

CANISTEO-CLIFFS MINE  
ANNUAL REPORT  
YEAR 1930

13. EQUIPMENT AND  
PROPOSED  
EQUIPMENT:  
(Continued):

	<u>Received:</u>
1 8' x 60' Steel Pan Conveyor,	10-15-30
1 5' x 22' Steel Pan Conveyor,	10-15-30
1 40" x 30" x 10' Bed Hamilton Planer,	10-21-30
1 2" Acme Bolt Threading Machine complete with heads,	10-21-30
1 75 H.P. Motor,	10-28-30
1 Boiler for Air Receiver, 5' x 16' Horizontal,	10-30-30
1 West Side Iron 36" Band Saw with Motor,	11-12-30
1 Tawnewitz Type F Variety Saw, with guard & Motor,	11-12-30
1 Oliver Motor on Head planer and jointer,	11-28-30
2 18" Belt Conveyors, 28'0" Centers,	11-29-30
2 24" Belt Conveyors, 38'0" Centers,	11-29-30
3 150 KVA Transformers,	11- -30
1 42" Diameter Vertical Boiler, for Salt Tank,	11- -30
1 30" Lathe,	12- -30
1 Wooden Water Tank,	11-3 -30

18. NATIONALITY  
OF  
EMPLOYEES:

<u>NATIONALITY:</u>	<u>NO. OF MEN</u>
	<u>1930</u>
American, -----	33
Irish, -----	9
Jugo-Salvish, -----	38
English, -----	26
Finnish, -----	22
Serbian, -----	10
Swedish, -----	17
Norwegian, -----	14
French, -----	12
Italian, -----	3
Austrian, -----	2
German, -----	1
Danish, -----	1
Total, -----	188

THE CLEVELAND-CLIFFS IRON COMPANY-AGENTS  
ALEXANDRIA MINE  
ANNUAL REPORT  
YEAR 1930

1. GENERAL:

All mining on this property is confined to underground operation. The entire production is hoisted through No. 2 hoisting shaft, located near the Southeast corner of the South Forty. This shaft is 280 feet deep and four compartment. There are two hoisting compartments, one ladder-way and one cage compartment. The cage compartment is not being used. This shaft is located in the area where the ore lies at greatest depth. Prior to November, 1928, all ore was hoisted through the No. 1 shaft, located to the North of No. 2 shaft on the West Forty, where the ore occurred nearer the surface.

Mining operations have been carried forward on all three forties, during the past year, so as to exhaust the ore on all the forties as near simultaneously as possible. The purpose of this is to maintain a long working face and permit single shift operation for a maximum period of the life of the mine. Shore lines are being drawn in so that the last ore to be mined will be along the East boundary of the South Forty.

A small slice of ore was left along the East boundary line of the East Forty, adjoining the Godfrey Mine, by the M. A. Hanna Company while operating the mine prior to 1924. This ore, totaling 122 tons, was mined by the Oliver Iron Mining Company during the past year and delivered to us in cars, at the request of the fee owner's representatives. Same is included in our production under the caption of "Godfrey Trespass".

For convenience, the three Forties are referred to as follows: The SW of SE of Section 29 as East Forty; the SE of SW of 29 as West Forty and the NE of NW of 32 as South Forty.

The description of St. Anthony No. 2 Reserve is: SW of SE of 32, 58-20. This is an isolated forty included in the Alexandria lease.

2. PRODUCTION,  
SHIPMENTS &  
INVENTORIES:

a. Production by Grades:

Pocket to Dock, -----	179,002 tons.
Pocket to Stockpile, -----	141,208 "
Total, -----	320,210 "

b. Shipments:

Alexandria Pocket to Dock, -----	178,880 "
Alexandria-Godfrey Trespass to Dock, -----	122 "
Alexandria Stockpile to Dock, -----	55,786 "
Total, -----	234,788 "

ALEXANDRIA MINE  
ANNUAL REPORT  
YEAR 1930

2. PRODUCTION,  
SHIPMENTS &  
INVENTORIES:

c. Stockpile Inventories:

January 1st, 1931, ----- 133,948 tons.

e. Production by Months:

January, -----	29,771 tons.	
February, -----	28,550 "	
March, -----	29,948 "	
April, -----	30,505 "	
May, -----	36,531 "	
June, -----	31,545 "	
July, -----	27,209 "	
August, -----	23,153 "	
September, -----	24,266 "	
October, -----	24,389 "	
November, -----	16,155 "	
December, -----	18,188 "	
Total, -----		320,210 tons.

f. Ore Statement:

	<u>1 9 3 0</u>	<u>1 9 2 9</u>
On Hand January 1, 1930, -----	48,526	-
Output for Year, -----	320,210	-
Total, -----	368,736	-
Shipments, -----	234,788	-
Balance on Hand January 1, 1931	133,948	-

g. Delays:

The following delays were reported during the year 1930:

<u>DATE:</u>	<u>TIME LOST</u>	<u>CAUSE</u>
April 29th -	30 Min.	Break in high tension line.
November 17th -	3 Hrs. -	Blockade in haulage drift due to holeing in cross-cut.
November 24th -	1 " 30 Min.	Broken trolley wire on stockpile.

3. ANALYSIS:

a. Average Analyses on Shipments:

	<u>Tons</u>	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Mois.</u>	<u>Nat.</u>	<u>Fe.</u>
Alexandria Pocket, -----	178,880	56.15	.097	5.68	1.92	1.66	12.53	49.11	
Alexandria-Godfrey Tres- pass to Dock, -----	122	55.93	.076	6.02	1.29	1.38	11.50	49.50	
Alexandria Stockpile to Dk. -----	55,786	56.35	.092	5.59	1.50	1.77	12.06	49.55	
Total, -----	234,788	56.20	.096	5.66	1.82	1.69	12.42	49.22	

a.a. Analyses of Production:

Pocket to Dock, -----	179,002	56.08	.097	5.67	1.93	1.66		
Pocket to Stockpile, ---	141,208	56.59	.095	5.56	1.50	1.64		
Total, -----	320,210	56.30	.096	5.62	1.74	1.65		

ALEXANDRIA MINE  
ANNUAL REPORT  
YEAR 1930

3. ANALYSIS:b. Average Analyses of Cargoes:

<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Moist.</u>	<u>Fe.</u>
56.20	.096	5.66	1.82	1.69	12.42	49.22

d. Composite Analyses of Seasons Shipments:

<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sul.</u>	<u>Loss</u>
56.26	.095	5.60	1.80	1.65	.20	.17	.013	9.30

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

Displacement factor based on Oliver Curve.

15.72 Cubic Foot = 1 Ton.

No deduction for rock. (Included in factor used above).

East Forty, -----	268,993 tons.
West Forty, -----	176,586 "
South Forty, -----	918,876 "
 Total Alexandria, -----	 1,364,455 "

b. Undeveloped Ore:

St. Anthony #2 Reserve, ----- 800,317 "

c. Estimated Analyses:

	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Moist.</u>	<u>Fe.Nat.</u>
Alexandria, -----	56.41	.106	5.74	1.44	1.41	13.00	49.08
St. Anthony #2 Reserve--	55.43	.088	6.34	1.43	3.78	-	-

The estimated analysis of Alexandria ore is based on the records of exploration drill holes. Our past experience indicates that the ore when mined shows a slightly lower iron content and a slight increase in Manganese. This is particularly true on the South Forty which contains slightly more than one-half of the remaining tonnage.

5. LABOR & WAGES:a. Comments:

The labor conditions at the mine throughout the year were satisfactory. There never has been a time during the operation of this mine when there has been any shortage of men. The labor turnover is very small compared with other mines of the Mesaba Range.

Wage rates were the same as during the preceding year. Increased average underground day rates resulted from larger average production by contract miners.

ALEXANDRIA MINE  
ANNUAL REPORT  
YEAR 1930

5. LABOR & WAGES:  
(Continued)

b. Comparative Statement of Wages & Product:

	<u>1930</u>	<u>1929</u>	<u>Increase</u>	<u>Decrease</u>
<u>PRODUCT: -----</u>	320,210	337,735		17,525
<u>No. Shifts &amp; Hours, -----</u>	31,663	37,128		5,465
 <u>AVG. NO. MEN WORKING:</u>				
Surface, -----	19	21		2
Underground, -----	95	99		4
Total, -----	114	120		6
 <u>AVG. WAGES PER DAY:</u>				
Surface, -----	4.97	5.05		.08
Underground, -----	5.77	5.72	.05	-
Total, -----	5.64	5.61	.03	-
 <u>WAGES PER MO. OF 25 DAYS:</u>				
Surface, -----	124.25	126.25	-	2.00
Underground, -----	144.25	143.00	1.25	-
Total, -----	141.00	140.25	.75	-
 <u>PRODUCT PER MAN PER DAY:</u>				
Surface, -----	59.96	50.72	9.24	-
Underground, -----	12.16	11.08	1.08	-
Total, -----	10.11	9.10	1.01	-
 <u>LABOR COST PER TON:</u>				
Surface, -----	.083	.099	-	.016
Underground, -----	.474	.516	-	.042
Total, -----	.557	.615	-	.058
 <u>AVG. PRODUCT BRK'G. &amp; TRM'G:</u>				
	15.82	14.94	.88	-
 <u>AVG. WAGES CONTRACT MINERS:</u>				
	5.98	5.93	.05	-
 <u>TOTAL NO. OF DAYS:</u>				
Surface, -----	5,340	6,658	-	1,318
Underground, -----	26,323	30,470	-	4,147
Total, -----	31,663	37,128	-	5,465
 <u>AMOUNT FOR LABOR:</u>				
Surface, -----	26514.31	33648.09	-	7133.78
Underground, -----	151991.90	174494.08	-	22502.18
Total, -----	178506.21	208142.17	-	29635.96

Prop. Surface to Underground Mine 1930, 1 to 4.93  
" " " " " 1929, 1 to 4.58

The mine was operated on a single shift basis:

6 Days per Week - January 1st to July 19th.  
5 " " " - July 19th to November 8th.  
4 " " " - November 9th to December 31st.

ALEXANDRIA MINE  
ANNUAL REPORT  
YEAR 1930

6. SURFACE:

a. Buildings, Repairs:

No building repairs of any consequence were made during the year. The interior of the change-house was given two coats of paint by the regular surface men employed on the property.

b. Stockpiles:

The stockpile ore was loaded with a Bucyrus "70" shovel. There were 96,295 tons of ore in stockpile, not including overrun, at the close of the shipping season. There is ample room for stocking the production of the present winter under the reduced operating schedule.

c. Tracks, Roads, Transmission Lines, etc:

During the early part of the past year request was made to the State Highway Department for relocation of State Highway No. 35, which crosses the Westerly part of the South Forty, to a new location, farther West over caved ground, where the ore had been mined. This request was complied with by the Department and traffic removed to the new location, prior to July 5th, so that no interference was occasioned with the mining operations on this Forty. This work was done at the expense of the Highway Department.

7. UNDERGROUND:

a. Shaft Sinking:

A new two-compartment cribbed timber shaft, located near the East side of the South Forty, was sunk to the main ore body, a total depth of 158 feet. The purpose of this timber shaft is to serve a small ore body in this vicinity located in a higher horizon of the ore formation, and also to serve the main ore body in this vicinity. The lower 100 feet of this shaft was raised from the underground workings, through rock, and the upper 58 feet was sunk through the surface.

b. Development, South Forty:

Two rock raises were put up from the main haulage drift to a small ore body located about fifty feet above the main ore body in the North-easterly part of the Forty. The first raise was located adjacent to drill holes No. 207. The drill hole record shows 13 feet of ore, analyzing over 57%, but the raise disclosed a maximum depth of 10 feet.

Crosscuts were driven to the North, East, South and West. The crosscut to the West encountered the shore line immediately West of the drill hole. A crosscut driven to the North encountered lean ore and shore line, indicating that the West shore line extends in a Northeasterly direction to the Northeast corner of the Forty and probably connects with the ore body in the same horizon, which was mined on the East Forty. The crosscuts to the East and South disclosed an ore of good quality extending to the East Forty line and the South shore line about 45 feet South of the drill hole. We estimate this ore as about 13,500 tons. An average analysis of the drift samples of the work done to date is: Iron 56.93; Phos. .301; Silica - 6.72; Mang. - 1.19; Alum. - 2.41. The purpose of this development during the past year was to ascertain the location of the shore lines so as to prohibit the possibility of under-mining this ore in the main ore body.

ALEXANDRIA MINE  
ANNUAL REPORT  
YEAR 1930

7. UNDERGROUND:  
(Continued)

c. Stopping:

The ore hoisted during the past year has been derived from all three Forties. The production by forties is as follows: East - 70,149.97; West - 70,681.69 - and South - 179,348.34 tons. The average depth of the ore mined on the East and West Forties was from 13 to 14 feet, while on the South Forty the depth was from 10 to 11 feet. Comparatively small troughs in the footwall where the ore extended below an additional six to ten feet, were encountered on all three forties. Where these troughs occurred it was usually necessary to take out the ore in two subs.

In the Southeast corner of the South Forty there is a channel in the iron formation containing ore, less than 100 feet in width, extending from the Southeast corner in a Northerly and slightly West-erly direction, a distance of over 300 feet, in which the ore body extends about 100 feet upward from the main ore body horizon, to the top of the iron formation. The entire top sub and part of the second sub of this ore body, for a distance of 300 feet North of the South line, was mined during the past year. Such ore, as lies immediately North of the area which was mined, lies under the surface plant and cannot be mined at this time.

d. Timber:

The increase in the amount of timber used per ton over 1929 is accounted for in the larger proportion of ore mined from the South Forty, or shallower depth of ore, where the proportionate footage of timber to the ton of ore is obviously larger.

