Pump	2			
Exciter Motor-Generator Set	17½			
Air Compressor	5			
				24½
ESCANABA PLANT:				
Air Compressor	5			
Oil Pump	5			
Valve Operating Motor	1			
				11
TOTAL MINING DEPARTMENT and CLIFFS POWER & LIGHT CO.	26,754½ HP.	1,245 HP.	2,193¼HP.	25,806¼ HP.

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

Electrical Department: (Cont'd)	INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	CONNECTED JAN. 1,1934 TOTALS
TOTAL MINING DEPARTMENT and CLIFFS POWER & LIGHT CO.	26,754½ HP.	1,245 HP.	2,193¼ HP.	25,806¼ HP.
PIONEER FURNACE:				
Furnace & Sawmill	1,195			1,195
L. S. & I. RR. CO.				
Shops, Sawmill, Ore Dock & Pumps	800			800
LAND DEPARTMENT:				
Grand Island 3 motors	15½			15½
LUMBERING DEPARTMENT: (Dixon)				
Location Water Supply Pump	5			
Tie Mill Saw	75			
" " Conveyors	37			
" " Shop	10			127
MICHIGAN GAS & ELECTRIC CO.				
Ishpeming	2,170			
Munising	250			
Munising City Pumping	125			2,545
REPUBLIC TOWNSHIP:				
Water Supply Pump	25			25
OLIVER IRON MINING CO.				
Pumps at Angeline & Sec. 16 Mines	525			
Holmes Mine	2,552½			3,077½
CITY OF ISHPEMING:				
Booster Pump at Brownstone	15			
Air Compressor for Tank		10		25
CITY OF NEGAUNEE:	435			435
THE CLIFFS ELECTRIC CO.	100 Est.			100
PALMER MINING COMPANY:				
Volunteer Mine, Palmer	800			800
MUNISING WOODENWARE CO.	695			695
NORTH RANGE MINING CO.				
Blueberry Mine	1,165			1,165
INLAND STEEL CO.				
Greenwood Mine	450			
Morris Mine	3,145	215		3,810
INLAND LIME & STONE CO.				
Quarry & Dock	4,000			4,000
MICHIGAN GOLD MINE:	150	150		150
TOTAL OUTSIDE LOAD	18,590	375	0	18,965 HP.
GRAND TOTAL CONNECTED LOAD	45,344½ HP.	1,620	2,193¼	44,771¼ HP.

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

Electrical Department: (Cont'd)

The following motors are not connected to our Power System:

MESABA RANGE:		INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	CONNECTED JAN. 1,1934 TOTALS
CANISTEO MINE:					
Centrifugal Pump		600 HP.		600	
Priming Pump		3			
Shop		10			
Washing Plant Compressor		50			
Belt Conveyors	4 - 5 HP. motors	20			
Jaw Crusher		100			
Centrifugal Pumps	2 125 " "	250			
Symons Crushers	2 100 " "	200			
Belt Conveyor		75			
Dorr Washers	2 75 " "	150			
" "	2 30 " "	60			
Armstrong Drills	2 15 " "	30			
Centrifugal Pumps	2 25 " "	50			
Portable Drill		1/2			
Hacksaw		1/2			
Wood Planer		3			
Band Saw		5			
Circular Saw		5			
Shaper		3			
Portable Drill	(from Holman)		1/8		
Clear Water Pumps	2 - 3 HP. motors	6			
Motor-Generator Set on Shovel		250			
Exciter Set	" "	20			
Dipper Trip	" "	2			
Fan		3			
Heater Motors	6 - 1/2 HP. motors	3			
" "	8 - 1/8 " "	1			
Bolt & Pipe Machine		5			
Machine Shop Planer		10			
Boring Machine		15			
Pressure Pump in Boiler House		30			
Shop Air Compressor		50			
Portable Grinder		1			
Bench Grinders	2 - 1 HP. motors	2			
Blacksmith Shop Forge		1/4			
Electric Welder		15			
Punch & Shear Machine		5			
Small Pump		3			
Portable Saw		7½			
Priming Pump		2			
Blacksmith Shop		10			
Roll Motor in Laboratory		5			
Pulverizer " "		1			
Fan " "		1/8			
Heater " "		1/8			
Fan " "	(from Holman)		1/8		
Centrifugal Pump	" "		125		
Motor-Generator Set - Washing Plant			225		
Tyler Screen			5		
Allis-Chalmers Screen			5		
Electric Welder	(from Hill-Trumbull)		15		
Priming Pump			3		
Armstrong Drill			15		
Ro-Tap in Laboratory	(from Holman)		1/2		
	fwd.	2,062 HP.	393¾	600	1,855¾ HP.

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Electrical Department: (Cont'd)

		INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	CONNECTED JAN. 1,1934 TOTALS
	brt. fwd.	2,062 HP.	393¾ HP.	600 HP.	1,855¾ HP.
HOLMAN-CLIFFS MINE:					
Layne & Bowler Pump		350			
Bench Grinder		1/4			
Portable Drill		1/4			
Belt Conveyor		75			
Symons Crushers	2 - 100 HP. motors	200			
Jaw Crusher		100			
Dorr Classifiers	2 - 10 " "	20			
Air Compressor		50			
Screen		25			
Centrifugal Pumps	(1 to Canisteo)	250		125	
Picking Belts	2 - 5 HP. motors	10			
Centrifugal Pump		85			
Machine Shop		30			
Exhaust Fan		1/2			
Centrifugal Pump		275			
Blacksmith Forge Fan	(to Drew Mine)	1/2		1/2	
Motor-Generator Set		225			
Underground Haulage Set		150		150	
Locomotive Water Tank Pump		20			
Clear Water Pump, Washing Plant		5			
Armstrong Drills	(1 to Canisteo)	30		15	
Hummer Screen		5			
Bench Grinder		1/4			
Portable Grinder		1			
Shop Heaters	2 - 1/2 HP. motors	1			
" "	10 - 1/8 " "	1¼			
Roll Motor in Main Laboratory		5			
Pulverizer " " "		1			
Fan " " "	(to Canisteo)	1/8		1/8	
Ro-Tap " " "	" "	1/2		1/2	
Air Compressor " "		1½			
Motor-Generator Set on Shovel		250			
Exciter Set " "		20			
Dipper Trip " "		2			
Fan " "		3			
Portable Drill	(to Canisteo)	1/8		1/8	
Flotation Machine (sold)	8 - 1/4 HP. motors	2		2	
Hydrotator		15			
"		20			
Centrifugal Pump at Pit		125			
Sump Pump - spare		5		5	
Sample Crusher	(to Hill-Trumbull)	10		10	
					2,057¼
	fwd.	4,427½ HP.	393¾	908¼	3,913

MECHANICAL DEPARTMENT
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Electrical Department: (Cont'd)

		INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	CONNECTED JAN. 1,1934 TOTALS
	brt. fwd.	4,427½ HP.	393¾ HP.	908¼ HP.	3,913 HP.
HILL-THUMBULL MINE:					
Log Washer		50			
" "		40			
Belt Conveyors	4 - 5 HP. motors	20			
Crusher		100			
Sample Crusher (from Holman)			10		
Prescott Plunger Pump		125			
Centrifugal Pump		150			
Tables (to Drew Mine)		20		20	
Shops		30			
Punch & Shear Machine in Shop		5			
Band Saw in Carpenter Shop		5			
Compressor in Shop		50			
Screen		20			
Conveyor		100			
Planer in Shop		2			
Variety Saw in Shop		5			
Electric Drill		1/4			
Motor-Generator Set		65			
Blacksmith Shop Fan		1/4			
Drill		1/4			
Washing Plant Laboratory Rolls		3			
Picking Belt		5			
Car Puller		7½			
Portable Grinder		1			
North Pit Pump		30			
Air Compressor at Washing Plant		25			
Churn Drill		10			
Boiler Feed Pump		5			
Chip Screens (1 to Canisteo)		4		2	
Layne & Bowler Pump		125			
Tool Post Grinder		1/4			
Electric Welder (to Canisteo)		15		15	
Armstrong Drill (to Drew Mine)		15		15	
Rack Drives on Classifiers	2 - 10 HP. motors	20			
Hummer Screen		2			
Pulverizer in Laboratory		1			
Fan " "		1/8			
Symons Crushers	2 100 " "	200			
Bench Grinder		1/2			
Motor-Generator Set on Shovel		250			
Exciter " "		20			
Dipper Trip " "		2			
Fan		3			
Fan for Blacksmith Shop		5			
Clear Water Pump		3			
Flue Machine		5			
Bench Grinder at Washing Plant			1/2		1,503½
	fwd.	5,972½ HP.	404¼	960¼	5,416½ HP.

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Electrical Department: (Cont'd)

	INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	CONNECTED JAN. 1,1934 TOTALS
brt. fwd.	5,972½ HP.	404¼ Hp.	960¼ HP.	5,416½ HP.
BOEING MINE:				
Air Compressor	225		225	
				0
WADE MINE:				
Hoist (to Ishpeming)	125		125	
Air Compressor " "	150		150	
Compressor Cooling Water Pump	2		2	
Underground Haulage Set (to Ishpeming)	150		150	
" Triplex Pump " "	50		50	
Top Tram " "	50		50	
Clear Water Pump " "	15		15	
Blacksmith Shop Fan " "	3		3	
Sump Pump " "	7½		7½	
Sinking Hoist " "	35		35	
Underground Centrifugal Pump " "	125		125	
" Fan	15		15	
				0
DREW MINE:				
Skip Hoist (from Helmer Mine)	200			
Tailings Pump (" Hill-Trumbull)		20		
Centrifugal Pump (" Ishpeming)		20		
Washing Plant Feed Pump	20			
Dorr Washers	30			
Rakes	10			
Conveyor	15			
Feeder	5			
Air Compressor		60		
Armstrong Drill (from Hill-Trumbull)		15		
Blacksmith Forge Fan (from Holman)		1/2		
Hoist on Shovel	100			
Crowd " "	40			
Swing " "	40			
Trip " "	.7			
Air Compressor on Shovel	2			
Cyclone Drill	10			
				588
TOTAL MESABA RANGE MINES	7,397½ HP.	519¾	1,912¾ HP.	6,004½ HP.
SPIES-VIRGIL MINE:				
Underground Triplex Pump	50			
Crusher	50			
Air Compressor	403			
Compressor Cooling Water Pump	3			
Hoist	400			
Boiler Feed Pump	2			
Circular Saw in Carpenter Shop	25			
Shop	5			
Compressor Cooling Water Pump	3			
8th level Prescott Plunger Pumps 2 - 150 HP.	300			
Underground Haulage Converter	150			
Sump Pump	2			
Auxiliary Air Compressor for Hoist Brakes	5			
			TOTAL	1,398

MECHANICAL DEPARTMENT
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Electrical Department: (Cont'd)

The following A.C. motors are on hand, (Dec. 31, 1933) but are not installed:

CLIFFS SHAFT MINE:		
Top Tram (stator only)		50 HP.
Spare Top Tram		50
Small Conveyor Motor		2
Scraper Motors	7 - 25 HP.	175
Crusher		25
Battery Charger from Republic		30
New Picking Belt Motor		5
Scraper Motor		15
Top Tram Motor from Republic		50
		402 HP.
GENERAL STOREHOUSE & BARN:		
Spare from Republic concrete mixer		5
" General Electric pump		50
" from Hard Ore #3 plunger pump		35
Bag Cleaner from D.R.Storage Dam		1/2
Spare for Centrifugal Pump used at North Lake		200
" Motor		40
Pump Motor from Republic Mine		10
2 - 500 HP. Hoist Motors from Cliffs Shaft Mine		1,000
Hoist Stator only " " " "		500
Feeder Belt " " " "		5
Conveyor Belt " " " "	2 motors	40
Concrete Mixer from Au Train		7½
Picking Belt		5
Beach Concrete Mixer		10
Air Compressor from Republic Mine		200
Pump from 11th level " "		7½
Carpenter Shop from " "		20
Undg. Hoist " " "		50
" " " Maas "		50
Centrifugal Pump		2
" " " Republic "		20
Cyclone Drill " Tilden "		10
Pump " Au Train Dam		100
" " Republic Mine		50
" " " "		7½
Screen #9 Shaft " " "		25
Crusher " " "		100
Coal Tram " " "		7½
Pump from 3rd level " "		50
Screen from Crusher " "		10
Underground Hoist " "		100
Pump from " "		35
Top Tram Motor " Athens "		50
Pump from Mackinaw Mine		20
Spare for Small Compressors		5
Pump Motor from Cliffs Shaft Change House		2
Prescott Pump Motor from Maas Mine		325
Tilden Fan Motor (in Shop for repairs)		1/4
Pump Motor from Morris Mine		50
" " " " "		40
Gwinn Crushing Plant Conveyor Motor (Shop for repairs)		40
Sinking Hoist from Wade Mine		35
Top Tram " " "		50
Sump Pump " " "		7½
	fwd.	3,377¼
	fwd.	402 HP.

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Electrical Department: (Cont'd)

	brt. fwd.		402 H.P.
GENERAL STOREHOUSE & BARN: (Cont'd)	" "	3,377¼	
Blacksmith Shop Fan from Wade Mine		3	
Air Compressor " " "		150	
Hoist " " "		125	
Clear Water Pump " " "		15	
Triplex " " " "		50	
Haulage Converter " " "		150	
Pump Motor " " "		100	
Centrifugal Pump " Morris "		50	
Allis-Chalmers 3K2164.1 " Armour "		5	
Hoist " " "		150	
" " " "		250	
Tex Rope Fan " " "		60	
Centrifugal Pump " " "		150	
" " " " "		200	
" " " " "		35	
Blacksmith Shop Blower (C.S.Lab.)		1/2	
		4,870¾	
ISHPEMING HOSPITAL:			
Spare for Dumb Waiter		3	
" " Hot Water Return		5	
			8
ATHENS MINE:			
Pump Motor		35	
" "		50	
			85
MAAS MINE:			
Winze Pump		15	
Pump (from Morris Mine)		50	
Hoist Motor from Stephenson Mine		75	
Rheostat Pump		2	
Cooling Water Pump		5	
Return " "		2	
Sump Pump (new)		5	
			154
NEGAUNEE MINE & BARN:			
Flywheel Hoist Set Motor		350	
Top Tram		50	
Hoist from South Jackson		75	
Crusher " " "		150	
Pump " Maas Mine		50	
			675
PRINCETON MINE:			
Underground Pump		150	
			150
PRINCETON CENTRAL SHOPS & CENT. POWER PLANT:			
Grinder		3	
Austin Mine Hoist Motor		200	
Rock Tram from Stephenson Mine		25	
Ore " " " "		50	
			278
GWINN STORAGE SHED & STEPHENSON TRANSFER:			
Stephenson 5th level Plunger Pump		250	
" " " " "		250	
" 8th " " "		50	
" 6th " Centrifugal Pump		125	
Top Tram from Gardner Mine		25	
" " " Stephenson Mine		50	
Spare for Pumping Station		30	
			760
	fwd.		7,402¾ HP.