Statement of Timber Used:

	<u>LINEAL</u> <u>FEET</u>	<u>AVG. PRICE</u> <u>PER FOOT</u>	<u>AMOUNT</u> <u>1930</u>	<u>AMOUNT</u> <u>1929</u>
7" to 9" Timber, -----	338,290	.0722	24420.92	23115.68
9" to 12" Timber, -----	58,068	.1292	7501.42	7407.72
TOTAL TIMBER - 1930 ----	396,358	.0805	31922.34	30523.40
TOTAL TIMBER - 1929 ----	393,845	.0775	-	-
	<u>LINEAL</u> <u>FEET</u>	<u>PER 100</u> <u>FEET.</u>	<u>AMOUNT</u> <u>1930</u>	<u>AMOUNT</u> <u>1929</u>
6" Lagging, -----	472,302	.746	3521.56	3587.02
3" Poles, -----	459,740	1.184	5444.76	4930.39
Cribbing Timber, -----	26,185	3.519	921.34	-
1" Covering Boards, Bd.Ft.	749,565	1.20	8969.11	8545.99
Product, -----			320210	337735
Ft. Timber Per Ton of Ore, -----			1.238	1.166
Ft. Lagging Per Ton of Ore, -----			1.475	1.424
Ft. Lagging Per Foot of Timber, -----			1.192	1.199
Cost Per Ton For Timber, -----			.0997	.0904
"    Covering Boards, -----			.0280	.0253
"    Lagging, -----			.0110	.0106
"    Poles, -----			.0170	.0146
"    All Timber, etc., -----			.1586	.1409
Cost of timber, lagging, poles, etc., 1930 ----			50779.11	
"    "    "    "    "    "    1929 ----				47586.80

ALEXANDRIA MINE  
ANNUAL REPORT  
YEAR 1930

7. UNDERGROUND:  
(Continued)

e. Drifting and Raising:

<u>Year</u>	<u>Ore Drifting</u>	<u>Ore Raising</u>	<u>Rock Drifting</u>	<u>Rock Raising</u>
1930	2,299	165	260	202

The greater portion of all drifting and raising was done on the South Forty. The development of the top ore body in the Northeast portion included 400 feet of ore drifting and 130 feet of rock drifting. The balance of the rock drifting was for drainage purposes. The rock raising includes the new timber shaft.

f. Statement of Explosives Used:

<u>KIND:</u>	<u>QUANTITY</u>	<u>AVERAGE PRICE</u>	<u>AMOUNT 1930</u>	<u>AMOUNT 1929</u>
40% Dup. R.C. Powder,	44,000	11.75	5,170.00	27,490.87
35% Herc. L.F. Powder,	35,000	11.65	4,077.50	-
40% Dup. Spec. Gel. Powder,	134,430	11.728	15,765.59	-
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Total Powder, 1930 -	213,430		25,013.09	-
Total Powder, 1929 -	233,700			27,490.87
Fuse, -----	492,100	5.769	2,839.21	2,695.39
Caps, -----	98,600	11.598	1,143.60	1,177.08
Tamping Bags, etc., ----	15,000	2.35	35.25	-
<hr/>				
Total Fuse, Etc., 1930	507,000		4,018.06	
Product,			320,210	337,735
Pounds of Powder Per Ton of Ore,			.666	.692
Cost per ton For Powder,			.078	.0814
Cost per ton for Fuse, Caps, etc.,			.013	-
Cost per ton for All Explosives,			.091	-
Avg. Price per Lb. for Powder, etc.,			11.72	11.763
Note: Cap Sealing Compound,	6	.50	3.00	4.00
Fuse Cutter,	1		22.00	-

The reduction in powder cost per ton can be accounted for only in the change from Red Cross to Gelatin powder.

g. Mining & Loading:

At the beginning of the past year a number of single-drum tigger hoists were discarded and all underground loading of ore has been done with double-drum machines. This has resulted in an increase in the average production per miner. All contracts were provided with electric tigger hoists and scrapers with which the ore is loaded into two-ton hand-tram cars and trammed to the chutes.

i. Ventilation:

Ventilation is provided by a 13,000 cubic feet per minute fan, located at the old hoisting shaft, forcing air into the mine at this point. This fan is used only during summer and periods of mild temperatures. During the cold weather months natural ventilation is sufficient.



ALEXANDRIA MINE  
ANNUAL REPORT  
YEAR 1930

8. COST OF  
OPERATION:

a. Comparative Mining Costs:

<u>PRODUCT</u>	<u>1930</u>	<u>1929</u>	<u>Increase</u>	<u>Decrease</u>
	320,210	337,735		17,525
Average Daily Product,	1,152	1,097	55	
Tons Per Man Per Day,	10.11	9.21	.90	
Days Operation,	278	308		30
Budget, Estimated Production,	340,000	337,735	2,265	-
"    "    Cost at Mine,	1.188	1.243		.055
 <u>COST:</u>				
<u>Total Cost at Mine:</u>				
Underground Costs,	.842	.867		.025
Surface Costs,	.054	.062		.008
General Mine Expense,	.098	.107		.009
Cost of Production,	.994	1.036		.042
 <u>Loading &amp; Shipping:</u>				
Steam Shovel,	.009	.020		.011
Pocket,	.004	.005		.001
Total Loading & Shipping,	.013	.025		.012
Depreciation, Plant & Equipmt.	.056	.053	.003	
"    Development,	.012	.012	-	-
Taxes - Ad Valorem,	.071	.072	-	.001
" - Occupational,	.048	.018	.030	
" - Royalty,	.020	.027	-	.007
 TOTAL COST AT MINE,	 1.214	 1.243		 .029
Administrative & Gen'l. Exp.	.054	-	.054	
Miscellaneous Income,	.005		.005	
 TOTAL COST,	 1.263	 1.243	 .020	 -

The decreased production in 1930 was necessitated by the reduced demand for ore. An increased daily production was, however, obtained,

The increase in tons per man per day was the result of slightly increased efficiency on the part of the miners and larger output per day without any increase in the number of non-productive men.

The budget figure for "Cost at Mine" was arrived at without taking into consideration the Administrative and General Expense charge and assuming that the Occupational Tax would be the same as during the year 1928.

Underground costs show a decrease as a result of increased production per miner brought about by the replacement of a single-drum tuggers with double drum machines and increased production per day without any increase in the non-productive underground labor.

ALEXANDRIA MINE  
ANNUAL REPORT  
YEAR 1930

8. COST OF  
OPERATION:  
(Continued)

Surface costs were reduced as a result of larger output per day.

General Mine Expense shows a decrease as this account for the preceding year included all administrative and accounting expense.

A decrease is shown in steam shovel cost on account of the smaller tonnage loaded and the opportunity afforded of using the same loading crew at the Wade Mine during a part of the period.

The item of pocket loading shows a decrease due to larger tonnage hoisted per day without any increase in labor.

The increase in depreciation is the result of reduced annual output with the same annual charge for depreciation.

10. TAXES:

a. Tax Statement:

	<u>1930</u>	<u>1929</u>	<u>Increase</u>	<u>Decrease</u>
Alexandria Mine,	\$ 11,266.78	14,255.93		2,989.15
St. Anthony No. 2 Reserve,	2,020.07	1,973.09	46.98	
Village Lot,	166.75	-	166.75	
Total,	\$ 13,453.60	16,229.02		2,775.42
Personal Property,	9,453.27	7,524.98	1,928.29	
GRAND TOTAL,	\$ 22,906.87	23,754.00		847.13

The increase in taxes on the St. Anthony No. 2 Reserve is due to increased tax rate.

The larger tonnage of ore in stockpile was responsible for the increase in personal property taxes.

11. ACCIDENTS  
AND  
PERSONAL  
INJURY:

There were twelve lost-time accidents at the Alexandria Mine during the year 1930. A brief description of these accidents follows:

NAME: Steve Verderbar DATE: January 6th.  
CAUSE: While stepping down from slide injured party slipped and struck back on slide.  
NATURE: Contusion to back about 2 inches to right of second lumbar vertebra.  
TIME LOST: 5 Days.

ALEXANDRIA MINE  
ANNUAL REPORT  
YEAR 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURY:

NAME: Emil Sironen DATE: January 7th.  
CAUSE: Injured party caught his finger between gin pole and tigger pole.  
NATURE: Crushing of little finger on right hand nearly severing tip.  
TIME LOST: 4 Days.

NAME: Mache Yatauro DATE: January 30th.  
CAUSE: Piece of mining timber rolled off timber truck and fell on right foot.  
NATURE: Fracture of first phalanx, great toe, right foot.  
TIME LOST: 1 Day.

NAME: Sam Wuori DATE: March 15th.  
CAUSE: Cap timber slid off posts before it was blocked and struck injured party on back.  
NATURE: Severe bruising to left lumbar region.  
TIME LOST: 3 Days.

NAME: Joseph Bovitz DATE: June 16th.  
CAUSE: Motor struck plank near track and caught the injured person's left leg between the air line and the plank.  
NATURE: Severe contusion to left ankle.  
TIME LOST: 11 Days.

NAME: Joe Gersich DATE: July 22nd.  
CAUSE: The injured person was standing on a staging trimming the back, when a piece of ore dropped on the platform and bounded upon his toe.  
NATURE: Crushing injury of great toe on left foot.  
TIME LOST: 3 Days.

NAME: Arcangelo Zaiotti DATE: September 10th.  
CAUSE: A piece of cable wire pierced the injured person's glove and became lodged in the middle finger of his right hand.  
NATURE: Infected finger.  
TIME LOST: 12 Days.

NAME: Gunder Peterson DATE: October 19th.  
CAUSE: Injured party slipped on icy part of road and twisted his right knee.  
NATURE: Moderate swelling; probable tearing of crucial ligament in knee joint.  
TIME LOST: 14 Days.

NAME: Tony Knezovich DATE: October 28th.  
CAUSE: The accident occurred while dumping a top tram car. A piece of pipe which is used to dump cars, bent inward where the injured person held it, and caught his left hand between the pipe and the car frame.  
NATURE: Laceration and partial loss of soft parts of third finger over distal 2 Phalanges. Mangling and amputation of second finger at distal joint. Soft parts over second phalanx was fractured missing so that amputation was necessary 1/2" from distal end of proximal Phalanx.  
TIME LOST: Injured party has not returned to work to date.

ALEXANDRIA MINE:  
ANNUAL REPORT  
YEAR 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURY:

NAME: John Oberto DATE: October 30th.  
CAUSE: Injured person slipped and fell against steel water barrel, striking right chest against edge of barrel.  
NATURE: Fractured rib.  
TIME LOST: 16½ Days.

NAME: Joseph Bovitz DATE: December 8th.  
CAUSE: While sending a load of timber down #2 timber shaft, the injured person was struck on the lower lip by the handle of a cant-hook which is used to turn the cable drum enough so that the timber will slide into the shaft.  
NATURE: ¾" lacerated cut through lower lip at right median line.  
TIME LOST: 4½ Days.

NAME: Leo Anderson. DATE: December 16th.  
CAUSE: The injured person struck his finger on a post, as he jerked the hand chain of a chain block to loosen it.  
NATURE: Mild swelling of right forefinger with false motion. 2 Phalanx right forefinger very tender to manipulation. Xray reveals a fracture through bone cyst 2 Phalanx right forefinger.  
TIME LOST: Injured person worked from date of accident to December 30th, inclusive and has not worked since.

13. EQUIPMENT AND  
PROPOSED  
EQUIPMENT:

a. Steam Shovels:

The Bucyrus Model "70" steam shovel, built in 1892, and used for loading stockpile ore, required considerable repair work at the beginning of the season. The main frame on the boom end was cracked in a number of places and repairs were made by means of welding. Some of the repairs made showed weakness during the latter part of the season and will probably necessitate some overhauling before same can again be put into service.

d. Tugger Hoist and Scrapers:

The mine is completely equipped with tugger hoists and scrapers. There are twenty-two Sullivan 7½ H.P. - one 10 H.P., and 1 - 15 H.P. hoists. A number of the small machines have been in service since 1924 and have loaded in the neighborhood of 100,000 tons of ore each. Two new tugger hoists were purchased during the early part of the year to replace single-drum machines.

f. General:

The mine has sufficient machine equipment for present requirements, and no additions or replacements are anticipated in the immediate future.

ALEXANDRIA MINE  
ANNUAL REPORT  
YEAR 1930

15. POWER:

The mine is completely equipped with electrically-driven machinery. The power is furnished by the Minnesota Power & Light Company.

16. WATER SUPPLY:

The water supply for the change house and location dwellings is furnished by the Oliver Iron Mining Company through a pipe line from the Godfrey Mine.

Pumping:

The pumping of mine water varied from a minimum of 18 gallons per minute in February to a maximum of 65 gallons per minute in July, with an average for the year of about 35 gallons per minute.

17. CONDITION OF  
PREMISES:

An effort was made to keep the premises as neatly as possible. The location buildings are in a good state of preservation, having been painted during the year 1929. The mine buildings are in a good state of preservation and require no immediate repairs.

18. NATIONALITY  
OF  
EMPLOYEES:

<u>NATIONALITY:</u>	<u>NO. OF MEN</u>
Finnish, -----	31
Austrian, -----	23
American, -----	16
Italian, -----	10
Slovanian, -----	9
Polish, -----	4
English, -----	3
German, -----	1
Norwegian, -----	1
Swedish, -----	1
Total, -----	99

22. REPORT OF THE GEOLOGIST FOR THE YEAR ENDING DECEMBER 31, 1930.

A. STAFF.

The staff of the Geological Department for the year 1930 is shown in Table I below. The personnel has remained the same throughout the year:

TABLE I.

NAME.	OCCUPATION.	DURATION OF EM- PLOYMENT IN 1930.	DAYS LOST. SICKNESS. VACATION.	% OF WORKING DAYS WORKED.	
E.L.Derby, Jr.,	Chief Geologist,	Entire year	10 $\frac{1}{2}$	0	96.1
A.H.Tillson,	Assistant Geologist,	" "	23 $\frac{1}{2}$	1 $\frac{1}{2}$	90.8
Gustav Afuhs,	Draftsman,	" "	8	7 $\frac{1}{2}$	94.3
E.A.Allen,	Assistant,	" "	0	10	96.3

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

TABLE II.

Total days of eight hours worked,	- - -	272 days
Sundays,	- - - - -	52 "
Full days resulting from Saturday afternoons,	- - - - -	26 "
Holidays,	- - - - -	15 "
Total,		365 days

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

TABLE III.

YEAR.	AVERAGE NUMBER OF MEN.
1926	4.0
1927	4.0
1928	4.0
1929	4.0
1930	4.0

B. DIVISION OF WORK AMONG THE MEMBERS OF THE DEPARTMENT.

The division of time actually consumed by the members of the Department is shown in Table IV below:

TABLE IV.

ITEMS.	DAYS WORKED.				TOTAL DAYS.
	DERBY.	TILLSON.	AFUHS.	ALLEN.	
<u>MINES:-</u>					
Athens, - - - - -	3	1	80	21	105
Bingham-North Star, - - - - -	95	2	47	0	144
Canisteco, - - - - -	327	4	182	0	513
Cliffs Shaft, - - - - -	17	787	215	451	1470
Corrigan, McKinney Mines, - - - - -	136	0	17	0	153
Dean-Itasca, - - - - -	12	0	10	0	22
Drew, - - - - -	4	3	31	0	38
Erickson Lease, - - - - -	4	0	9	0	13
Gardner-Mackinaw, - - - - -	5	178	2	0	185
Hartford-Cambria-Jackson, - - - - -	7	0	0	0	7
Hill-Trumbull, - - - - -	42	0	4	0	46
Holman-Brown, - - - - -	191	0	2	0	193
Holmes, - - - - -	68	159	34	198	459
Maas, - - - - -	1	100	11	4	116
Morris-Lloyd, - - - - -	55	400	208	255	918
Neely Lease, - - - - -	12	0	0	0	12
Negaunee, - - - - -	0	89	13	4	106
Tilden, - - - - -	68	28	228	604	928
Virgil, - - - - -	26	182	499	291	998
Wade, - - - - -	43	0	0	0	43
<u>MISCELLANEOUS ITEMS:-</u>					
Annual Report, - - - - -	58	0.	50	0	108
Assisting Engineers, - - - - -	0	0	2	44	46
Beneficiation of Iron Ores, - - - - -	48	0	0	0	48
Cliffs Power & Light Company, - - - - -	16	0	0	0	16
Driving Engineering Department truck, - - - - -	0	0	0	95	95
Federal Taxes, - - - - -	72	0	0	0	72
General Departmental, - - - - -	496	30	109	119	754
Investigating Mineral Land Offers, - - - - -	136	4	202	0	342
"    Outside Explorations, - - - - -	15	1	33	6	55
Michigan Mineral Land Company, - - - - -	5	0	2	0	7
Mumising Silica Sand Exploration, - - - - -	218	0	48	4	270
Total Hours Worked,	2180	1968	2038	2096	8282

E. L. Derby, Jr. I continued to have charge of the Geological Department as Chief Geologist. A large part of my time, as in the past, was taken up with the general oversight and supervision of the work of the Department. This has included, besides the usual routine office work, surface explorations at the Canisteo, Holman and North Star Mines on the Mesaba Range in Minnesota, the Munising Silica Sand exploration Northeast of Munising, and the drilling at the Tilden Mine on the Marquette Range; underground drilling in the Athens, Cliffs Shaft, Holmes, Morris-Lloyd and Virgil Mines; and geological surveys in the Athens, Cliffs Shaft, Gardner-Mackinaw, Holmes, Maas, Morris-Lloyd, Negaunee and Virgil Mines.