MECHANICAL DEPARTMENT
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Electrical Department: (Cont'd)

brt. fwd.		7,402¾ HP.
TILDEN MINE:		
Conveyor Belt	50	
Trip Motor for Shovels	1¼	
Water Supply Pump	2	
Scraper Motor	50	
		103¼
LLOYD MINE:		
Hoist Motor from Republic Mine	500	
		500
AU TRAIN PLANT:		
Centrifugal Pump	5	
		5
TOTAL		8,011 HP.

Spare Motors at Spies-Virgil Mine:

Underground Haulage Set	150	
Grinder Motor	3	
TOTAL		153 HP.

Spare motors on Mesaba Range:

HILL-TRUMBULL MINE & SHOPS:		
Log Washer	25	
Picking Belt	2	
Spare	3	
Log Washer from Crosby Mine	40	
Screen " " "	20	
Picking Belt " " "	3	
Chip Screen " " "	3	
Tables " " "	20	
Centrifugal Pump " " "	85	
#2 Turbo " " "	20	
Feeder " " " (Loaned to Buffalo Mine)	20	
North Pit Pump	30	
		271
CANISTEO MINE:		
Crosby Mine Planer	3	
Centrifugal Pump	600	
" "	600	
Chicago Pump	3	
Old Band Saw	3	
Dipper Trip	2	
Air Compressor from Pontiac Mine	100	
		1,311
HOLMAN-CLIFFS MINE:		
Shaft Pump	150	
Motor-Generator Set	150	
Sump Pump	5	
		305
TOTAL		1,887 HP.

Electrical Department: (Cont'd)

Total C.C.I.Co. & C.P.&L.Co. load connected to Power System - 12/31/33 -		25,806¼ HP.
" Outside " " " " " - " -		18,965 "
TOTAL CONNECTED LOAD		44,771¼ HP.
Total connected load at Mesaba Range Mines - Dec. 31st, 1933 -		6,004½ HP.
" " " " Spies-Virgil Mine - " " " -		1,398 HP.
Total spare motors on hand Dec. 31st, 1933 -	Ishpeming District -	8,011 HP.
" " " " " " " " -	Spies-Virgil Mine -	153 HP.
" " " " " " " " -	Mesaba Range Mines -	1,887 HP.

MECHANICAL DEPARTMENT
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YEAR 1933

Electrical Department: (Cont'd)

The following direct current generators and exciters are installed and operating as needed:

		INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	JAN. 1,1934 TOTALS
AU TRAIN WATER POWER PLANT:					
Exciters	(2)	34 KW.			34 KW.
CARP RIVER WATER POWER PLANT:					
Exciters	(2)	150			150
HOIST PLANT:					
Exciter		17½			
"		37			54½
McCLURE PLANT:					
Exciters	(2)	110			
M. G. Exciter		12			122
ESCANABA PLANT:					
Exciter		28			28
REPUBLIC PLANT:					
Exciter		18			
"		15			33
MAAS PLANT:					
Motor Driven Exciter		22½			
Turbo " "		22½			
Compressor Motor Exciters	(2)	20			65
PRINCETON CENTRAL POWER PLANT:					
Motor Driven Exciter		22½			
Turbo " "		22½			45
CLIFFS SHAFT MINE:					
Compressor Motor Exciters	(2)	20			20
BROWNSTONE SUBSTATION:					
Battery Charging Set		2			
Line Testing Set		1/2			
Voltage Regulator Control		1/2			
Condenser Exciter		15			
M. G. Set in Shop			10		28
ATHENS MINE:					
Nordberg Compressor Motor Exciter		10			
Flywheel Set Exciter		15			
Skip Hoist Generator		700			
Battery Charging Motor-Generator Set		1/2			
Ingersoll-Rand Compressor Motor Exciter		10			735½
MAAS CRUSHING PLANT:					
Pan Conveyor Generator		35			
" " " Exciter		1¾			36¾
	fwd.	1,341¾ KW.	10	0	1,351¾ KW.

MECHANICAL DEPARTMENT
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Electrical Department: (Cont'd)

	INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	JAN. 1,1934 TOTALS
brt. fwd.	1,341¾ KW.	10 KW.	0	1,351¾ KW.
NEGAUNEE MINE:				
Skip Hoist Generator	400			
Cage " "	150			
Flywheel Set Exciter	25			
Exciters for Underground Pump Motors	28			
Ingersoll-Rand Compressor Motor Exciter	10			
Nordberg " " "	10			
Bell Signal Set	1/2			
Skip Hoist Generator #2	400			
Cage " " #2	200			
Exciter on new Hoist Set	35			
				1,258½
MORRIS MINE:				
Ingersoll-Rand Compressor Motor Exciter	10			
				10
LLOYD MINE:				
Compressor Motor Exciter (from Boeing)		6		
				6
MACKINAW MINE:				
Compressor Motor Exciter	10			
				10
TILDEN MINE:				
Thrust Generator on Electric Shovel #29	15			
Hoist " " " " "	75			
Swing " " " " "	15			
Exciter " " " "	5½			
" " " " #31	5½			
Thrust " " " " "	15			
Hoist " " " " "	75			
Swing " " " " "	16			
Exciter for Synchronous Motor	15			
				237
TOTAL	2,857¼ KW.	16 KW.	0	2,873¼ KW.

MECHANICAL DEPARTMENT
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Electrical Department: (Cont'd)

Underground Haulage Generators:

	INSTALLED TO JAN. 1 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	JAN. 1,1934 TOTALS
CLIFFS SHAFT MINE:				
Motor-Generator Set #2	100 KW.			
" " Charging Set	5			
" " Set #1	100			
				205 KW.
ATHENS MINE:				
Rotary Converter #1	100			
" " #2	100			
				200
MAAS MINE:				
Motor-Generator Set #1	100			
" " " #2	100			
				200
NEGAUNEE MINE:				
Motor-Generator Set #1 (new)	200			
" " " #2	150			
				350
MORRIS MINE:				
Motor-Generator Set #1 (to Inland Steel Co.)	100		100	
				0
LLOYD MINE:				
Converter (from Inland Steel Co.)		90		
				90
MACKINAW MINE:				
Rotary Converter	100			
				100
TOTAL	1,155 KW.	90 KW.	100	1,145 KW.

Direct Current Motors:

AU TRAIN WATER POWER PLANT:				
Governor Control Motors	(2)	1/4		
				1/4
CARP RIVER WATER POWER PLANT:				
Rheostat Control	(2)	1/4		
Governor "	(2)	1/4		
				1/2
McCLURE PLANT:				
Valve Control	(2)	2		
Rheostat "	(2)	1/2		
				2½
CLIFFS SHAFT MINE:				
Portable Hoist		10		
Car Puller		6½		
12 Scrapers		180		
				196½
fwd.		199¾ HP.	0	0	199¾ HP.