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

In January, I assisted Messrs. Jackson and Meyers in their report on the Hartford-Cambria and the Sherwood-Aronson-Minckler properties of the Republic Steel Corporation. I accompanied Messrs. D. T. Croxton and J. S. Fraser, of our Furnace Department, on an examination trip to the so-called Davis Direct Process Furnace at the Experimental Station of the University of Minnesota in Minneapolis. I also spent some time in Hibbing on a revised estimate of ore in the Canisteo Mine based on the results of our drilling campaign which was completed on that property the latter part of December 1929. In this connection, I worked up with Mr. Bolthouse two proposed routes for the approach into this property. This work was not completed until the early part of February.

In February, I prepared a complete report on the Canisteo property, including the comparative costs of the two routes of approach and production of ore for the first year with the necessary stripping program, etc. I went over the Tax Commission estimates and maps of the Holmes, Morris and Virgil Mines with Mr. F. G. Pardee, State Appraiser of Mines, in company with Messrs. Jackson and Stakel on the first two and Mr. Pellow on the Virgil. I went over carefully our estimates on the Neely lease in connection with negotiations being carried on with the Oliver Iron Mining Company to combine this lease with their property to the South.

In March, I spent a couple of weeks on the Mesaba Range laying out exploration work for the coming season in the Holman forty of the Holman-Cliffs Mine and visited the drilling which we were doing on the North Star property, and the test pitting being done at the Drew Mine and also the Perkins Reserve, East of Aurora, which was offered to us by Mr. E. F. Remer. I went over with Mr. Sterling, District Engineer, our operating ore estimate at the Wade Mine and recommended a new estimate be made to submit to the Tax Commission engineers in Minneapolis in April.

In April, during my monthly visit to the Mesaba Range, I examined the data of a land offer from Mr. E. F. Remer located at the West end of the Mesaba Range in the vicinity of Pokegama Lake. I also prepared an estimate of the current year's operations at the Holman-Cliffs Mine, mapping out the areas from which the ore must be taken during the 1930 operation at this property. Mr. Rohn and I went to Minneapolis and had a conference with Professor E. M. Lambert, of the University of Minnesota, and Engineer for the Tax Commission, on the valuation of our Wade Mine. We presented him at this time our revised estimate of the ore in this property. Here in Ishpeming I spent several days going over with Dr. Henry Bowman, of Sault Ste. Marie, Ontario, data on an iron ore property which he claims to have discovered about 55 miles Southeast of the Canadian Soo.

In May, I examined the surface, including several test pits, old shaft, etc, of the old Chicago Mine, just North of Wakefield on the Gogebic Range. This property had been offered to us by Mr. J. H. Trebilcock of Ishpeming. I reported on this, recommending that the Company purchase the fee for \$44,000.00. During my monthly visit to the Mesaba Range, I made a joint classification of the drill-



ing completed on the North Star property with Mr. Bolthouse, of our Company, and Mr. MacIntosh, of the Arthur Iron Mining Company. I spent some time in the Canisteo pit looking over the bank faces of portions exposed by the receding water and laid out a campaign of test pitting and sampling to be started at once.

In June, I was called to serve on the Traverse Jury in the Federal Court at Sault Ste. Marie, Michigan, from the 2nd to the 9th, inclusive. I attended a meeting of the Michigan Section of the American Institute of Mining Engineers at Houghton. I spent four days in company with Messrs. Elliott, Jackson and Graff visiting the underground workings and going over the maps and other data of the Corrigan, McKinney Steel Company's mines on the Gogebic Range. Later in the month I made a similar examination of the Corrigan, McKinney Steel Company properties on the Mesaba Range in company with Messrs. Barber and Rohn and of their properties in the Crystal Falls-Iron River District in company with Mr. Meyers. Mr. Elliott also spent one day with us on the examination of the latter properties. While in Hibbing, I went over the maps and cross-sections and ore estimates of the Dean and Trumbull Mines in preparation for a contemplated revision of the Tax Commission estimates on these properties by engineers representing the Tax Commission.

In July, I spent considerable time preparing a detailed report of my examination of all the Corrigan, McKinney Steel Company mines which was made in June. I spent some time with engineers from the Duluth office of the Oliver Iron Mining Company going over the maps and cross-sections of the Holmes Mine and arranged for their underground examinations. I also spent several days with Professor John W. Gruner, of the Geological Department of the University of Minnesota, and an assistant, Mr. T. W. Bennett, showing them the geological features of the Marquette Range and supplying them with miscellaneous related information. Dr. Gruner is advancing a new theory on the origin of iron ores which I think has much merit and promises to revolutionize our ideas of the iron ores of Lake Superior. I gave some time to Mr. C. O. Swanson, Professor of Geology at the Michigan College of Mining & Technology, and Mr. Osgood, of the Michigan State Geological Survey, relative to the work the College and State are doing in mapping the geology on the Western part of the Marquette Range, and more particularly along the South limb. Messrs. C. E. Williams and Byron Bird, Metallurgists from the Battelle Memorial Institute of Columbus, Ohio, came to my office to talk over the problem of concentrating lean iron ores and I attempted to acquaint them with the ores of the Marquette Range, and, to some extent, the problems of concentration which they are hoping to solve ~~to some extent~~ as a result of their research work. During my monthly trip to the Mesaba Range, I classified jointly with Messrs. Bolthouse and MacIntosh the current samples from our drilling on the North Star property. I also visited the new sintering plant at the Bruce Mine with Messrs. S. L. Mather and Barber.

In August, while on the Mesaba Range, I completed the joint classification of the current drilling on the North Star property with engineers from the Great Northern. I also went over in detail the estimates prepared by Mr. Sterling for the Tax Commission on the Dean, Trumbull and Wade Mines. I spent one day examining the surface of the old McComber Mine on the Vermillion Range between Tower and Ely, Minnesota. Mr. W. C. Gordon, Engineer in the Metal Section of the Internal Revenue Department in Washington, and Mr. Sadler, of our Cleveland office, spent a day at my office discussing the question of depletion on the Tilden Mine. We also touched on a possible revaluation for depletion purposes of the Morris-Lloyd Mine. Following this, I made an estimate for the valuation of the Tilden, which was included in a special report to Mr. Geffine.

In September, I went to Minneapolis and had a conference with Messrs. Lambert and Heilig, Engineers for the Minnesota State Tax Commission, on the recent ore estimates submitted to them of the Dean, Trumbull and Wade Mines. I conferred with Mr. E. C. Congdon and Mr. W. G. Swart and others in the

former's office in Duluth relative to the Holman-Brown properties of the Holman-Cliffs Mine. They were eager to know if our operations to date had led us to believe that our first estimate of this property was too conservative. While on the Mesaba Range, during my regular monthly trip, I visited the experimental jigging plant being operated by Pickands, Mather & Company at their Danube Mine. This equipment was borrowed for the test from the Experimental Station at the University of Minnesota, Minneapolis. As a result of this we decided to make jig tests on our own jig type ores from the Canisteo Mine some time during the early spring of 1931 at the Experimental Station in Minneapolis. I attended a meeting of the American Institute of Mining & Metallurgical Engineers in Chicago and then went on to Cleveland where I conferred with Messrs. Croxton and Sallee on the Munising Silica Sand exploration. I also went over with Messrs. Geffine and Sadler our proposed depletion valuation on the Summit exploration of the Tilden property and a revaluation of the Morris-Lloyd Mine.

In October, while on my monthly trip to the Mesaba Range, I met with Mr. W. L. Remick, General Manager of the Hydrotator Company of Hazleton, Pa., and with Mr. McMorris went over the question of the adaptation of the Hydrotator process to the beneficiation of our Mesaba wash and jig ores. I also made a revised estimate of stripping at the Canisteo Mine for the first year's operation of this property necessitated by disappointing results obtained from eight test pits put down on the West side of Bovey Bay, so-called, in a territory from which we had originally planned to get the greater part of the first year's ore supply. At Ishpeming, I spent considerable time on the Munising Silica Sand exploration in preparation for a test on a 5000 lb. sample which I had taken from the face of the sandstone cliff in the vicinity of our recent drilling campaign. This sample was sent to Dickson City, Pa., where during November I supervised a washing test on it, using Hydrotator machines.

In November, I spent one day in Washington, D. C. with Messrs. Geffine and Sadler in a conference with Mr. Gordon, Engineer for the Metal Section of the Income Tax Unit, going over depletion estimates of the Holmes, Morris-Lloyd and Tilden Mines. I then went to Cleveland and continued work on these figures. From there I went to Dickson City, Pa., and supervised a three day washing test on Munising Silica Sand using the Hydrotator process.

In December, while in Hibbing, I went over in detail Mr. McMorris' report on tests he had conducted during the month of June on the Dorr-Bowl classifiers at our Holman washing plant, and particularly as to the possibility of adopting the Hydrotator process to improve the recovery of iron in fine sizes now being made by these Bowl classifiers. I prepared a detailed report accompanying that of Mr. McMorris' on this subject. I attended a meeting of the Minnesota Section of the American Institute of Mining & Metallurgical Engineers in Minneapolis. This is now an annual affair held the early part of December each year and papers are presented on subjects of vital interest to the operators of iron mines on the Minnesota Ranges. I went to Cleveland and Washington, spending one day at each place, on matters pertaining to the revaluation for depletion purposes of the Holmes and Morris-Lloyd Mines. Mr. D. E. Sadler, of our Cleveland office, accompanied me to Washington. I went to Hibbing again the latter part of the month to prepare revised ore and stripping estimates on our Holman-Brown properties of the Holman-Cliffs Mine as a result of our past season's exploration campaign. This was particularly in connection with the annual settlement of royalty with the Canisteo Mining Company, underlying lessees of this property.

A. H. Tillson. Mr. Tillson continued as Assistant Geologist throughout the year. He made regular underground geological surveys in the Cliffs Shaft, Gardner-Mackinaw, Holmes and Morris-Lloyd Mines and occasional surveys in the

Athens, Maas and Negaunee Mines. He posted all these surveys on the geological maps and cross-sections of the several properties. The new sub-levels opened up in a number of these properties necessitated making many new geological tracings to cover this development work.

Mr. Tillson spent a considerable amount of his time, while the underground drilling was going on in the Virgil Mine, assisting Mr. Afuhs in calculating the sulphur from the water tests taken in this drilling. The ore contained soluble sulphur and it is onoy by this means that its quantity can be determined. The calculations involved in getting the results are quite voluminous. He also checked over the plotting of all of our current drilling on both maps and drill sections and he checked the plotting of all the drilling information for our outside exploration files which came to the office during the year in the form of land offers, outside explorations, etc.

Gustav Afuhs. Mr. Afuhs continued as our Draftsman throughout the year. His work, as in the past, has, in part, consisted in preparing cross-sections of all current drilling done by, or for, the Company and of all the drill results that have been submitted to this office in the form of land offers, outside explorations, etc. The latter has taken a considerable time the past year since an unusually large amount of this outside exploration information has been submitted to us.

During January, he completed posting all of the Canisteo drilling results on our regular drill section tracings and prepared blue prints of all of this information which were sent to the fee owners and underlying lessees. He also spent considerable time coloring the annual report exploration sheets and legends and posted our book of maps showing the various Canadian land offers that have come into the office since our last posting.

Mr. Afuhs prepared a number of copies of white print maps of the Canisteo pit showing the two proposed routes for approach to the pit, switch-backs into the pit, ore outlines, stripping limits, etc. He posted to date the land offer plat book, putting in all the land offers that have come to the office since the last posting. He worked up a new legend for annual reports to improve on and take the place of the one now in use, reconciling the legend of the Minnesota operations with that of the Michigan operations.

He spent a considerable amount of time each month, while the drilling was going on in the Virgil Mine, calculating the soluble sulphur content of the ore encountered from the water tests taken in the drilling. As explained in connection with Mr. Tillson, the calculations involved in these tests are quite voluminous. He made and colored a number of valuation charts for Mr. Adams in connection with public hearings of the Michigan State Tax Commission on our operating mines.

Mr. Afuhs also posted to date our geological maps of the Michigan Mineral Land Company's holdings. He made several tracings and blue prints for Mr. Elliott showing the systems of mining in the Iron-ton and Puritan Mines on the Gogebic Range and colored several white prints for him showing the Corrigan, McKinney Steel Company lands. He prepared white prints for Mr. Jackson of the Virgil-Sherwood map to be used in the latter's report on the joint operation of these two properties. He made a tracing and white prints of an idealized cross-section of the Cliffs Shaft Mine showing the different mining operations which was given to a party of Russian engineers visiting the district. He also prepared for me special white print cross-sections through the drilling at the Tilden Mine, both East and West pits, which accompanied my tonnage estimates of these properties for depletion.

He spent much of December posting the past year's extensions on the special sets of geological cross-section tracings of the Athens, Cliffs Shaft, Morris-Lloyd and Negaunee Mines which are photographed each year to accompany the annual ore estimates submitted to the Michigan State Tax Commission. He also assisted Mr. Tillson at times in posting the current extensions on the geological maps and cross-sections of our several mines. The rest of his time was spent on the routine work of the office.

E. A. Allen. Mr. Allen continued as an Assistant in the Department during the year. At times, however, he also assisted several of the engineers with their surveys and particularly in making the estimates of ore in stock at the several mines. He drove the Engineering Department truck at various times. The major part of his time, however, was spent in collecting, sampling, labeling and filing diamond drill samples from the current explorations and making tests for the dip and bearing of the holes with the Maas Compass whenever this data was required.

Mr. Allen also classified and reported on the core and sludge samples from the current explorations and made all of the necessary thin sections of rocks for examination under the microscope. He made the regular monthly carbon report, assisted Mr. Tillson in a number of his underground geological surveys and joined with Mr. Kalm in making the annual inventory of the diamond drill equipment. In December, he spent considerable time assisting in the photographing of our annual report maps and in making a large number of prints.

#### C. SURFACE GEOLOGICAL SURVEYS.

No detailed surface geological surveys were made during the year.

#### D. UNDERGROUND GEOLOGICAL SURVEYS.

##### D-1. ATHENS MINE.

The geological surveys at the Athens Mine were made periodically by Mr. C. W. Allen, Engineer at the property, and occasionally by Mr. Tillson, of the Geological Department. We have kept this information posted on both the geological maps and cross-sections.

The horse of jasper just South of and in contact with the main East-West dike and between the 6th and 8th levels, first encountered in 1928 and discussed in my report for 1929, finally flattened out and the ore in contact with it was found to extend North as far as the main dike.

On the 6th level a drift is now being driven in the hanging wall ore encountered in drill hole No. 11 drilled early in the year from the 480' sub-level. Raises are also being put up from this 6th level drift to locate and outline the hanging wall contact. Mining above the 4th level progressed to a point where it was stopped temporarily to allow mining in the several steps below this elevation to catch up.

The principle mining during the year was confined to stoping between the 4th and 6th levels and the 6th and 8th levels.

##### D-2. CLIFFS SHAFT MINE.

We have kept the Cliffs Shaft geology up to date by making surveys each month coincide with those made by the engineers. We have also made surveys of small portions of the mine more frequently where extra detail was necessary.

Both the geological maps and cross-sections were posted regularly.

Further opening up of the main so-called Bancroft vein on the North side of the mine continued to be the most important development during the year. Thus far the openings in this ore are mainly on Lot 2 Section 3, or the Bancroft lease, but the ore extends Easterly on to C.C.I. Company land and development work was also carried on in this section of the vein during the year. Mining was done in this territory on the 1st to the 8th levels, inclusive, and on the 10th level, all from "A" Shaft/ An ore connection was found between the main vein on the 8th level and the Incline ore. Also, the Westerly extension of the No.3 Mine ore is proving to be an interesting development on the 6th level. A new drift has been started on the 15th level "A" Shaft to get under the Bancroft ore development on the 10th level.