MECHANICAL DEPARTMENT
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Electrical Department: (Cont'd)

		INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	JAN.1,1934 TOTALS
	prt. fwd.	199¾ HP.	0	0	199¾ HP.
TILDEN MINE:					
Hoist Motor on Electric Shovel #29		100			
Swing " " " " "		20			
Thrust " " " " "		20			
Swing " " " " #31		20			
Thrust " " " " "		20			
Hoist " " " " "		100			
					280
ATHENS MINE:					
Skip Hoist		900			
Ventilating Fans	7 - 5 HP. motors	35			
Sullivan Scrapers	2 - 6½ " "	13			
" "	14 -15 " "	150	60		
Ventilating Fan		15			
Sullivan Scrapers	2 -20 " "	40			
I.-R. "	2 10 " "	20			
					1,233
MAAS MINE:					
Timber Hoist - skip pit (scrapped)		10		10	
" " - 4th level		10			
Ventilating Fan		15			
Sullivan Scrapers	14 - 15 HP. motors	180	30		
" "	5 - 6½ " "	45½		13	
Scraper Slide		15			
Ventilating Fans	7 - 5 " "	35			
Scrapers	2 - 25 " "	50			
I.-R. Scrapers	8 - 15 " "	105	15		
" "	3 - 10 " "	30	15		
Scrapers	2 - 20 " "	40			
Blower for Shop			3		
					575½
MAAS CRUSHING PLANT:					
Pan Conveyor		40			
					40
NEGAUNEE MINE:					
Skip Hoist		500			
Cage "		200			
Timber Hoist - 11th level		10			
" " - 12th "		10			
Scrapers	12 - 7½ HP. motors	90			
Sullivan Scrapers	10 - 6½ " "	65			
" "	2 - 25 " "	75		25	
Ventilating Fans	4 - 5 " "	5	15		
Denver Scrapers	3 - 10 " "	30			
Sullivan Scrapers	7 - 15 " "	105			
Ingersoll-Rand Scrapers	5 - 15 " "	45	30		
" " "	5 - 10 " "	50			
					1,205
LLOYD MINE:					
Scraper		15			15
	fwd.	3,428¼ HP.	168 HP.	48	3,548¼ HP.

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Electrical Department: (Cont'd)

		INSTALLED TO JAN. 1, 1933	INSTALLED IN 1933	TAKEN OUT IN 1933	JAN. 1,1934 TOTALS
	brt. fwd.	3,428¼ HP.	168 HP.	48 HP.	3,548¼ HP.
MORRIS MINE:					
Sullivan Scraper		10		10	
" Scrapers	4 - 15 HP. motors	60		60	
Scraper Slide		15		15	
Scrapers	2 - 25 " "	50		50	
Ingersoll-Rand Scrapers	2 - 15 " "	30		30	
					0
	TOTAL D.C. MOTORS	3,593¼ HP.	168 HP.	213 HP.	3,548¼ HP.

Spare Generators and Exciters on hand December 31st, 1933:

CLIFFS SHAFT MINE:		
Motor-Generator set for Battery Charging	20 KW.	
		20 KW.
GENERAL STOREHOUSE:		
Old Hoist Exciter	22	
		22
NEGAUNEE MINE:		
Skip Hoist (armature only)	500 HP.	
TOTAL		42 KW.

Spare Underground Haulage Generators on hand December 31st, 1933:

GENERAL STOREHOUSE:		
Motor-Generator Set (from Morris)	100	
TOTAL		100 KW.

Spare Direct Current Motors on hand December 31st, 1933:

CLIFFS SHAFT MINE:		
Spare Scraper Motor	15	
Stored at Cliffs Shaft for Lloyd Mine:		
Sullivan Scrapers (from Morris) 4 - 15 HP. motors	60	
" " " " 3 - 6½ " "	19½	
" " " " 1 - 10 "	10	
" " " " 1 - 25 "	25	
I.-R. " " " 1 - 15 "	15	
Sullivan " " Range 5 - 15 "	75	
		219½ HP.
ATHENS MINE:		
Timber Hoist Motor	10	
Fan	15	
		25
LLOYD MINE:		
Crane Motor	10	
Ore Loader	2	
		12
	fwd.	256½ HP.

Electrical Department: (Cont'd)

		brt. fwd.	256½ HP.
GENERAL STOREHOUSE:			
Pump Motor		20	
Spare Hoist Motor for Shovel		105	
" Swing " " "		20	
			145
GARDNER-MACKINAW MINE:			
Sullivan Scrapers	3 - 10 HP. motors	30	
" Scraper		20	
Hoist		15	
			65
	TOTAL		466½ HP.

MESABA RANGE:

Exciters and Generators installed up to December 31st, 1933:

CANISTEO MINE:		
Hoist Generator on Shovel	150	KW.
Swing " " "	40	
Thrust " " "	39	
Washing Plant Generator	150	
Arc Welder	10	
Exciter on Shovel	12	
Arc Welder (from Hill-Trumbull)	10	
		411 KW.
HILL-TRUMBULL MINE:		
Hoist Generator on Shovel	150	
Swing " " "	40	
Thrust " " "	39	
Exciter " "	12	
		241
HOLMAN-CLIFFS MINE:		
Hoist Generator on Shovel	150	
Swing " " "	40	
Thrust " " "	39	
Generator for Feeder	150	
Exciter on Shovel	12	
		391
TOTAL		1,043 KW.

Underground Haulage Generators installed up to Dec. 31st, 1933:

HOLMAN-CLIFFS MINE:	
Motor-Generator Set	115 KW
HILL-TRUMBULL MINE:	
Motor-Generator Set	55
" " " for Rock Haulage	25
TOTAL	195 KW.

Direct Current Motors installed up to December 31st, 1933:

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Electrical Department:

		brt. fwd.	0
CANISTEO MINE:			
Rack Drives on Classifiers	4 @ 5 HP. motors	20 HP.	
Hoist Motor on Shovel		187½	
Swing " " "		40	
Thrust " " "		40	
Pan Conveyor		40	
			327½ HP.
HILL-TRUMBULL MINE:			
Feeder Motor		60	
Hoist Motor on Shovel		187½	
Swing " " "		40	
Thrust " " "		39	
Dorr Bowl Classifiers	2 - 5 HP. motors	10	
			336½
HOLMAN-CLIFFS MINE:			
Pan Conveyor		40	
Log Washers	3 -40 " "	120	
Hoist Motor on Shovel		187½	
Swing " " "		40	
Thrust " " "		40	
			427½
	TOTAL		1,091½ HP.

Spare Direct Current Motors on Mesaba Range Dec. 31st, 1933:

CANISTEO MINE:		
Generator (from Pontiac Mine)	7 KW	
		7 KW.
HOLMAN-CLIFFS MINE:		
1 D. C. Motor	5 HP.	
1 " "	3	
1 " "	3	
		11 HP.

MESABA RANGE:

Total Exciters and Generators installed to December 31st, 1933 - 1,043 KW.

" Haulage Generators " " " " " - 195 KW.

" Direct Current Motors " " " " " - 1,091½ HP.

SPIES-VIRGIL MINE:

Exciters installed to December 31st, 1933:

Compressor Motor Exciter		10 KW.
Underground Haulage Generators installed to December 31st, 1933:		150 KW.
Top Tram Larry Cars	2 - 20 H.P. D.C. Motors	40
Fan		15
		55 HP.

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

Electrical Department: (Cont'd)

ISHPEMING DISTRICT:

Total	D.C. Generators and Exciters installed to December 31st, 1933 -	2,873¼ KW.
"	Underground Haulage Generators " " " " " -	1,145 KW.
"	Direct Current Motors " " " " " -	3,548¼ HP.
"	Spare D.C. Generators and Exciters on hand " " " -	42 KW.
"	" Underground Haulage Generators " " " " " -	100 KW.
"	" Direct Current Motors " " " " " -	466⅔HP.