In "B" Shaft, on the 7th level and Northeast of the shaft, the stope of good ore first opened in 1929 was found to continue through to the 5th level and exploring is now going on in this ore above the 5th level. In the Southwest ore body on the 13th level, a large stope raise has been put up to above the 12th and the ore in the breast is still looking good. Drifting in the rock drift running Northeasterly on the 15th level toward the Section 3 ore body was continued until about October when progress was stopped in order to construct a concrete dam for the protection of the mine in case unusual amounts of water are encountered in this work.

#### D-3. GARDNER-MACKINAW MINE.

Mr. Tillson, of the Geological Department, has made regular underground geological surveys at the Gardner-Mackinaw Mine and has kept the geological maps and cross-sections posted regularly.

During the year just past, a new underground shaft, or winze, has been sunk from the 5th level on an incline averaging about 45° to allow for the opening up of three additional levels, the 6th, 7th and 8th, located 125' apart vertically. The shaft is now down to a point 150' on the incline below the 6th level. This level was opened up during the year and ore between it and the 5th level about one third stoped out. The ore proved to be of approximately the same width and length as on the 5th level and the sulphur content remaining about the same, still high. The phosphorus content of the ore has increased steadily with depth since it was first found to get higher at the Northwest end of the 5th level.

Stoping in the Gardner Mine has now been completed as far as it is safe to go. The pillars that remain must be left in place to support the hanging wall. Stoping was completed about the middle of the year.

#### D-4. HOLMES MINE.

The Holmes Mine, together with its equipment, was sold to the Oliver Iron Mining Company, who took possession November 1, 1930. Up to this time, we had made regular geological surveys during the year and had kept the geological maps and cross-sections posted to date. Opening up the main sub-level half way between the 4th and 5th levels, which was started in 1929, was completed during the past year. The ore outlines were found to be about as anticipated from our cross-sections. The other operations at the Holmes consisted wholly of stoping in previously developed areas.

#### D-5. MAAS MINE.

Mining continued throughout the year in the territory between the 2nd and 3rd levels on the footwall side of the deposit. This part of the mine has been

somewhat behind the balance of the operations and all possible speed has been made to the limit of the capacity for its mining in order to catch up with the other operations.

The new riser of ore which was first encountered on the 4th level on the footwall side of the Race Course property was during the year found to extend not only to the 3rd level but to a point about 100' above it. A connection was made with this ore on the 3rd level and raises put up above. At the elevation of the 3rd level it has been opened up to a width of 80' and a length of 300'. The true length, however, has not been determined as a drift is still going Westerly in ore.

The Southeast drift on the 4th level, 150' East of the drift along the Race Course boundary, was extended about 150' to its completion. Also, the main footwall drift on the 4th level, on the Race Course property, was extended in ore as far as the main dike. Development work continued on the new 5th level which comprised carrying the main drift from the shaft due South for approximately 700'. The drift started in footwall quartzite and was still in it mixed with slate at the end of the year. Underground geological surveys have been made at the Maas periodically and all of the information has been posted on the geological maps and cross-sections.

#### D-6. MORRIS-LLOYD MINE.

We have made geological surveys regularly at this mine and have kept the geological maps and cross-sections posted to date.

Developing on the 8th level Morris in the main deposit continued throughout the year. A drift was driven South of the main dike to drain the ground East of this dike. Also, a drift was driven Westerly along the South boundary of the ore in this main deposit and a number of raises put up to the elevation of the 7th level. Drifts are now being driven from the tops of these raises to the North to connect with the main 7th level footwall drift. Three raises were also put up in this ore on the hanging side from the 8th to the 7th level. The main footwall drift on the 8th level was advanced about 800' and diamond drill stations cut at 200' intervals. This work was not continuous on account of using the same gangs on a new development on the 6th level.

The 6th level was extended about 2200' East to develop the downward extension of the main Section 6 ore body on its pitch beneath the old Lloyd Mine. This ore was encountered and will be developed during 1931.

In the main Section 6 operation, No. 8 deposit was found to pinch out just below the 1160' sub-level. Very little mining was done in the Lloyd Mine as all the ore has been removed in the main ore body except a pillar on the 3rd level sufficient to hold it open and the little ore that remains below this level.

#### D-7. NEGAUNEE MINE.

Mr. Moulton, Engineer at the Negaunee Mine until June, and Mr. Pellow, Engineer the balance of the year, collected the essential geological data at this property regularly and we have kept the geological maps and cross-sections posted to date.

The principle mining was conducted between the first sub below the 10th level and the 11th level. The work of developing the ore between the 11th and 12th levels was carried on throughout the year. A number of additional raises were put up from the 12th to the 11th in the course of this work and resulted in a slight increase in ore reserves on the Southwest side of the property just below the hanging.

A new East-West drift was driven on the 11th level between dikes 1 and 2 from which some ten raises were put up to the first sub below the 10th. Another drift was driven East and West on the 11th level and between No.1 dike and the footwall. The ore contacts in this drift indicate that there is a considerable contraction in the horizontal section of the ore body in this area. Aside from this, the ore outlines have developed as anticipated.

#### D-8. TILDEN MINE.

The Tilden Mine continued to produce an excellent grade of hard siliceous ore throughout the shipping season and shipped approximately 385,000 tons. This open pit is worked with two benches, the upper one varying from 60' to 100' in height and the lower being about 50' in height.

The Westerly extension of the large diorite sheet which had been encountered in previous drilling was found to limit the good siliceous ore on the North sooner than anticipated. Also, drilling to the North of this dike under the swamp disclosed much jasper mixed with the ore, rendering it too leab to be shipped. Development of an East pit for this property, from which will be mined the so-called Summit deposit, was started during the year. A railroad track has been constructed to the West limits of this pit and churn drilling already begun in preparation for blasting to make ready to ship some of this ore the coming season. This ore will be very low in phosphorus. Geological data was collected and mapped by Mr. Allen, Engineer at the property.

#### D-9. VIRGIL MINE.

Regular geological surveys were made at the Virgil Mine by Mr. Pellow, Engineer, until June, and later by Mr. Trosvig and Mr. Haller, who followed one another in doing engineering work at this property. We have kept the geological maps and cross-sections posted regularly.

Stoping continued but on a somewhat reduced scale in the main ore body above the 6th level. The principle new development work, however, was done above the 8th level. A new drift was driven on the level itself to the North-west and raises put up to develop the 8th level ore. It was pretty well outlined on the -132' sub-level but found to be too high in sulphur to be merchantable. Small raises were then put up from the back of this sub-level and found that above this elevation the ore dropped down in sulphur sufficiently to be mined. Development work then went ahead above this sub-level and the ore outlined on the -100' sub-level. Raises were continued on up to the 6th level and the ore body is now being laid out for regular stoping operations.

#### E. OPTIONS AND LEASES.

No new options to explore or lease were taken during the year.

A lease on the Dean Mine, which was optioned in 1929 and covered by my last year's report, was signed but I do not have a record of the date. A lease on the Drew Mine was taken on February 1, 1930. The lease runs for a term of twenty years and covers the NW $\frac{1}{4}$  of the SE $\frac{1}{4}$  of Section 13, 58-20, St. Louis County, Minnesota, near Buhl on the Mesaba Range. The property was opened during the past season as an open pit and is being operated by the Dohm Mining Company, in which the C.C.I. Company owns a half interest. The Alexandria Mine, also on the Mesaba Range and just East of Hibbing and an underground property which has operated for a number of years, was taken over by the Company January 1, 1930. This property is leased to the Donner Steel Company, which is now a part of the Republic Steel Corporation.

F. EXPLORATIONS AND COSTS.

Drilling explorations were carried on during 1930 in the following districts and mines:

F-1. FROM SURFACE.

<u>DISTRICT.</u>	<u>RANGE.</u>
Munising, Taconite, Tilden,	- Mesaba Marquette

F-2. FROM UNDERGROUND.

<u>MINE.</u>	<u>DISTRICT.</u>
Athens, Cliffs Shaft, Holmes, Morris-Lloyd, Virgil,	Negaunee Ishpeming " North Lake Iron River.

Table V, which follows, gives the footage drilled, the ore encountered and the cost per foot of drilling for both the surface and underground explorations. It will be noted that the average cost of surface drilling was \$4.70 per foot, excluding certain items which are not actual drilling expense but which are charged to explorations. By including these items, the average cost was \$5.34 per foot. The average cost of underground drilling in the same way was \$2.69 per foot and \$3.13 per foot, respectively.

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

The cost per foot of surface drilling for 1930 is quite out of proportion to this cost in recent years due to the high cost of the Munising Silica Sand exploration. This was special work where unusual care was necessary, as well as extra supervision and a certain amount of extra labor that is not necessary in ordinary drilling for iron ore. For example, the casing in the holes had to be treated with a solution to remove the scale in order that even this small amount of iron would not contaminate the samples of sand. This high cost had the effect of raising the total cost for all the drilling quite markedly as will be noted in Table VI. If we omit this Sand exploration drilling from the above costs, we find that the total cost of surface drilling, excluding the several items mentioned above, was only \$4.23 and including these items \$4.71. Also in this case the total costs will be only \$3.32 per foot in the one case and \$3.78 per foot in the other. These costs then are very close to the costs experienced in 1929 under quite similar conditions of kind of drilling and total footage. I consider the drilling costs for 1930, as a whole, very satisfactory:



316

TABLE V.  
SUMMARY OF DRILLING FOR 1930.

EXPLORATION.	DESCRIPTION. SEC. T. R.	STAND- PIPING FT.	CHURN DRILLING FT.	DIAMOND DRILLING FT.	TOTAL DRILLING FT.				TOTAL COST "A".	COST PER FT. "A".	TOTAL COST "B".	COST PER FT. "B".
						FIRST CLASS ORE FT.	SECOND CLASS ORE FT.	LEAN ORE FT.				
<u>SURFACE DRILLING.</u>												
Munising Silica Sand Expl., 30 & 31,	47-18, Mich.	93	36	1060	1189				\$9,838.57	\$8.27	\$8,186.89	\$6.89
North Star Lease,	21, 56-24, Minn.	1299	762	198	2259	5	-	635*	11,163.15	4.94	10,127.22	4.48
Tilden Mine,	26, 47-27, Mich.	351	1026	1918	3295	-	-	1897	15,019.15	4.56	13,362.15	4.06
Total Surface Drilling,		1673	1824	3176	6743	5	-	2532	\$36,020.87	\$5.34	\$31,676.26	\$4.70
* This is Crude Wash Ore all of which can be concentrated to high grade ore.												
<u>UNDERGROUND DRILLING.</u>												
Athens Mine,	5 & 6, 47-26, Mich.			435	435	399	-	-	\$938.20	\$2.16	\$892.00	\$2.05
Cliffs Shaft Mine,	3, 9 & 10, 47-27, "			2705	2705	210	219	79	8,887.73	3.29	8,042.13	2.97
Holmes Mine,	9, 47-27, "			816	816	24½	-	38½	3,190.91	3.91	2,953.91	3.62
Morris-Lloyd Mine,	(6, 47-27, #											
	(1, 47-28, "			1619	1619	324	170	216	4,944.27	3.05	4,347.06	2.69
Virgil Mine,	24, 43-35, "			2338	2338	958	139	85	6,787.88	2.90	5,034.37	2.15
Total Underground Drilling,				7913	7913	1915½	528	418½	\$24,748.99	\$3.13	\$21,269.47	\$2.69
Grand Total Drilling,		1673	1824	11089	14656	1920½	528	2950½	\$60,769.86	\$4.15	\$52,945.73	\$3.61

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

The drilling on the North Star Lease 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 PAST FIVE YEARS.

YEAR.	TOTAL FEET DRILLED.	COST PER FOOT.	
		"A".	"B".
1926	19,299	\$3.21	\$2.86
1927	20,169	3.88	3.30
1928	4,770	3.00	2.63
1929	13,189½	3.75	3.36
1930	14,656	4.15	3.61

F-3. DIAMOND DRILL CARBON.

We had on hand January 1, 1930 a total of 371.24 karats of diamond drill carbon which inventoried at \$40,259.88. On March 5th, we purchased 30 new stones having a total weight of 108.03 karats at a total cost of \$18,905.25, or \$175.00 per karat. One of these stones, after a short use, proved to be soft and was replaced by Bernard Bandler & Sons from whom it was purchased. The new stone weighed .08 karat less than the original weight of the one replaced and we were reimbursed \$14.00 for this difference. We consumed, in 1903, a total of 81.52 karats in our drilling at a cost of \$10,217.93. We had on hand December 31, 1930 a total of 397.91 karats which, after applying the credit allowed on the imperfect stone returned, is inventoried at \$48,933.20.

F-4. DRILL SECTIONS.

Cross-sections showing a detailed report of the drilling at the Munising Silica Sand and Tilden Mine explorations and in the Cliffs Shaft, Holmes and Virgil Mines will be found in the Annual Report book labeled: "The Cleveland-Cliffs Iron Company - Ishpeming, Munising and Iron River Districts, December 31, 1930". Cross-sections showing a detailed report of the drilling in the Athens Mine will be found in the Annual Report book labeled: "The Cleveland-Cliffs Iron Company - Negaunee and Gwinn Districts, December 31, 1930". Cross-sections showing a detailed report of the drilling in the Morris-Lloyd Mine will be found in the Annual Report book labeled: "The Cleveland-Cliffs Iron Company - North Lake District, December 31, 1930". Cross-sections showing a detailed report of the drilling at the North Star Mine will be found in the Annual Report book labeled: "The Cleveland-Cliffs Iron Company - Minnesota Districts, December 31, 1930". These books are submitted as a part of the annual report of the Engineering and Geological Departments.

G. SURFACE EXPLORATIONS.G-1. MUNISING SILICA SAND EXPLORATION, SECTIONS 30 & 31, 47-18, MICHIGAN.

During the last of March and first of April, a diamond drill outfit was moved to the SE $\frac{1}{4}$  of the NE $\frac{1}{4}$  of Section 30, 47-18, about four miles Northeast of the City of Munising on top of the bluff running approximately parallel with the shore line of Lake Superior. The steep precipice forming the Western face of this bluff shows it to be sandstone having promising characteristics for the manufacture of several grades of glass, for blast sand and steel molding sand, and for all the principal uses required of a well rounded, high grade silica sand.

Three vertical holes were drilled from the top of this bluff to the elevation of Lake Superior, or to depths of 240', 218' and 230', respectively. The first hole was located at the center of the SE $\frac{1}{4}$  of the NE $\frac{1}{4}$ ; the second hole at the center of the SW $\frac{1}{4}$  of the NE $\frac{1}{4}$  and the third hole half way between, or on the line between these two forties. The surface averaged from 5' to 14' in depth. Immediately under this and with a thickness varying from 30' to 100' the ledge consisted of hard lime sandstone, the lime acting as the cementing material for the quartz grains of the sand. This material would have to be wasted in a silica sand operation. Below this, to the depth drilled, a fairly good grade of silica sandstone was encountered, varying in color from brown to brownish white. The maximum iron oxide content for a high grade glass sand is .06%. The iron oxide content of these three holes varied from .785% to 1.03% which bars it absolutely as a glass sand. A satisfactory minimum silica content in sand for the uses we anticipate is 98%. All of these three holes encountered layers averaging better than 98% silica but they were mixed with leaner material. As a whole, they averaged between 96.20% and 97.80%. In structure, a high grade

silica sand should have well rounded grains and be of such size that from 25% to 40% will be larger than 40 mesh. The grains of sand in this drilling were found to be well rounded but in size averaged from only 9.27% to 19.30% larger than 40 mesh. I should say that a good deal of this low percentage retained on a 40 mesh screen was due to the breaking up of the grains in the course of drilling. This is unavoidable. It is safe to assume that the run of bank sand will average to contain perhaps nearly twice as much of this indicated percentage larger than 40 mesh. My reason for this assumption will be found in a following paragraph.

The three holes drilled in Section 30 convinced us that the sandstone in that locality was not of particularly high grade. It also proved that instead of the sandstone layers being fairly uniform over a considerable area, there is a very perceptible variation in quality, structure, etc, within relatively limited areas. Because of this, we moved our drill down near the West quarter corner of Section 31, 47-18, or as close as we could and remain on our own land, to the drilling done in this locality by Mr. W. I. Sallee, of Cleveland and Milwaukee. Mr. Sallee first interested us in the sand possibilities of this locality and is connected with us in this venture. His drilling, consisting of eight holes put down about two years ago South and Southeast of this locality, were quite encouraging and convinced us that a large demand could be created for this sand. We drilled three holes in this locality, all to the lake level.

Hole No.1 was located approximately 150' North and 150' East of the West quarter corner of Section 31 and drilled to a depth of 161'. Hole No.2 was located approximately 660' due North of the West quarter corner of Section 31 and drilled to a depth of 160'. Hole No.3 was located approximately 1320' North and 660' East of the West quarter corner of Section 31 and drilled to a depth of 180'. By comparison it will be seen that these holes are drilled from a considerably lower bench on the bluff running along the lake than those drilled in Section 30. In this drilling the surface material varied from a minimum of 7' to a maximum of 20'. The lime sandstone capping in this locality was found to be much thinner than in Section 30 and varied from a maximum thickness of 48' to a minimum thickness of 12'. Below this we found a brownish white sandstone with occasional seams of almost white sandstone. Both the silica content and structure of the sand were considerably better than we encountered in the first three holes, or those drilled in Section 30, but the iron oxide content still remained high, averaging from .585% to .678%, which bars the sand from the manufacture of any of the higher grades of glass. Its well rounded and coarse structure, however, together with its higher silica content, makes this locality a much more desirable one than Section 30 to the North.

Following the completion of this drilling, we selected 25 points along the face of the sandstone bluff and took two 100 lb. sacks of samples from each locality. These were shipped to Dickson City, Pennsylvania, just outside of Scranton, where in November I ran a wash test using the Hydrotator equipment. The results of this test have not yet been worked up due to some of the analyses not having been received from our Laboratory. A complete report, however, will be prepared on this whole proposition within a short time. I might say, however, that all of the samples taken from the face of the bluff showed a uniformly higher silica content and better structure than any of the drilling. Some of these samples were taken from a part of the bluff only 400' to 500' away from hole No.1 Section 31. Our drilling was done with the greatest care possible. Neither time nor expense were spared to get just as good a sample as could be obtained. In spite of this, it is apparent to me that the drilling does not give us a true picture of the grade of the sand passed through. In other words, in some unavoidable way there has been a contamination of the samples in drilling. In discussing this point with Mr. Sallee, he told me that he had had the same experience, that the discrepancy was considerable greater than shown in our work. This is explained by the extra care that we had used since his work was done by a drill contractor.

We are led to believe by Mr. Croxton, of our Cleveland office, that there is a ready market for at least 500,000 tons of silica sand containing from 98% to 98.5% and better in silica and having a structure of well rounded grains with a minimum of from 25% to 40% held on 40 mesh in spite of an iron oxide content as high as we found in our drilling. If this is so, our work to date would indicate that we had many millions of tons of satisfactory silica sand that can probably be very cheaply mined hydraulically and loaded directly into boats from a dock located close by.

G-2. NORTH STAR MINE EXPLORATION, NW $\frac{1}{4}$  OF NE $\frac{1}{4}$  OF SECTION 21, 56-24, MINNESOTA.

Drilling was commenced in the middle of March on the West forty of the North Star property of the Holman-Cliffs Mine to check drill and more completely outline the limits of the deposit of wash ore on the West side of this property, which is a Northerly continuation of the ore in the Brown No.1 property. The work was done under contract by J. S. Schultze, of Grand Rapids, Minnesota, using two churn drill rigs. The holes were all put down vertically, using a 3" pipe, and drilled with his special bit which preserves, as far as possible, the original structure of the ground passed through. They are, therefore, called "structure holes".

A total of ten holes, Nos.1001 to 1010, inclusive, were drilled in this area, called Mt. Griffen, and located on three North-South cross-sections. A total of 2259' of drilling was done, which included 1299' of standpiping through surface. Of the balance, 762' were drilled with the churn drill structure bit in wash ore, or decomposed material, and 197 $\frac{1}{2}$ ' with a diamond drill in taconite. Of the 762' of churn drilling, 635' was good wash ore.

From the point of view of tonnage, this drilling was quite disappointing. In the first place, the results did not check the old drilling very closely. They showed that a number of samples from the old holes, which indicated from their crude analyses a tonnage of direct shipping ore, were apparently concentrated in drilling and represented wash ore. Also a lot of material classified as wash ore from the results of the old drilling proved on this check drilling to be unwashable material. Using the old drilling, we had estimated 314,700 tons of direct shipping ore and 866,300 tons of wash ore concentrates, or a total of 1,181,000 tons. As a result of this check drilling, we now estimate a total of 577,295 tons of wash ore concentrates and no direct shipping ore. The drilling was completed early in August.

G-3. TILDEN MINE EXPLORATION, SECTION 26, 47-27, MICHIGAN.

Diamond drilling, with ~~to~~ of our own outfits, was commenced in December 1929 to sample the large exposure of lean siliceous ore in the NE $\frac{1}{4}$  of the NE $\frac{1}{4}$  of Section 26, forming a part of the South slope of Summit Mountain, and about a half mile East of the present Tilden Pit. This work was carried on up until the end of September 1930. Nine holes were drilled, Nos.12 to 18, inclusive, and 35 and 36. Nos.12, 13, 14, 16, 17, 35 and 36 were drilled with a dip of -60° due South. Nos.15 and 18 were drilled vertically. They were all arranged on a North-South cross-sections 300' apart East and West and varied in depth from 140' to 250'. A series of shallow churn drill holes were also drilled in this area, all of them on the West end in order to test the ledge to the depth of the proposed railroad grade for the development of an open pit in order to determine the best location for such railroad and to lay out the first part of the operation of this pit. This particular area of the Summit deposit is lower than the average in phosphorus and will be in demand first. There were twelve such churn drill holes put down, Nos.19 to 22, inclusive, 24, 26, 27, 28, 29, 32, 33 and 34. They varied in depth from 33' to 60'.

Drilling was also carried on during the past year in the swampy area on top of the hill just to the North of the present Tilden pit, both with a diamond drill and churn drill, to determine the limits of this operation. Eight holes in all were drilled in this area. Five of them, Nos. 23, 25, 30, 30-A and 31, were vertical churn drill holes varying in depth from 25' to 142'. The balance, Nos. 37, 38 and 39, were diamond drill holes varying from 119' to 183' in depth. Nos. 37 and 38 were drilled with a dip of  $-60^{\circ}$  S.  $15^{\circ}$  E. and No. 39 with a dip of  $45^{\circ}$  S.  $15^{\circ}$  E. As a result of this drilling, the main body of siliceous ore was found to be limited on the North by a greenstone dike near the South edge of this swampy area. All of the drilling to the North of this dike found considerable jasper mixed with the siliceous ore, rendering it unmerchantable, at least at the present time. This was quite disappointing since it was anticipated that this entire hill would contain siliceous ore of about the grade now being mined.

It is ultimately planned to operate the two siliceous ore deposits on the Tilden jointly, calling the West deposit the "West pit" and the East deposit the "East pit".

#### H. UNDERGROUND EXPLORATIONS.

##### H-1. ATHENS MINE.

A diamond drill was moved into the Athens Mine the fore part of March in order to drill one hole horizontally and S.  $53^{\circ}$  E. from the Southeast side of the -480' sub-level above the 6th main level. The object of this hole was to explore the hanging side of the ore trough to determine the presence of ore in this direction and its approximate extent in order, if much ore was found, to start development work in that section of the mine before the ore so encountered would be undercut by the current mining operations on the North side of the deposit.

This hole is No. 11 and was drilled to a depth of 435', or to the footwall. It encountered good ore right at the start and continued in ore uninterruptedly to a depth of 407' where the footwall was cut. This was very encouraging as it showed the ore to be more extensive on the hanging side than had been anticipated. The work of developing this area was started immediately.

##### H-2. CLIFFS SHAFT MINE.

One diamond drill was operated intermittently in the Cliffs Shaft Mine during the year. During the balance of the time the crew was drilling in either at the Munising Silica Sand exploration or in the Holmes Mine. Eight holes were drilled, all in "A" shaft, with a total of 2705'. Of these eight holes, five of them encountered good ore in mineable thicknesses, or a total of 210'. Also, a total of 219' of second class ore and 79' of lean ore were encountered. These results are very encouraging.

Hole No. 411 was drilled horizontally and due East from the East end of the 3rd level "A" shaft to cut through the main North-South fault zone and explore for possible ore to the East. The hole encountered only hanging wall slate and quartzite, indicating that the down throw of the fault on the East had dropped the hanging wall below this elevation.

Holes Nos. 412 to 415, inclusive, were drilled from the Northeast side of the 10th level "A" shaft to explore the Bancroft ore body in this part of the mine and to determine its downward trend in order to facilitate its development at lower levels. Hole No. 412 was drilled with a dip of  $-44^{\circ}$  approximately due North; No. 413 was drilled with a dip of  $-58^{\circ}$  approximately due South; No. 414 was drilled vertically and No. 415 was drilled with a dip of  $-15^{\circ}$  practically due North. Holes 412 and 415 encountered good runs of ore. The first had 42'

and the second 21'. Also, in the latter hole, there was a run of 64' of 54% second class ore.

Hole No.416 was also drilled from the Northeast side of the 10th level "A" shaft but on the South side of the fault, North of which is located the main Bancroft vein. This hole was drilled vertically and encountered 10' of good ore.

Hole No.417 was drilled horizontally and due North from the Northeast end of the 8th level "A" shaft and No.418 horizontally and due North from the Northeast end of the 9th level "A" shaft, both of them to explore the Eastward continuation of the main Bancroft ore zone in its extension on to Cleveland-Cliffs Iron Company property in Section 3, or the SW $\frac{1}{4}$  of the SE $\frac{1}{4}$ . This property lies between our Bancroft lease, Lot 2, and the Northwest limits of the old No.3 Mine. No.417 encountered 58' of first class ore and a considerable footage of lean and second class material. No.418 encountered 79' of first class ore and was still drilling in 53% material at a depth of 562' at the end of the year.

#### H-3. HOLMES MINE.

Hole No.32, which at the beginning of the year was drilling in hard ore jasper at a depth of 439', was completed in January at a depth of 549' in footwall dike. Drilling was then temporarily discontinued in order to use the crew elsewhere. In June, however, another hole, No.33, was started and drilled intermittently until its final completion in October. This hole had a depth of 706'.

Both holes Nos.32 and 33 were located at the South end of a hanging wall drift on the 4th level opened for this exploratory purpose. Like Nos.30 and 31, they were both drilled with steep angles to test the ground at some distance below the 5th level and discover if possible a thickening of the iron formation and a consequent deposit of hard ore similar to that above the 4th level.

Holes Nos. 30 and 31, drilled in 1929, demonstrated a thickening of the hard ore formation on the dip and its Southwesterly pitch below the 4th level. Hole No.32 actually encountered 10' of good hard ore the latter part of 1929 from 420' to 430' in depth. Hole No.33, which was drilled with a dip of -68° S. 87° W., was so laid out that it encountered the hard ore horizon considerably deeper on both dip and pitch and to the Southwest of hole No.32. Fortunately 24 $\frac{1}{2}$ ' of hard ore was cut at a depth of 664' to 688 $\frac{1}{2}$ '. This was indeed very encouraging as it showed that the ore encountered in No.32 widened considerably on its dip, and its pitch to the Southwest. It indicated the possibility of several hundred thousand tons of typical Holmes hard steel ore within the boundaries of the Holmes property below the 5th level. Further drilling, however, to develop this ore was discontinued with the completion of No.33 because the mine was sold to the Oliver Iron Mining Company and possession taken by them November 1, 1930.

#### H-4. MORRIS-LLOYD MINE.

Diamond drilling was resumed in the Morris-Lloyd Mine the latter part of January with hole No.102. A campaign of drilling was laid out for the new 8th level and a series of holes will be drilled from North to South ~~to~~ at regular intervals as the main East-West footwall drift progresses Westerly. These holes will crosscut the iron formation from foot to hanging and thus completely explore it for the downward extension of the various ore bodies and lenses encountered on the level above,- also for possible new ore bodies that may be found at this new elevation.

Hole No.102 was drilled horizontally and due South from this new level drift to a depth of 270'. It encountered extremely rich iron formation with alternate seams of lean and second class ore as a whole but also 15' of good ore at a depth of 235' to 250'.

Holes Nos. 103 and 104 were then drilled horizontally and due South at 200' intervals West of No.102. No.103 encountered good ore from 75' to 90', from 95' to 100', from 125' to 130' and the main ore body, from 345' to 425'. Also the intervening iron formation was considerably richer than that cut in No.102. Hole No.104 encountered good ore from 160' to 165', 220' to 225', 230' to 280' and 310' to 330'. In fact, the hole was bottomed in good ore at 330' owing to difficulty with caving ground and the fact that enough ore has been encountered to warrant a more complete exploration of this ore by drifts and crosscuts. The results of these first three holes were very encouraging and since this drilling had pretty well caught up with the advance of the main 8th level drift, the work was temporarily discontinued and the crew used elsewhere.

Drilling was resumed again in October. Hole No.105 was drilled horizontally and S. 4° W. from the -90' sub-level, 40' above the main 8th level, to test the ground South of the main ore controlling dike in this vicinity. It encountered ~~only~~ a narrow seam of 52% second class ore but no good ore and was stopped at a depth of 199'.

The drill was then moved to the East end of the 6th level. Here hole No.106 was drilled horizontally and due South, starting in footwall slate. It cut second class ore from 90' to 115' averaging 54% iron. At the latter point, good ore was cut which extended from 115' to 160'. This ore is undoubtedly a downward continuation on the pitch of a part of the main Lloyd East ore body and at this point the ore is held in a crotch of footwall slate formed by faulting and also controlled by a dike on its South side. The hole was bottomed the last of the year at a depth of 323'.

The Morris drilling the past year has been very encouraging. In the five holes drilled, with a total footage of 1619', there have been encountered 324' of high grade ore, 170' of second class ore and 216' of lean ore.

#### H-5. VIRGIL MINE.

Diamond drilling in the Virgil Mine was continuous from the first of the year until the early part of September when the work was completed. During this time, nine holes were drilled, Nos.112 to 119-A, inclusive, and all from the 6th level.

The first four holes, Nos.112 to 115, inclusive, were drilled on the same North-South cross-section from the Northwest side of the level on the 200 East Meridian to cross-section this part of the main deposit and to determine if possible a parallel lens of ore in the footwall of the main ore body which might extend up to and above the 6th level elevation. The holes all encountered the main ore body and the water carefully sampled for soluble sulphur. They also encountered a deeper seam of ore in the footwall of the main body but they did not find this ore to extend above the 6th level on this Meridian.