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

Electrical Department: (Cont'd)

Substation Transformers installed up to December 31st, 1933:

	Phase	No.	K.V.A.	TOTAL K.V.A.	
66,000/2,300 Volts					
Munising Substation	1	3	667	2,001	
Seney "	1	1	25	25	
Inland #1 "	1	3	500	1 500	
" #2 "	1	3	500	1 500	
					5,026 K.V.A.
33,000/66,000 Volts					
Gwinn Substation	1	3	1,250	3,750	
					3,750 "
33,000/13,200 Volts					
Clarksburg Substation	1	3	37½	112½	
					112½ "
33,000/6,600 Volts					
Eben Substation	1	1	25	25	
					25 "
33,000/2,300 Volts					
Brownstone Substation	1	3	400	1,200	
Cliffs Shaft-Holmes Substation	1	6	500	3 000	
Morris-Lloyd Substation	1	3	590	1 770	
Princeton "	1	3	250	750	
Republic "	1	3	400	1 200	
Maas "	1	6	590	3 540	
Escanaba Plant "	1	3	590	1 770	
Gwinn "	1	3	625	1 875	
Munising "	1	3	200	600	
McClure Plant "	3	2	5,000	10 000	
Carp " "	1	3	1 900	5 700	
Au Train " "	3	1	1 250	1 250	
Palmer "	1	3	625	1 875	
Hoist "	1	3	667	2 000	
Greenwood "	1	3	150	450	
Chatham "	1	2	15	30	
					37,010 "
6,600/2,300 Volts					
Carp Plant Substation	1	6	185	1,110	
Gwinn "	1	3	350	1 050	
Mackinaw "	1	3	350	1 050	
Inland #1 "	1	3	25	75	
Blaney Park "	1	2	25	50	
" " "	1	1	15	15	
					3,350 "
6,600/115-230 Volts					
Germfask	1	1	15	15	
"	1	2	1.5	3	
"	1	2	3	6	
					24 "
			GRAND TOTAL		49,297½ K.V.A.

Transformers used for Underground Haulage installed to 12/31/33:

Athens Mine converters	1	6	35	210	
Mackinaw " converter	1	3	35	105	
					315 K.V.A.

Electrical Department: (Cont'd)

Distribution Transformers installed up to December 31st, 1933:

2300/220/110 Volts	Phase	No.	K.V.A.	Total K.V.A.
ANGELINE MINE:				
Hoist Control	1	1	7½	
				7½
CLIFFS SHAFT MINE:				
Office Lights	1	1	10	
" "	1	1	15	
"A" Shaft Hoists	1	2	(15) 30	
Pump Station Lights	1	1	3	
Crusher House Lights	1	2	(1) 2	
Crushers & Surface Lights	1	3	(10) 30	
Gravel Scraper	1	2	(37) 75	
Underground Scrapers	1	4	(50) 200	
" "	1	3	(25) 75	
Motor-Generator Set for Battery Charging and 1st level "A" Scrapers	1	3	(15) 45	
Rectifiers	1	7	(5) 35	
Lights	1	34	(1½) 51	
Scraper Lights	1	1	2	
Signal in Engine House	1	1	5	
Scraper Lights	1	1	3	
Top Tram Control	1	1	1	
Laboratory	1	2	(15) 30	
				612
HARD ORE, BROWNSTONE, ETC.				
Light & Power	1	1	15	
" " "	1	1	7½	
Shop	1	1	30	
Manager's Residence	1	2	(10) 20	
" "	1	1	5	
F. C. Stanford & Testing	1	1	7½	
" " " "	1	1	5	
Manager's Residence	1	1	7½	
" "	1	1	1½	
Hospital	1	3	(25) 75	
				174
TILDEN MINE:				
Pump	1	2	(10) 20	
Lights & Power	1	2	(5) 10	
" " "	1	2	2	
Drills	1	3	(10) 30	
Shovel	1	3	(5) 15	
Crusher	1	3	(10) 30	
Synchronous Condenser	1	2	(7½) 15	
Scrapers	1	3	(15) 45	
				167
ATHENS MINE:				
Machine Shop	1	2	(10) 20	
Surface Lights & Lab. Hot Plates	1	3	(10) 30	
Pump Station Lights	1	1	5	
" " "	1	1	2	
100 G.P.M. Pump	3	1	40	
Signal System	1	1	1	
Engine House Lights	1	1	5	
" " "	1	1	4	
Top Tram	1	1	2	
" " Control	1	1	1	
				110
			fwd.	1,070½

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

Electrical Department: (Cont'd)

Distribution Transformers (Cont'd)

	Phase	No.	K.V.A.	Total K.V.A.
brt. fwd.				1,070½
MAAS MINE:				
Lights & Injection Pump	1	3	(10) 30	
Coal Crusher & Shop	1	2	(10) 20	
Signal System	1	1	1/2	
3rd level Pump Station	1	2	(5) 10	
Cage Hoist Control	1	1	10	
Skip " "	1	1	2	
" " "	1	1	3	
Rock Tram	1	1	1	
Heaters in Engine House	1	1	7½	
Top Tram	1	1	2	
Shop	1	1	15	
				101
MAAS CRUSHING PLANT:				
Lights	1	1	7½	
				7½
NEGAUNEE MINE:				
Shop Light & Power	1	1	10	
" " " "	1	1	7½	
Engine House Lights & Power	1	1	10	
" " " " "	1	1	5	
Signal System	1	1	1/2	
Pump Station Lights, etc.	1	3	(7½) 22½	
13th Level Pump	1	3	(5) 15	
Barn	1	1	5	
Gravel Pit	1	1	7½	
Hoist & Lights - #2 Shaft	1	3	(10) 30	
Laboratory Lights & Power	1	2	(15) 30	
Undg. Haulage	1	1	3	
				146
LLOYD MINE:				
Cage Hoist Control	1	1	7½	
Skip Hoist "	1	1	7½	
Water Supply Pump House Lights	1	1	2	
Engine House Lights & Bell System	1	1	5	
Shaft House Lights	1	1	5	
Auxiliary Compressor	1	1	2	
Lights & Power	1	1	2½	
				31½
MORRIS MINE:				
Location Lights	1	1	7½	
Club House "	1	1	10	
				17½
SECTION 6 SHAFT:				
Hoist Control	1	1	7½	
Lights	1	2	(2) 4	
				11½
REPUBLIC MINE:				
Engine House Lights	1	1	7½	
Office Lights	1	1	3	
Water Power Plant Lights	1	1	1½	
" " " "	1	1	3	
				15
			fwd.	1,400½

Electrical Department: (Cont'd)

Distribution Transformers (Cont'd)

	Phase	No.	K.V.A.	Totals K.V.A.
brt. fwd.				1,400½
AUSTIN MINE:				
Shop	1	1	10	
				10
GARDNER MINE:				
Cage Hoist Control	1	1	10	
Power & Lights	1	2 (10)	20	
				30
MACKINAW MINE:				
Machine Shop	1	2 (5)	10	
Hoist Control	1	1	10	
Top Tram	1	1	1	
7th level Engine House Lights	1	1	1	
Engine House Heaters	1	1	3	
				25
PRINCETON #2:				
Stockpile	1	2 (10)	20	
				20
PRINCETON #3:				
Lighting & Bell System	1	1	1½	
				1½
PRINCETON CENTRAL POWER PLANT:				
Coal Crusher	1	3 (7½)	22½	
Power Plant Lights	1	1	10	
				32½
PRINCETON CENTRAL SHOPS:				
Power & Lights	1	2 (10)	20	
				20
GWINN DISTRICT OFFICE:				
Lights	1	1	10	
				10
PRINCETON PUMP STATION:				
Power	1	3 (15)	45	
Lights	1	1	5	
				50
GWINN DISTRICT CRUSHER:				
Power & Lights	1	2 (10)	20	
				20
GWINN SUBSTATION:				
Lights	1	1	1/2	
				1/2
AU TRAIN WATER POWER:				
Operators Dwelling Lights	1	1	2	
Control	1	3 (1)	3	
Power & Lights, Dixon Location	1	2 (5)	10	
" " " Grand Island	1	2 (5)	10	
Lights, Forest Lake Location	1	1	10	
Chief Operator's Dwelling Lights	1	1	5	
Surge Tank Heaters	1	2 (5)	10	
Dixon Tie Mill	1	3 (3)	9	
Gravel Pit	1	2 (5)	10	
Camp Lights	1	1	5	
Grand Island	1	1	7½	
" "	1	2 (5)	10	
				89½
			fwd.	1,709½