Holes Nos. 116 and 117 were then drilled from the 100 East Meridian, or 100' West of the first four holes, in order to continue outlining and sampling the downward continuation of the main Virgil ore body. No.116 was a very disappointing hole. From our previous knowledge of the downward extension of this ore as projected on our geological cross-sections, we expected a clean run of ore for at least 85' in depth at this point. Instead, it was clean only to a depth of 35' and mixed with seams of slate the rest of the distance.

It was, however, encouragingly low in sulphur content and the slate seams may prove to be only a local phenomenon.

One more hole, No.118, was drilled horizontally and due North from the North end of the 6th level but 100' East of the first four holes, Nos.112 to 115, inclusive, in a final attempt to locate an upward extension, as far as this elevation, of the deeper ore encountered in No.113. It was a blank hole, however, and was bottomed at a depth of 100'.

Hole No.119 was drilled with a dip of  $-43^{\circ}$  S.  $23^{\circ}$  W. from the West end of the 6th level principally to determine the grade of ore in the Southwesterly pitch of the main ore body as it crosses the West line of the property on to the Sherwood, and also particularly to determine its sulphur content. Continuous ore was encountered from the very beginning of the hole to a depth of 254' where it became mixed with seams of black slate. It was finally bottomed in massive black slate at a depth of 316', which point is close to the Sherwood boundary. After the hole was completed, it was found that a different source of water was used for washing out the samples. It came from an old drill hole and was quite clear but on analysis was found to carry a much higher percentage of dissolved sulphur before being fed to the drill than the water we had been using in the work up to date. Also, the water meter used in measuring this water gave considerable trouble during this drilling. For these reasons, the results of the sulphur analyses were very erratic and we were not satisfied with them, particularly in the upper 100' of the hole. On account of all this, it was decided to drill an auxiliary hole, No.119-A, located very close to No.119 and drilled with the same dip and course to recheck the first 100'. In this hole, the regular water supply, such as had been used in all of the other drilling and containing much less sulphur, was used in this latter hole. The results were satisfactory and consistent with our expectations that this upper ore is relatively low in sulphur.

A total of 2338' of drilling was accomplished in the nine holes drilled and resulted in getting 958' of first class ore, 139' of second class ore and 85' of lean ore. The results as a whole were satisfactory and in accord with our expectations.

## I. EXPLORATIONS AND NEW DEVELOPMENTS BY OTHER COMPANIES.

### I-1. MARQUETTE RANGE.

The Inland Steel Company started to sink a shaft on their hard ore prospect in Section 23, 47-28, South of Greenwood, during the past summer. A concrete shaft was sunk through the surface overburden, which was mainly water-soaked quicksand, by the Foundation Company and a seal made at ledge after considerable trouble with boulders at a depth of approximately 105'. The Inland Steel Company is now sinking the shaft in ledge and will get down far enough to explore by drifting and crosscutting the ore they encountered in their campaign of surface drilling during 1928 and 1929.

Pickands, Mather & Company completed their campaign of drilling along the hard ore contact in the vicinity of Humboldt during the past summer. They found nothing of any consequence and I understand they surrendered their ~~lease~~ options. A considerable area, which had been shown on the government and state geological maps as favorable oxidized iron formation, turned out to be intrusive greenstone and unoxidized iron formation.



I-2. MENOMINEE RANGE.

The Jones & Laughlin Ore Company has been very actively engaged in the Iron River and Crystal Falls Districts throughout the year, continuing its drilling campaign commenced in 1929. Most of the drills have been operating East and Northeast of Crystal Falls but they have recently started drilling South of the Rogers Mine and in one or two other localities nearer Iron River. They have at present eight or nine drills in operation, all under contract. It is stated that a mine has been developed by their work in Section 26, 43-32, although I understand that later drilling did not show up as favorably as the first few holes that were put down and which made the discovery. Some parts of the deposit were found to be unusually high in both phosphorus and sulphur.

The M. A. Hanna Company, which in 1929 tied up under option to lease over 15,000 to 20,000 acres in three or four blocks of land, and discussed in my report for 1929, has kept at least one drill engaged throughout the past summer testing ledge and acquiring general geological data on these lands. As far as I can find out, the results have been discouraging.

I understand that Coates and Tweed have completed rounding up several blocks of land mentioned in my report for 1929 located North and West of Crystal Falls and also South and West of Mansfield. It is understood that Coates and Tweed have acted as agents for Pickands, Mather & Company in this venture. I have not heard whether or not actual drilling operations were started the past season.

In Dickinson County, Mr. R. B. Whiteside of Duluth has been exploring in the Felch-Metropolitan area, North of Iron Mountain with one diamond drill. Also a number of test pits have been sunk to ledge. Mr. John T. Spencer of Iron Mountain and Mr. Carl A. Carlson, a storekeeper at Felch, are also connected with the project. What apparently is a repetition, probably due to folding, of the old Menominee Range, has been pretty well outlined by this work in this particular area. The surface is shallow, averaging from 1' to 3' in most of the area, the formation finally dipping to the North under sandstone hills. In places the width has been found to be at least 50' with indications of much greater width elsewhere. The best of the formation generally has proven to be quite typical old Menominee Range siliceous ore averaging perhaps 35% or 36% iron, with occasional small seams up to several inches in width, of high grade ore running as high as 68% iron. The phosphorus content, however, is very low, most of it below .010%. I understand that recently the Jones & Laughlin Company have had their field representatives in this territory going over it pretty carefully.

The old Walpole and Millie properties, Southeast of the Chapin Mine, have recently been acquired in fee by the Ford Motor Company. They have not been operated for many years and produced essentially, siliceous ore. It is rumored that Mr. Ford has been financing the so-called Smith Direct Reduction Process in the manufacture of steel, experiments of which have been conducted in Detroit during the past several years, and that these properties have been acquired anticipating the process could economically treat these siliceous ores.

I-3. GOCEBIC RANGE.

There have been no unusual developments of importance come to my attention from the Gogebic Range during the past year.

I-4. MINNESOTA RANGES.

There have been a number of small properties picked up by the Oliver Iron Mining Company and one or two other mining companies located on both the Mesaba and Cuyana Ranges during the past year. They are, however, of insignificant importance and I do not have the descriptions or other details in this office. The great scramble for iron ore properties on both these Ranges which was under way during 1929 has subsided almost to the vanishing point.

J. EXAMINATION OF MINERAL LAND OFFERS.

Forty three mineral land offers were received and reported on during the past year as follows:

NUMBER.	DESCRIPTION.	REMARKS.
1796,	SW $\frac{1}{4}$ of SE $\frac{1}{4}$ of Section 33, 48-26, Michigan,	Declined.
1798,	Various in Sections 8 & 9, 47-45, "	Chicago Mine - recommended.
1800,	Various on Cuyana Range, Minnesota,	Declined.
1801,	NW $\frac{1}{4}$ of SE $\frac{1}{4}$ & SW $\frac{1}{4}$ Section 13, 58-20, "	Drew Mine - acquired.
1802,	SW $\frac{1}{4}$ of NW $\frac{1}{4}$ of Section 26, 59-15, "	Pending.
1803,	55 miles E. of Sault Ste. Marie, Ont., Can.,	Pending.
1804,	Various in Sections 5 & 6, 58-15, Minnesota,	(Embarrass Lake Mine -
	" 31 & 32, 59-15, "	(pending.)
1805,	Lots 2,3,4,7,8 & 9 Sec.34, 55-26, "	Declined.
1806,	Various in 55-25, Minnesota,	Pending.
1809,	160 acres in Emmons County, North Dakota,	Gold - declined.
1810,	960 acres in Deroche & Shields Twps, Ont.,	
	Canada,	Declined.
1811,	Michipicoten District, Ont., Canada,	Josephine Mine - declined.
1812,	Various in Section 3, 57-20, Minnesota,	(Declined.
	" 34, 58-20, "	(
1813,	N $\frac{1}{2}$ of SE $\frac{1}{4}$ of Section 6, 46-29, "	Declined.
1814,	14 claims in Deroche Township, Ont., Can.,	Pending.
1815,	Tennessee, - - - - -	Iron Ore -, pending.
1816,	Moa District, Cuba, - - - - -	Chrome Iron Ore - pending.
1817,	Various in Section 29, 43-32, Michigan,	(Declined.
	" 25, 43-33, "	(
1818,	Various in Sections 11 & 12, 58-19, Minnesota,	Declined.
1819,	Various in T. 25 N. R. 36 W., "	Declined.
1820,	NE $\frac{1}{4}$ of Section 30, 47-25, Michigan,	Declined.
1821,	Various in Section 31, 131-30, Minnesota,	Declined.
1823,	Near Temagami Lake, Ont., Canada,	Declined.
1824,	Various in Sections 14, 22 & 23, 47-43,	
	Michigan,	Pending.
1825,	Various in Section 2, 46-28, Minnesota,	Declined.
1826,	Various in Sections 13 & 14, 62-14,	
	Minnesota,	McComber Mine - pending.
1828,	Various in Section 25, 40-30, Michigan,	Ruth Mine - declined.
1829,	Various in Sections 29, 30, 31 & 32, 40-30,	(Pewabic and Walpole Mines -
	Michigan,	(declined.
1830,	W $\frac{1}{2}$ of SW $\frac{1}{4}$ of Section 23, 47-28, "	Declined.
1831,	SE $\frac{1}{4}$ of Section 27, 43-35, Michigan,	Declined.
1832,	Various in T. 49 R. 17 and T. 49 R. 18,	
	Minnesota,	Pending.
1833,	NW $\frac{1}{4}$ of SW $\frac{1}{4}$ of Sec.34, 47-29, "	Declined.
1834,	E $\frac{1}{2}$ of SW $\frac{1}{4}$ of Section 2, 55-25, "	Declined.
1835,	NE $\frac{1}{4}$ of Section 1, 46-29, "	Withdrawn.
1836,	Ontario, Canada,	Murdock-Edward - declined.
1837,	T. 46 R. 29, Minnesota,	Declined.
1838,	Various in Section 28, 47-30, Michigan,	Declined.

NUMBER.	DESCRIPTION.	REMARKS.
1839,	Various, Minnesota, - - - - -	Declined.
1841,	Various, Iron County, Michigan, - - - - -	Declined.
1843,	34 miles Southeast of Kingman, Arizona, - - - - -	Declined.
1844,	SW $\frac{1}{4}$ of NE $\frac{1}{4}$ of Section 25, 58-21, Minnesota, - - - - -	Declined.
1845,	15 claims in Twps. 28 & 29 Range 23, Ont., Canada,	Pending.
1846,	Various in Sections 26, 27 & 34, 55-26, Minnesota,	Pending.

K. EXPENSE STATEMENTS.

Tables VII and VIII, which follow, show a detailed statement of charges to Geological expense for the year 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 1930.

Salaries, - - - - -	\$15,495.00
Travel and hotel, - - - - -	100.33
Operating automobiles, - - - - -	852.90
Supplies and office expense, - - - - -	1,537.74
Unclassified, - - - - -	295.00
Total,	\$18,280.97

TABLE III.

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

	<u>1930.</u>	<u>1929.</u>	<u>1928.</u>
Salaries, - - - - -	\$15,495.00	\$13,754.60	\$12,696.77
Travel and hotel, - - - - -	100.33	343.52	393.93
Operating automobiles, - - - - -	852.90	1,018.25	873.95
Supplies and office expense, - - - - -	1,537.74	1,127.77	694.26
Unclassified, - - - - -	295.00	0	5.27
Total,	\$18,280.97	\$16,244.14	\$14,664.18

## L. RESEARCH DEPARTMENT.

During the summer of 1929, it was decided to organize a Research Department to carry on experiments and investigations in the field of the beneficiation of iron ores. The immediate necessity of such a procedure is the decomposed taconite in the Holman-Cliffs and Canisteo-Cliffs Mines, recently acquired, which does not wash up to a shipping grade ore but which contains a lot of rich material that may produce a shipping ore if treated by some other means than by the standard washing process.

The other large operators on the Range have run into the same class of material. They recognize the possible value of a Research Department to develop methods for handling this material. Pickands, Mather & Company and Butler Brothers have had a well organized Research Department for a number of years and other companies are following suit.

On October 1, 1929, Mr. W. L. McMorris, Jr., a Mining Engineer of some Mesaba Range experience and formerly employed by Pickands, Mather & Company, was engaged to assist me in all of my work on the Mesaba Range and to organize a Research Department under my supervision. The greater part of his time, however, up to the present has been spent in engineering duties for both Mr. Barber and myself in working up special estimates in the West end wash ore properties. This has included preparing progress maps for these properties showing the areas from which the ore was to be mined in any particular period and the estimated grade that would be removed from these areas. Also, a large number of reserve ore estimates, stripping estimates, etc, have had to be made.

He has had charge of all test pitting, drilling and other sampling, as well as the laboratory washing and preparation of these samples for analysis. Mr. George H. Beasley, formerly an Engineer's helper at our Hill-Trumbull Mine, has been transferred to become Mr. McMorris' assistant. Mr. McMorris also has one or two other regular helpers and augments this force during the busy parts of the season.

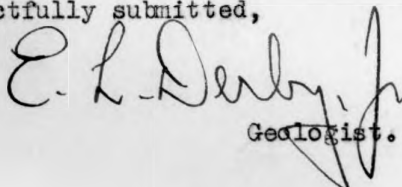
In the Research field we have kept in touch with the experimental work done on the Range and elsewhere on iron ores by all of the other companies. The principal work done so far has been with various types of jigs and the Rheo-Laveur units. We have also looked into quite carefully the Akins classifier made in Denver and the Hydrotator process developed in the anthracite region of Pennsylvania and used there quite extensively. We have come to the conclusion that the Hydrotator offers us an opportunity to save an appreciable amount of fine ore that is now being wasted from our Dorr-Bowl classifiers, particularly at the Holman-Cliffs mill. We also feel that there is a possibility of using this process on coarser material to an advantage and have prepared a special report recommending that an experiment be made with this process at our Holman-Cliffs plant during the coming season. In this connection, Mr. McMorris made an exhaustive test on the operation of the Dorr-Bowl classifiers at the Holman-Cliffs plant during June 1930. The results of this test are also embodied in my report on the Hydrotator.

We have shipped three railroad cars of lean, rocky wash material, which might be classified as jig ore, to the Experimental Station at the University of Minnesota in Minneapolis. It is our intention to conduct experiments on this ore in their experimental jig plant, commencing Monday, January 26, 1931. Mr. McMorris will be in direct contact with this work.

The analytical work from all of our mines on the Mesaba Range has been done by Lerch Brothers, independent chemists. During the past summer we established our own Central Laboratory at Taconite and a so-called quick laboratory for determinations of iron only at each of the washing plants. At the Central Laboratory we have provided also a Research Laboratory which acts as Mr. McMorris' headquarters. All of the samples from test pitting and drilling from the West end wash ore properties are brought here, hand washed and prepared for analysis. Mr. McMorris has also been provided with a mechanical screen testing machinery, heavy gravity liquids for making float and sink tests, and all of the equipment necessary for conducting the research work that he has had to do to date and anticipates in the near future.

It is our intention to add equipment from time to time as we find use for it in this work. It is apparent to us that new methods are going to be developed for treating much of the ore material in these Western properties now wasted in the ordinary washing process and thereby increase appreciably our ore reserves. It is our intention to keep abreast of the times of improved methods of beneficiation by this research work and have a Research Department second to none for this class of work.

Respectfully submitted,

  
Geologist.

## Safety Department

## Annual Report

Year 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURYa. Fatal Accidents:

There were five men accidentally killed at the mines in 1930, as compared with four fatalities during each of the three preceding years. Three of these accidents occurred at the Athens, Negaunee and Morris-Lloyd Mines in Michigan and the other two at the Hill-Trumbull and Canisteo-Cliffs Mines in Minnesota. Two occurred underground, two at surface trestles and one in an open pit. Four were classified preventable and one a trade risk.