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

Electrical Department: (Cont'd)

Distribution Transformers (Cont'd)

	Phase	No.	K.V.A.	Total K.V.A.
brt. fwd.				1,709½
CARP RIVER WATER POWER PLANT:				
Power & Lights	1	1	10	
" " "	1	1	20	
Pump	1	2	(1) 2	
				32
HOIST PLANT:				
Power & Lights	1	3	(10) 30	
				30
McCLURE PLANT:				
Power & Light	1	2	(10) 20	
				20
ESCANABA RIVER PLANT:				
Power & Light	1	3	(5) 15	
				15
GRAND TOTAL				1,806½
THE CLIFFS ELECTRIC CO.				
Austin Location Lighting	1	1	10	
Gwinn Street Lights	1	2	(1) 2	
" " "	1	1	2	
Gwinn Lighting - near Depot	1	1	1/2	
" " - Poplar Alley	1	1	30	
" Power - Club House	1	2	(5) 10	
" Lighting - " "	1	1	10	
" " - Mineral Street	1	1	10	
" " - Pine "	1	2	(15) 30	
" Power - School	1	3	(5) 15	
" Lighting - "	1	1	10	
Cyr Location Lighting	1	1	2	
Princeton Upper Location Lighting	1	1	10	
" Lower " "	1	1	5	
New Swanzy " "	1	1	10	
Little Lake " "	1	1	5	
" " " "	1	1	7½	
Chatham Lighting & Power	1	2	(7½) 15	
" "	1	1	10	
" "	1	1	5	
" "	1	1	1	
Eben Lighting - School	1	1	10	
Seney "	1	1	10	
" "	1	1	5	
Rumely "	1	2	(5) 10	
Dorsey Farm Lighting	1	1	2½	
" " "	1	1	3	
Eben " "	1	1	3	
" " "	1	1	2½	
Blaney Lighting Extensions	1	1	3	
Dorsey Lighting	1	1	5	
" "	1	11	(1½) 16½	
" "	1	2	(3) 6	
Chatham Rural Lighting	1	1	1	
Eben Corner "	1	1	7½	
			TOTAL	283

MECHANICAL DEPARTMENT
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YEAR 1933

Electrical Department: (Cont'd)

Spare Transformers on hand December 31st, 1933:

	Phase	No.	K.V.A.	Total K.V.A.
ANGELINE MINE:				
General Electric	1	1	1	
				1
GENERAL STOREHOUSE & BARN:				
Westinghouse from Hoist	3	1	1,250	
General Electric for 440 V. shaft pump	1	1	100	
" "	1	1	10	
" " from Republic	1	1	15	
" " " "	1	1	7½	
Western Electric	1	1	5	
General Electric	1	3	(75) 225	
" "	1	1	10	
" "	1	1	10	
" "	1	1	10	
Westinghouse	1	1	15	
General Electric	1	1	5	
Allis-Chalmers	1	1	7½	
General Electric	1	1	10	
" "	1	1	3	
" "	1	1	2	
Western Electric	1	1	10	
General "	1	1	2	
Westinghouse	1	1	5	
General Electric	1	1	5	
" "	1	1	1	
" "	1	2	(15) 30	
" "	1	1	25	
" "	1	1	1/2	
Pittsburgh	1	1	10	
General Electric	1	1	5	
" "	1	1	3	
" "	1	1	5	
" "	1	1	5	
" "	1	1	10	
" "	1	1	3	
Westinghouse	1	1	2	
General Electric	1	1	10	
" "	1	1	10	
" "	1	1	1	
" " Wade Converter	1	1	35	
" " " "	1	1	35	
" " " "	1	1	35	
Ft. Wayne	1	1	2	
General Electric	1	1	5	
				1,947½
ATHENS MINE:				
Spare	1	1	3	
"	1	1	3	
				6
REPUBLIC MINE:				
General Electric	1	1	4	
				4
			fwd.	1,958½

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

Electrical Department: (Cont'd)

	Phase	No.	K.V.A.	Total K.V.A.
brt. fwd.				1,958½
GWINN SUBSTATION:				
Spare	1	1	10	
				10
ESCANABA RIVER PLANT:				
Spare	1	1	10	
				10
PRINCETON MINE ENGINE HOUSE:				
Surface Lighting	1	1	5	
				5
		TOTAL		1,983½

MECHANICAL DEPARTMENT
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YEAR 1933

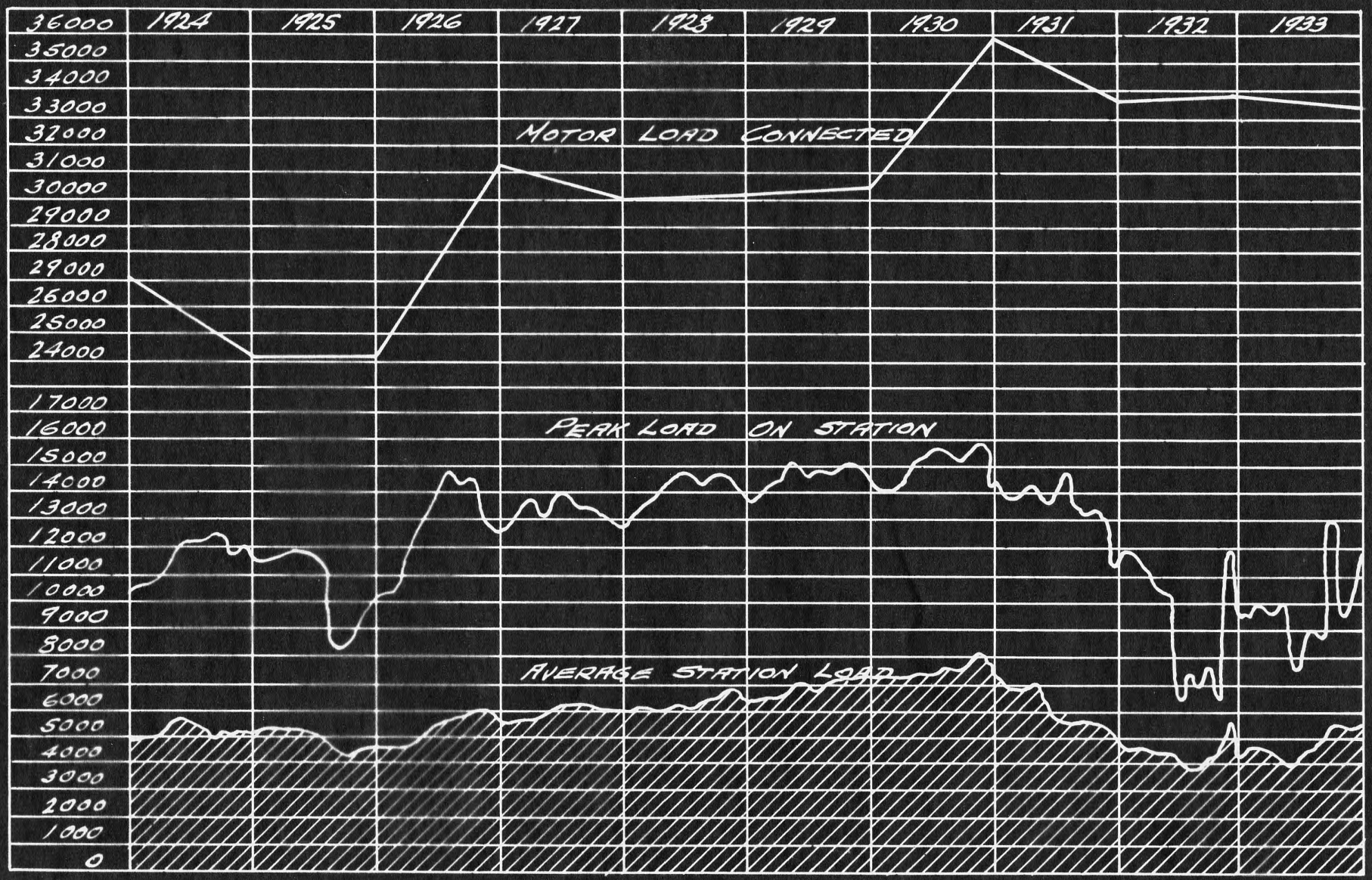
COMPARATIVE TABLES:

YEAR	TONS COAL BURNED	TONS ORE & ROCK HOISTED	CU. FT. AIR USED	CUBIC FT. AIR PER TON HOISTED	GALLONS OF WATER PUMPED
CLIFFS SHAFT MINE:					
1924	2,224	309,996	784,461,617	2,530	388,257,675
1925	2 900	322 928	824 005 547	2 551	327 655 585
1926	1 470	350 604	801 351 000	2 285	379 727 700
1927	957	426 830	766 647 000	1 796	440 517 425
1928	1 008	416 344	804 600 000	1 932	463 182 750
1929	934	451 334	853 572 500	1 891	461 403 025
1930	716	444 511	896 693 000	2 017	446 650 100
1931	560	315 492	592 506 000	1 878	350 061 000
1932	611	92 125	188 127 000	2 042	369 057 075
1933	495	61 623	160 033 500	2 596	362 896 379
ATHENS MINE:					
1924	685	246,352	581,130,000	2,359	116,161,813
1925	789	214 510	468 900 000	2 186	131 715 395
1926	869	226 229	547 650 000	2 421	140 788 044
1927	790	233 221	679 815 000	2 914	127 086 869
1928	827	241 977	710 640 000	2 936	120 178 303
1929	767	344 534	1,154,380,000	3 350	117 645 969
1930	657	384 801	1 060 650 000	2 756	181 785 145
1931	621	254 660	686 750 000	2 696	136 215 501
1932	578	77 639	209 925 000	2 703	205 070 447
1933	546	49 506	152 235 000	3 075	194 073 179
MAAS MINE:					
1924	682	224,291.	470,880,000	2,099	522,683,088
1925	670	144 408	372 735 000	2 581	480 918 511
1926	829	245 992	420 930 000	1 711	508 242 996
1927	767	274 586	521 730 000	1 900	534 129 791
1928	657	272 740	679 005 000	2 489	553 419 346
1929	577	347 232	1,067,265,000	3 074	554 452 221
1930	606	443 504	1 374 390 000	3 098	577 702 994
1931	618	332 206	756 405 000	2 076	585 922 823
1932	585	97 295	210 825 000	2 166	576 727 573
1933	662	143 845	367 560 000	2 555	554 157 402
NEGAUNEE MINE:					
1924	1,156	322,705	558,980,000	1,732	502,525,354
1925	1 100	342 824	660 600 000	1 927	436 422 253
1926	1 229	374 004	602 010 000	1 609	440 271 619
1927	1 139	501 516	895 680 000	1 785	603 746 976
1928	1 278	472 458	1,047,240,000	2 216	629 675 383
1929	1 410	569 489	1 123 840 000	1 973	648 591 436
1930	1 254	597 364	1 044 270 000	1 748	556 227 893
1931	885	346 533	620 641 000	1 791	482 294 599
1932	1 092	86 650	209 970 000	2 423	477 360 416
1933	708	65 661	166 050 000	2 528	448 928 213

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1933

COMPARATIVE TABLES: (Cont'd)

YEAR	TONS COAL BURNED	TONS ORE & ROCK HOISTED	CU. FT. AIR USED	CUBIC FT. AIR PER TON HOISTED	GALLONS OF WATER PUMPED
TILDEN MINE:					
1929	625	441,769			
1930	498	287 043			
1931	244	137 010			
1932	38	19 957			
1933	164	194 194			
LLOYD MINE:					
1933	96	4,554			
GARDNER-MACKINAW MINE:					
1928	336	91,293	214,020,000	2,344	52,760,063
1929	531	119 189	570 635 000	4 703	56 528 157
1930	316	129 321	621 450 000	4 805	74 823 761
1931	152	80 801	489 240 000	6 054	172 438 518
1932	106	24 781	126 945 000	5 122	119 155 845
1933	40	3 944	49 770 000	12 619	103 051 726