The year completed a 20 year period since the organization of the Safety Department. The average annual fatality rate from 1898 to 1910, inclusive, per thousand men employed, was 5.03. The rate from 1911 to 1930, exclusive of the loss of lives by the accident at the Barnes-Hecker Mine in 1926, average 2.20 per year. These figures represent a saving of 8 lives per year or a total of 162 men. Including all accidents in 1926, the record for the past 20 years shows that there has been a saving of 111 lives when compared with the record that prevailed before accident prevention work was given special study.

## DESCRIPTION OF FATAL ACCIDENTS.

## Accident No.1.

Peter Koskela, a miner, was killed at the Athens Mine by a fall of ground on March 25th.

This man and his son worked together in a contract gang on the 685 foot sub-level. At the time of the accident, they were mining the third slice of ore from a raise and were 25 feet from the raise. The mining captain and a shift boss inspected the place at 3:00 P.M., and found the miners had put up two legs of timber and were ready to raise the cap. After inspecting the ground and concluding everything appeared safe, they proceeded to another contract. Two miners were called upon to help Koskela place the cap into its position. When they departed Koskela started to sprag the timber. While engaged in this work, a movement in the timber gob above occurred. The cap was knocked off the legs and fell across his neck, causing instant death.

Koskela was a Finn, aged 49 years and is survived by a widow and 11 children, four of whom are adults. The accident was classified I,- Trade Risk.

## Safety Department

## Annual Report

Year 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURYa. Fatal Accidents - (Continued)Accident No.2.

Eugene Laneville, a miner, was buried under a run of fine ore at the Negaunee Mine on June 30th, and was dead when extracted a few minutes after the accident occurred.

Laneville and his partner, John Herman, were mining ore on a sub-level 25 feet above the 11th level. At the start of their day's work on the day of the accident, they put up a set of timber. While blocking the set of timber loose ore ran in from the back and side without warning. Both men were caught by the run, but miners, working 50 feet away, came to the rescue without delay. Herman was helped to safety but Laneville was buried under the cave and died of suffocation before rescued.

This man was a Frenchman, age 44 years, and was a widower survived by an adult son. The accident was classified II-4 - Improper method of mining a lost pillar of ore.

Accident No.3.

Leonard Hendrickson, a sampler, was instantly killed at the Hill-Trumbull Mine on September 2nd, 1930, by being dragged between the deck and the revolving body of a locomotive that was in operation in the open pit.

At the time of this fatality Hendrickson appeared on the scene as the crane operator was engaged in picking up pieces of taconite which had rolled in back of the shovel. He approached from the rear of the crane and stood with his arms on the platform and watched the operation of picking up a piece of taconite. When the operator swung the crane around, its tail end approached Hendrickson from the rear, catching the upper part of his body, crushing him and causing instant death. His position was such that he could not be seen by the operator. Hendrickson was engaged in no work which demanded his being near the crane.

This man was 26 years old and is survived by a wife and one child. The accident was classified III-3-A-4, An Improper Act.

Accident No.4.

Joseph Skorich met instant death at the Canisteo-Cliffs Mine Washing Plant track trestle on September 17th, 1930, by being knocked off the trestle and buried with dirt while engaged in dumping a train of cars loaded with waste material from the open pit.

Safety Department  
Annual Report  
Year 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURY

a. Fatal Accidents - (Continued)

A train of seven twenty-yard cars arrived at the trestle just before this accident occurred. Skorich and another dump-man, Dan Price, proceeded to unload the cars, starting to work from the far end of the train, backing toward the engine. When they had dumped four cars the trestle collapsed and dropped the cars to the ground, a distance of twenty feet. Skorich was killed but Price escaped with a scalp wound which was not of a serious nature.

The investigating committee reported the collapse of the trestle was probable due to the fact that recent rains had softened the fill upon which one of the trestle lifts was constructed, which allowed the footing under a sill to settle and caused one of the bents to kick out. After a deliberate consideration of all details the Central Safety Committee classified this fatality II-7, failure to provide a proper place to work, due to weak construction of trestle and insufficient inspection on the part of the foremen in charge of the dump.

Skorich was a single man, 36 years old.

Accident No.5.

Oscar Peterson, employed as a surface workman, was injured at the Morris-Lloyd Mine on October 17th, 1930, death resulting a few hours later after he had been taken to the Ishpeming Hospital.

A repair crew had been employed for about a month at the Lloyd shaft replacing steel members in the head frame and also putting in a new floor trestle. On the day of this fatality, Arthur Nault, the surface foreman, ordered the top landers to clean up the old plank as the repair work was about completed. Two of these men, Theo. Nault and Jacob Pantti, proceeded to do as instructed by the surface foreman. Nault picked up a plank, carried it to the railing, shouted "Look out", and then thru the plank. The pocketman stepped in view as the plank left Nault's hands. He was struck on the left temple, knocking him to the ground in an unconscious condition. Nault claimed that Peterson had replied to his warning with the words "Let her go".

Peterson was a married man, 26 years old and leaves a wife and one child. The accident was given a double classification by the Central Safety Committee, II-5, failure on the part of the foreman to give proper instruction and III-B-4, improper method of doing work by a fellow workman.



## Safety Department

## Annual Report

Year 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURY

TABLE I

Classification of Fatal Accidents 1911 to 1930, inclusive.  
By the Central Safety Committee

I	Trade Risks .....		106
II	Negligence of the Company .....		
	Violation of Rules .....	4	
	Failure to Provide Safety Devices .....	4	
	Improper Method of Doing Work .....	6	
	Failure to Provide Tools or Safe Place to Work .....	3	
	Failure to Instruct Men .....	3	20
III	<u>Negligence of Workmen:</u>		
A	Injured Men .....		
	Improper Method of Work .....	10	
	Violation of Rules .....	7	
	Carelessness .....	6	
	Failure to use Tools or Appliances Provided ..	4	
	Failure to use Safety Device .....	1	28
B	<u>Other Workmen:</u>		
	Improper Method of Work .....	9	
	Violation of Rules .....	3	
	Carelessness .....	3	
	Failure to use Tools or Appliances Provided ..	1	16
	Total .....		170

## Safety Department

## Annual Report

Year 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURY

TABLE II

Classification of Causes of Fatal Accidents  
from December 1st, 1898 to December 31st, 1930.

A	Fall of Ground or Timber .....	92	
	Run of Mud or Sand .....	60	
	Fall of Chunk or Ore from Chute .....	2	
	Stray Chunk or Stick down Raise or Stope .....	<u>2</u>	156
B	<u>Shaft Accidents:</u>		
	Falling down shaft .....	14	
	Rock or Timber falling down Shaft .....	2	
	Struck or caught by Cage, Skip, Bucket or Tool .....	8	
	Falling from Cage, Skip or Bucket .....	11	
	Falling from Ladder in Shaft .....	5	
	Carried or pushed into Shaft by Car .....	3	
	Jumping on or off Cage, Skip or Bucket .....	3	
	Struck by Crosshead .....	<u>5</u>	51
C	<u>Use of Explosives:</u>		
	Explosion of Powder .....	14	
	Premature Blast .....	3	
	Fall of Ground or Timber due to a Blast .....	4	
	Overcome by Gas .....	3	
	Miscellaneous Causes .....	<u>1</u>	25
D	<u>Mine and Railroad Cars:</u>		
	Caught by Haulage Cars .....	12	
	Riding or attempting to ride Cars .....	6	
	Falling with Car from Trestle .....	4	
	Run over by Railroad Car .....	6	
	Miscellaneous Causes .....	<u>1</u>	29
E	<u>Miscellaneous Causes:</u>		
	Falling in Raise or Pocket .....	7	
	Contact with Electric Wire .....	7	
	Falling from Ladder, Stage or Trestle .....	6	
	By Moving Machinery .....	4	
	Mine Fires .....	3	
	Miscellaneous Causes .....	<u>3</u>	30
	Total .....		291

## Safety Department

## Annual Report

Year 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURY

TABLE III

Showing number of fatalities and rates per 1000 employees  
for thirteen years prior to Safety work and for 20 years  
of Safety work.

<u>Year</u>	<u>Fatalities</u>	<u>Rate</u>	<u>Year</u>	<u>Fatalities</u>	<u>Rate</u>
1898	6	5.63	1911	5	1.89
1899	4	3.41	1912	4	1.71
1900	4	2.80	1913	11	4.19
1901	9	6.83	1914	10	4.10
1902	8	5.38	1915	5	2.17
1903	8	5.15	1916	8	2.61
1904	4	2.97	1917	6	1.73
1905	12	5.88	1918	13	3.45
1906	10	4.13	1919	11	2.79
1907	18	6.33	1920	5	1.21
1908	6	2.57	1921	6	2.60
1909	13	5.15	1922	1	.45
1910	20	6.52	1923	6	2.19
			1924	5	1.88
			1925	2	.81
			1926	55	23.90
			1927	4	1.82
			1928	4	2.00
			1929	4	1.91
			1930	5	2.25*
122 Avg. 5.03			170 Avg. 3.15		

TABLE IV

Comparison of Fatality Rates for Coal Mines, Metal Mines, Etc.

<u>Year</u>	<u>U.S. Coal Mines</u>	<u>U.S. Metal Mines</u>	<u>Minn. Metal Mines</u>	<u>Mich. Metal Mines</u>
1911	4.97	4.45	5.46	4.28
1912	4.46	4.09	3.15	3.22
1913	4.70	3.72	3.16	3.12
1914	4.66	3.92	2.93	3.97
1915	4.44	3.89	2.71	3.74
1916	3.94	3.62	2.59	3.76
1917	4.25	4.44	3.04	3.40
1918	3.94	3.57	3.25	3.31
1919	4.27	3.43	3.09	2.99
1920	3.62	3.16	2.61	3.25
1921	4.11	3.09	2.51	3.63
1922	4.89	3.54	3.03	2.17
1923	4.39	3.01	2.08	2.03
1924	4.80	3.51	5.61	2.30
1925	4.65	2.99	2.16	2.33
1926	4.50	3.47	1.67	5.79
1927	4.43	3.10	2.55	2.62
1928	4.64	2.50	1.25	2.82
1929				
1930				
	4.41	3.50	2.98	3.25

\*Estimated figure

Figures for 1929 and 1930 not available.

## Safety Department

## Annual Report

Year 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURYb. Non-Fatal Accidents:

A total of 77 lost time accidents, other than fatalities, occurred at all properties in the Mining Department. Including those that occurred at the Alexandria, the total in 1929 was 89. The number of man-shifts lost by employees because of their injuries was reduced approximately 20 per cent.

Several good accident records were established. The Tilden Mine had a perfect record. The Gardner-Mackinaw Mine had one accident, and is credited with a perfect record in 1929. Two years operation with only one accident is unusual in mining. The Cliffs Shaft Mine had three accidents, as compared with 25 in 1929. The Holmes Mine reported three for ten months operation and it had eight the year previous. The General Shops and Storehouse sustained none and the Cliffs Power & Light Company suffered only three, all being very slight injuries.

The causes of the accidents are listed in the following table. They are being given much study and attention at the present time and it is hoped that they can be controlled more successfully in order to eliminate accidents that can be prevented.

TABLE V

Classification of all accidents by causes - 1930

By falls of ground from side or back of drift, stope, etc. ...	16
By falling from trestle or platform, down raise, etc. ....	10
By haulage operations .....	6
By stumbling or slipping .....	6
By flying, glancing or bounding objects .....	6
By falling objects .....	6
By finger or foot caught between objects .....	5
By moving machinery .....	5
By barring or working under chutes .....	5
By hand tools .....	3
By operating drill machines .....	3
By handling timber .....	3
By explosion of dynamite .....	2
By chunks rolling down piles .....	2
By miscellaneous causes .....	4
Total .....	82

## Safety Department

## Annual Report

Year 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURY

TABLE VI

b. Number of Compensable and Non-Compensable Accidents

<u>Mine</u>	<u>Received Compensation</u>	<u>No Compensation</u>	<u>Total</u>
Athens .....	6	0	6
Cliffs Shaft .....	2	1	3
Holmes .....	3	0	3
Maas .....	10	0	10
Morris-Lloyd .....	10	0	10
Negaumee .....	10	1	11
Gardner-Mackinaw .....	1	0	1
Spies-Virgil .....	2	1	3
Miscellaneous .....	2	0	2
C.P. & L.Co. ....	1	2	3
Alexandria .....	5	5	10
Hill-Trumbull .....	1	4	5
Holman-Cliffs .....	3	2	5
Canisteo-Cliffs .....	4	1	5
Wade .....	4	1	5
Total .....	64	18	82

TABLE VII

Number of Accidents, number per 1000  
Men employed and Percentage Classified  
Preventable - 1912 to 1930.

<u>Year</u>	<u>Number of Accidents</u>	<u>Number per 1000 Men Employed</u>	<u>Percentage Classified Preventable</u>
1912	207	88	25
1913	316	120	24
1914	443	181	37
1915	427	185	23
1916	592	193	20
1917	639	184	23
1918	590	156	21
1919	670	172	22
1920	708	175	19
1921	351	170	18
1922	344	168	26
1923	453	166	23
1924	407	152	23
1925	363	152	27
1926	426	185	33
1927	211	90	43
1928	123	77	62
1929	85	40	66
1930	82	37	70

## Safety Department

## Annual Report

Year 1930

• ACCIDENTS  
AND  
PERSONAL  
INJURY

## TABLE VIII

b. Classification of All Accidents 1930  
By the Central Safety Committee

I	Trade Risk. (Incidental and Non-Preventable) .....	23	
II	<u>Negligence of Company:</u>		
	1. Failure to use Safety Devices Provided .....	0	
	2. Failure to use Proper Tools or Appliances Provided .....	0	
	3. Violation of Rules .....	0	
	4. Improper Act or Selection of Improper Method of Doing Work (By Foreman) .....	2	
	5. Failure to Instruct Men as to Method of Doing Work and Hazards Incident Thereto .....	2	
	6. Failure to Provide Safety Devices .....	0	
	7. Failure to Provide Proper Tools, Appliances or Place of Work .....	8	12
III	<u>Negligence of Workmen:</u>		
	1. Failed to use Safety Device Provided .....	3	
	2. Failed to use Proper Appliances or Tools Provided .....	1	
	3. Violation of Rules .....	2	
	4. Improper Act or Selection of Improper Method of Doing Work (By Foreman) .....	38	44
	<u>Other Workmen:</u>		
	1. Failed to use Safety Devices Provided .....	0	
	2. Failed to use Proper Appliances or Tools Provided .....	0	
	3. Violation of Rules .....	0	
	4. Improper Act or Selection of Improper Method of Doing Work (By Workmen) .....	3	3
	Total .....		82

## Safety Department

## Annual Report

Year 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURYc. Safety Inspection:

The Company's mines in Marquette were inspected by the Safety Inspector each month of the year, the Spies-Virgil five times and the Minnesota Mines four times. Abandoned properties were given attention and repairs were made to keep them up to requirements. A committee of three foremen inspected our Michigan Mines in September. Committees of workmen inspected the Wade and Alexandria Mines.

All safety suggestions and recommendations were submitted to the foremen directly in charge of operations where applicable. Those of more than ordinary importance were brought to the attention of the superintendents and also were reported either to the General Superintendent or the Manager. There is no difficulty in obtaining the adoption of practical recommendations that may be proffered, either by the inspector or members of the safety committees.

TABLE IX

Showing the number of Foremen and Workmen by Mines,  
who have served on Safety Inspection Committees.