36000
35000
34000
33000
32000
31000
30000
29000
28000
29000
26000
25000
24000
17000
16000
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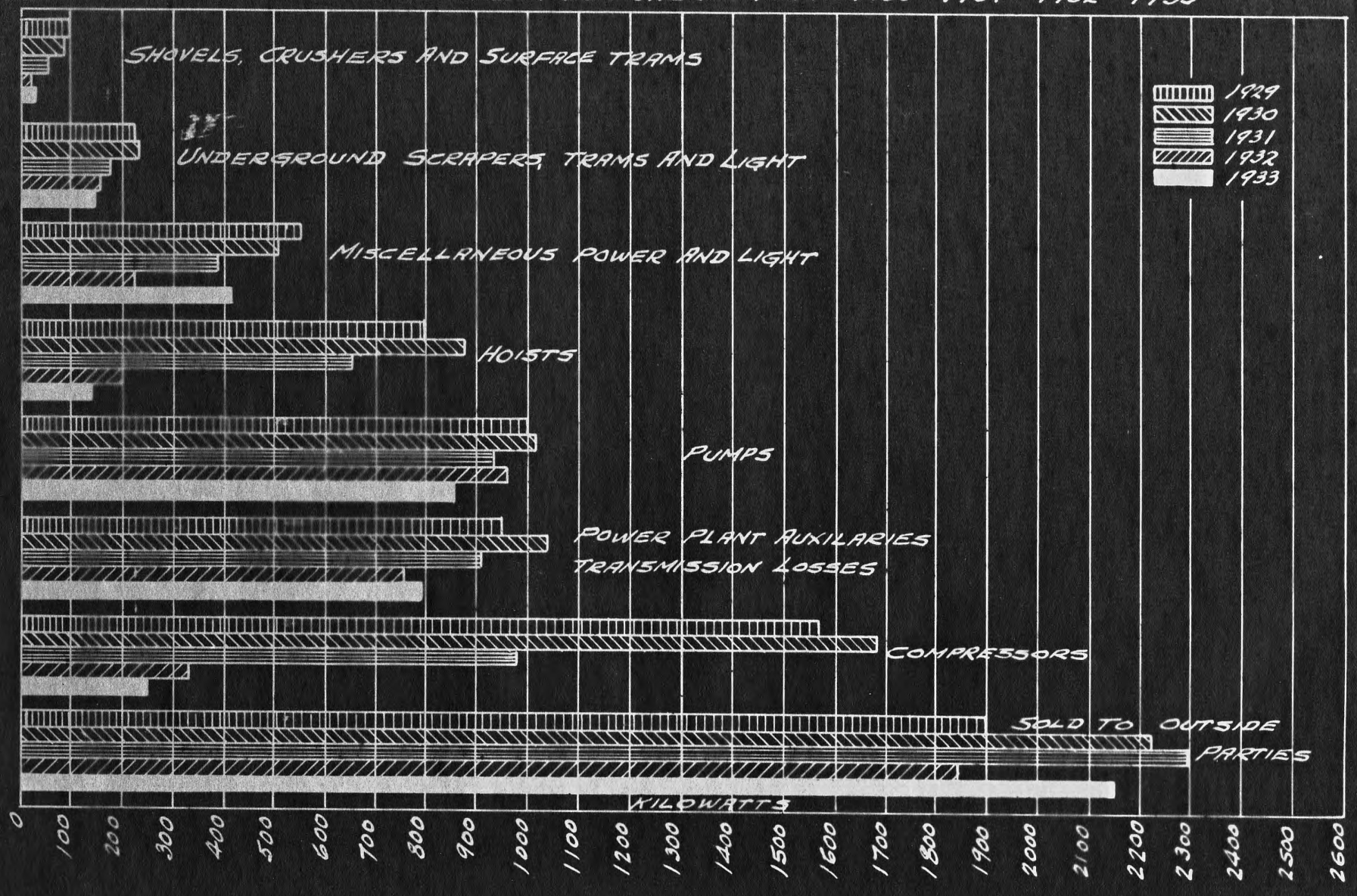
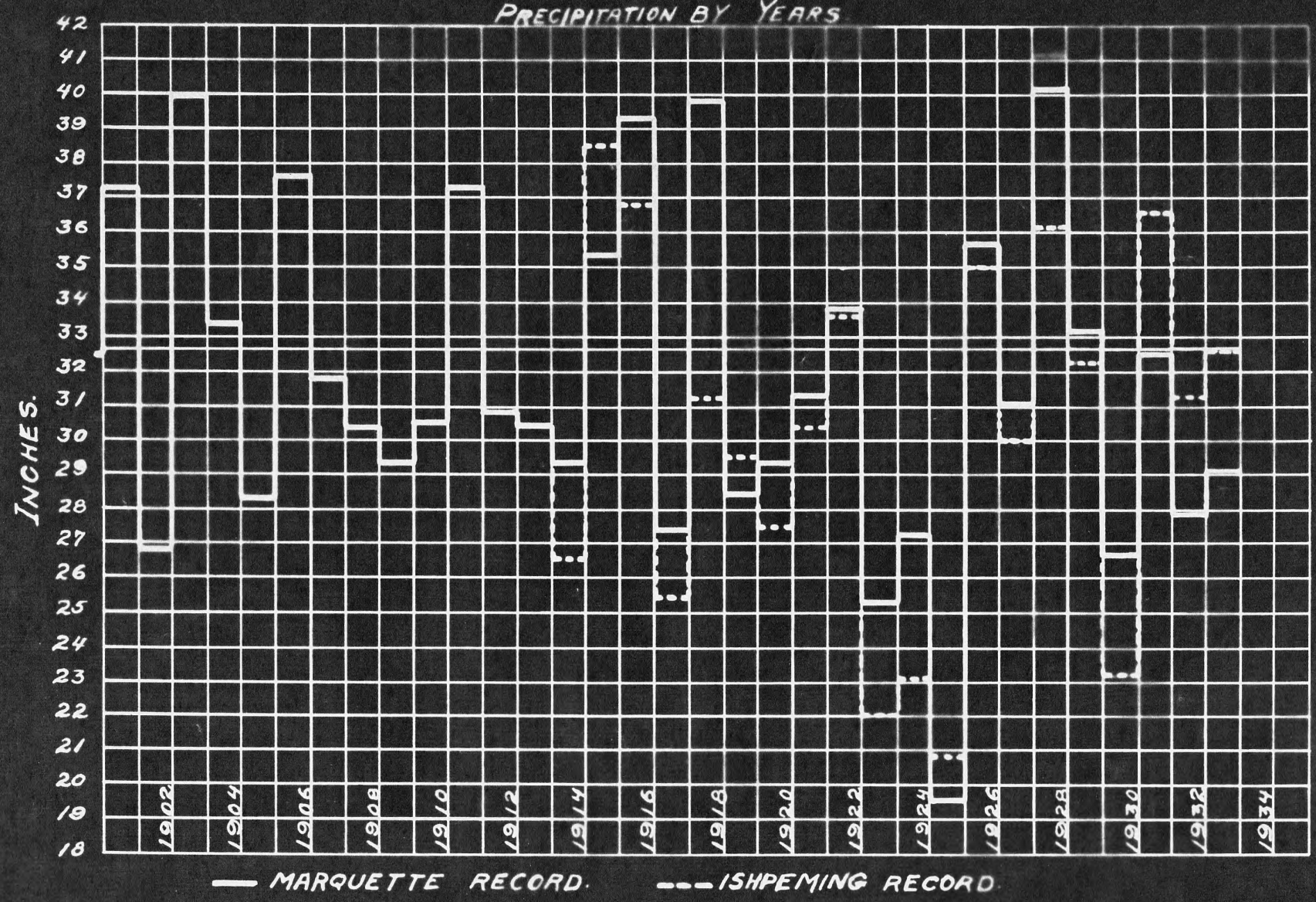
8000
7000
6000
5000
4000
3000
2000
1000
0
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
MOTOR LOAD CONNECTED
PEAK LOAD ON STATION
AVERAGE STATION LOAD


DISTRIBUTION OF ELECTRIC POWER 1929 - 1930 - 1931 - 1932 - 1933
SHOVELS, CRUSHERS AND SURFACE TRAMS
UNDERGROUND SCRAPERS, TRAMS AND LIGHT
MISCELLANEOUS POWER AND LIGHT
HOISTS
PUMPS
POWER PLANT AUXILARIES
TRANSMISSION LOSSES
COMPRESSORS
SOLD TO OUTSIDE PARTIES
1929
1930
1931
1932
1933
KILOWATTS
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600

1933

JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.
AVERAGE LOAD
KILOWATTS
5000
4000
3000
2000
1000
0
1000
2000
3000
4000
10000
11000
12000
13000
14000
15000
16000
17000
18000
19000
20000
26000
27000
28000
WATER LOST
KILOWATT EQUIVALENT
Au Train
Republic
Hoist
Carp
McClure
McClure
Carp
McCLURE 49.1%
CARP 25.4%
HOIST 13.5%
AU TRAIN 3.4%
REPUBLIC 2.3%
ESCANABA 6.3%
CURRENT MADE BY WATER POWER
WATER LOST BY OVERFLOW
POWER PURCHASED


PRECIPITATION BY YEARS
INCHES.
42
41
40
39
38
37
36
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
1902
1904
1906
1908
1910
1912
1914
1916
1918
1920
1922
1924
1926
1928
1930
1932
1934
MARQUETTE RECORD.
ISHPEMING RECORD.