<u>Mine</u>	<u>Foremen</u>	<u>Workmen</u>
Alexandria .....	0	3
Athens .....	9	21
Cliffs Shaft .....	14	57
Holmes .....	10	27
Maas .....	12	45
Morris-Lloyd .....	12	60
Negaunee .....	15	60
Wade .....	0	3
Idle & Miscellaneous	<u>51</u>	<u>294</u>
	123	570

TABLE X

List and number of all reports for prevention  
of Accidents made in 1930

Cage Riders .....	Daily .....	3530
Hoisting Ropes .....	" .....	2812
Ladderways .....	Weekly .....	402
Skip and Cage Roads .....	" .....	426
Cage Safety Catches .....	Monthly .....	115
Hoists .....	" .....	194
Mine Rescue and First Aid .....	" .....	152
Fire Equipment .....	Quarterly .....	152
Electrical Equipment .....	" .....	<u>17</u>
		7800

## Safety Department

## Annual Report

Year 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURYc. Safety Activities:Central Safety Committee:

This Committee held a regular meeting each month of the year with one exception.

Safety Conferences:

Conferences and mass gatherings of employees for the advancement of safety were held as follows:

All superintendents and foremen of our Mesabi Mines met at Hibbing on January 4th. Mr. Elliott presided.

All superintendents and foremen in the Mining Department met at Ishpeming, December 6. There were 111 men present and Mr. Elliott directed the entire proceedings. All superintendents participated, each one speaking upon a definite phase of accident prevention work.

Seven district conferences of foremen were held for formulating standards of operation. These meetings are now being held monthly by the Ishpeming-North Lake Districts in one group and the Negaunee-Gwinn foremen in another. Sectional groups of workmen will be gathered together during the coming year to study the hazards that characterize their work.

A mass meeting of all workmen was held at each of our Minnesota Mines, when Mr. Elliott addressed them and made a strong personal appeal for every employe's cooperation.

Safety Bulletin:

From 80 to 100 copies of a two page bulletin were given foremen monthly. In November this bulletin was in the form of a questionnaire to which every foreman employed by the Company returned a reply. Many valuable recommendations were submitted and all of them were transmitted to the Manager who instructed the superintendents to investigate and advise upon their practicality. With very few exceptions all were adopted.

Bulletin Boards:

An effort is being constantly made to keep all employees informed upon matters of safety by posting all available information on a bulletin board at each mine. Comparative accident data, striking illustrations of preventable accidents, all special notices, etc. are used for this purpose. Changes are made weekly.



## Safety Department

## Annual Report

Year 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURYc. Safety Flags:

At all of our mines a National Safety Flag, under the Stars and Strips, afloats in the air, indicates that the mine is exempted from a lost time accident of more than six days duration.

Special Safety Awards:

The men employed at Cliffs Shaft "A" division of this mine and those working at the General Shops and for the Cliffs Power & Light Company were given knives for completing a six month period without sustaining a lost time accident. The Holmes and Wade employees came within a few days of obtaining the record twice during the year and the latter part of 1929, Cliffs Shaft "B" and the Tilden Mine completed a year's period with perfect records and the men at these mines won gold buttons, the Company's award for this achievement.

Rules and Standards:

New Codes of rules or standards have been adopted the past two years for underground haulage, use of explosives, scraper operations and top slice system of mining. The standards for each of these operations have been printed in leaflet form and copies given to the men responsible for such work. A total of 274 copies of the General Rules for Workmen and 62 copies of new standards were distributed during the year.

All new standards were combined with the rules of the Company that have general application and bound in a substantial manner and copies given to all superintendents and mining captains. Additional space permits the insertion of new standards that may be adopted in the future.

It is proposed to continue the study of all hazardous occupations in and around our mines and to formulate safety standards covering them for the prevention of accidents.

Penalties:

It was necessary to lay off 42 men for failures to obey orders. In several instances, the punishment exceeded the customary inflictment of three days. No man was subjected to more than one penalty.

## Safety Department

## Annual Report

Year 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURYd. First Aid Work:

New first aid teams were organized at 11 mines. A complete course in training was received by 27 men employed at our mines in Minnesota. Teams at our local mines, consisting of 37 men, were trained monthly from January until August, but owing to the illness of J. H. Williams, this work was omitted during the balance of the year. Mr. Williams died in October. He had been in charge of our first aid and mine rescue work since 1912, rendering very capable service. Thomas Guy, who was working at the Cliffs Shaft Mine, was appointed to succeed him, taking the position November 1st.

Two cases of infection were reported, resulting from accidents. Both were the result of not reporting injuries when they occurred for first aid treatment. We have no record of the number of injuries treated each year by first aid men. Men employed in the mining industry prefer to have no publicity attached to injuries. Every day there are many accidents of a slight nature which are treated promptly and successfully by first aid men. Many injuries, such as cuts and lacerations, are treated frequently, as the nature of our work is such that bandages become dirty and raveled.

First aid supplies are maintained in change rooms, shops, shaft and pump stations and other desirable locations. Replenishment is made at least twice a month by the head first aid man. Leather cots for finger injuries, adhesive pads for minors cuts and mercurochrome are supplies used in largest quantities.

TABLE XI

Showing the number of men trained - 1912 to 1930

Number of men receiving training .....	794
" " " " First Aid Certificates .....	590
" " " deceased .....	26
" " " pensioned .....	6
" " " now employed by Company .....	381

## Safety Department

## Annual Report

Year 1930

11. ACCIDENTS  
AND  
PERSONAL  
INJURYe. Mine Rescue Work:

Teams in the use of oxygen breathing apparatus were trained at the Company's Michigan Mines from January to August by Mr. J. H. Williams and in November and December by Mr. T. H. Guy. A total of 54 men received instruction.

All rescue apparatus, including Edison electric lamps, pumps, tanks, breathing bags, mouth and nose attachments, etc. was overhauled in November and placed in good condition.

Our underground fire fighting equipment is tested monthly by using it. No opportunity is allowed for the men who are in charge of the surface equipment to neglect the same. Regular and frequent inspections are forward to the Safety Department. These inspections are for hose, water facilities, extinguishers, etc.

TABLE XII

Showing the number of men trained in Mine Rescue Work - 1912 to 1930

Number given training .....	449
" deceased .....	18
" pensioned .....	2
" disqualified .....	139
" left Company's Employment .....	164
" now employed and qualified to wear the apparatus .....	124

f. Department Expense

Salaries and expenditures for this department, as tabulated by our Cleveland Office, appear in the following table.

TABLE XIII

Salaries .....	7,040.00
Auto Expense .....	322.36
Postage .....	21.00
Stationery and Printing .....	81.76
Supplies .....	49.91
Travel and Entertainment .....	375.32
Telephone and Telegraph .....	78.60
General - Unclassified .....	188.80
Total .....	8,157.75

Respectfully submitted,

*William L. ...*  
Safety Inspector

CLIFFS SHAFT MINE:

In January the #8 McCully crusher showed considerable wear due to the material striking the body of the crusher. The lower concaves were removed from this crusher to get an 8" opening, this being formerly 4". The wearing of the crusher body has been taken care of by the use of wearing plates, which have to be changed about every three months. This crusher is operating satisfactorily at the present time.

A change was made to the hoisting equipment at this mine. The old 500 H.P. motors were too small to take care of the load. They were replaced by two 750 H.P. motors and the necessary control equipment. This change was made on August 31st. The old motors were General Electric and operations were beyond their capacity. The new motors are Westinghouse and include new and higher capacity and more modern control equipment. Hoisting at capacity is now practical from any level and at a normal rate of acceleration and hoisting speed. The hoisting capacity by this change was increased about 25%. This equipment is operating satisfactorily.

HOLMES MINE:

This mine was taken over by the Oliver Iron Mining Co. on November 1st, 1930.

TILDEN MINE:

Considerable changes were made to this plant last winter.

The #29 shovel was in very poor condition. It was necessary to re-build the four caterpillars and propelling equipment. The hoisting and swinging machinery had to be re-lined and bolted down, the boom re-riveted and the crowding machinery rebuilt. We had considerable trouble with hot bearings on the motor-generator set. This was taken care of by installing a small oil pump and using a force feed lubricating system on these bearings. After making the above repairs and changes, this shovel operated without giving us any trouble during the shipping season.

The #31 shovel was in fairly good condition. A force feed lubricating system was also installed on this shovel.

Two second-hand locomotives were bought from the Oliver Iron Mining Co. With a few minor repairs these locomotives operated satisfactorily during the season.

Changes were made to the pit cars, increasing their capacity about 30% and preventing the excessive spill that we formerly had during the loading at the pit.

At the crushing plant we changed the receiving bin and car dumping equipment. This was a big improvement over the old method. A rotary disc screen was replaced with a bar grizzly. The conveyor belt was raised up about 20", which improved conditions considerable, both in regards to wear on the belt and loading it equally. We had one breakdown on one of the fine reduction crushers. A pinion stripped and bent the shaft, but this did not delay operations as all the material was run through the other crusher. Repairs will not be excessive at this plant this Winter, as the equipment is in very good condition.

A new coke furnace was installed in the shop for heating drill steel.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

440

TILDEN MINE: (Cont'd)

Improvements were made in the electric distribution, particularly in and adjacent to the pit, and now seems satisfactory.

ATHENS MINE:

In January a new cylinder was installed on the #1 Prescott underground pump to replace a broken one.

A set of intake valves were installed in the Nordberg air compressor on June 22nd. These valves are of the feather type and replace a Corliss type valve, which, with its many valve rods and dashpots, gave us a lot of trouble.

A new brake band has been installed on the skip hoist to replace the old band, which broke. This new band is 1/8" thicker and 3" wider.

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

MAAS MINE:

The pinion shaft on the 5 $\frac{3}{4}$ " x 36" Prescott pump broke on January 13th. Repairs were made and a new pinion and shaft ordered. This pump is now in good condition.

The old underground haulage set from the Negaunee Mine was installed in the engine house to be used as a spare unit.

The power brake on the skip hoist broke on May 31st. Temporary repairs were made, with one hour delay to hoisting. This brake has since been repaired and is now in good condition.

The gear on the drum shaft of the cage hoist became loose on the shaft. Repairs were made and the hoist is now in good condition.

A leak developed in the intercooler of the #2 Ingersoll-Rand air compressor. A new set of tubes has been ordered and will be installed as soon as possible after they are received.

A new pump installation was made on the 3rd level for emergencies. A 1,000 G.P.M., 1060' head, Allis-Chalmers centrifugal pump, with a 1,000 G.P.M., 120' head, Allis-Chalmers pump connected to its suction. This gives us a pumping unit with a capacity of 1,000 G.P.M., 1180' head. The large pump was formerly used at the Francis Mine and the small one at the Stephenson Mine.

MAAS CRUSHING PLANT:

This plant was started on April 24th and operated intermittently until November 14th.

NEGAUNEE MINE:

The Nordberg air compressor intake valves were changed to the same type as we installed at the Athens Mine.

A boiler from the Stephenson Mine was installed in the Heating Plant to replace the old boiler, which was not in very good condition. We are making some changes to the Heating Plant. A vertical Aldrich triplex hot well pump is being installed in the boiler room to take the return water from the

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

441

NEGAUNEE MINE: (Cont'd)

heaters in the crusher room, laboratory, office, engine room, garage and change house and return it to the boiler. This change should make a considerable saving in fuel consumption.

The electric hoisting equipment installed 20 years ago had become inadequate and a complete new "Ilgner" type flywheel motor-generator set was installed. The original hoist motors being sufficient for present conditions, were not replaced. The new set is Westinghouse, driven by an 800 H.P. motor, direct connected to a 400 K.W. skip generator and a 200 K.W. cage generator, with a 40,000 lb. flywheel. Complete new controller was provided, which adds to operating efficiency and reliability. Forced circulation lubrication is provided.

A new 250 K.W. General Electric haulage set was installed, replacing the smaller set, which was sold to the Maas Mine.

SOUTH JACKSON CRUSHING PLANT:

This plant was idle the entire year.

LLOYD MINE:

There were no changes or additions made to the equipment at this mine. All mechanical equipment operated satisfactorily during the year. No trouble or delays.

MORRIS MINE:

New intake valves were installed in the Nordberg air compressor. These valves are the same type as were installed in the Athens and Negaunee compressors. The intercooler on the #1 Ingersoll-Rand compressor developed a leak. This intercooler was re-tubed with galvanized pipe and is now in good condition.

All other mechanical equipment operated satisfactorily during the year.

SECTION 6 SHAFT:

All mechanical equipment is in good condition. No changes or additions.

SPIES-VIRGIL MINE:

The air compressor at this mine was re-lined and given a general overhauling. This machine is now in good condition.

The hoist drum got loose on the shaft.. Repairs were made and this hoist is now in good condition.

All other mechanical equipment operated satisfactorily during the year.

GARDNER-MACKINAW MINE:

All mechanical equipment operated satisfactorily during the year. No changes to mechanical equipment. No trouble or delays.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

442

ALEXANDRIA MINE:

This mine was taken over from the Donner Steel Co. on Jan. 1st, 1930. It was operating smoothly when taken over and has given little trouble during the year.

The only addition to equipment was a wooden tank, 12' dia. x 3' high, to increase amount of cooling water to one compressor.

The mine has operated single shift all year and since November 8th has only worked four shifts a week.

In April the stockpile steam shovel was overhauled and is now in fair condition.

BOEING MINE:

Additional equipment removed from this mine during the year as follows:

<u>DATE</u>	<u>EQUIPMENT</u>	<u>SHIPPED TO</u>
October	Lathe, 30" swing, 14 ft. bed.	Canisteco Mine.
"	Drill Press, 20" dia. table.	" "
"	#3 Williams pipe threading machine.	" "
"	All shop counter-shafting and lockers; also blacksmith equipment.	" "

The 10 H.P. motor used for driving shop machines was first transferred to the Holman-Cliffs Mine to drive carpenter shop equipment, and in October moved to the Canisteco Mine shops.

The only machinery now left at the Boeing Mine is the Sullivan angle compound compressor with motor and receiver, the rotary dump tram cars, heating boiler, change house equipment and top tram engine with motor.

CANISTECO MINE:

Pumping continued on second class and dump current from January until May, when it was necessary to take first class current due to starting the 120-B electric shovel on stripping. The pit was pumped out by July 1st and since that time only one 7,000 G.P.M. pump operates when the electric shovel shuts down. This is sufficient to hold the water, as it gives approximately 200 hours per month for pumping. This pump layout will be used as installed for regular mine drainage, the only change being to remove one of the three lines of 16" discharge pipe to be used on washing plant water line.

As the Great Northern Railroad was behind schedule in getting its spur into the shop and washing plant site, it was necessary to lay a temporary track to shop location in order to start the stripping program on time. A 120-B electric shovel was set up in May and started stripping May 26th. The seventeen 30-yd. air dump cars bought from the Western Wheeled Scraper Co. were found better for regular mine work than stripping, so the Hill-Trumbull 20-yd. cars were used while tracks were ballasted, and the 30-yd. cars transferred to Marble.

A set of brick shop buildings, similar to the Hill-Trumbull shops, were erected by the Pfeffer Construction Co., starting in July and finishing in October. The Wisconsin Bridge & Iron Works furnished the steel work. The large steel warehouse was supplied by The Truscon Co., who also received the

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

443

CANISTEO MINE: (Cont'd)

contract for the steel pump house at the washing plant.

The following tools were purchased for the shops:

1 Lathe, 30" swing, 14' bed.	Second hand.	from Boeing Mine.
1 Drill press, 20" dia. table.	" "	" " "
1 #3 Williams pipe threading machine.	" "	" " "
1 36" x 30" Planer.	" "	" General Wrecking & Equip.
1 2" Bolt threading machine.	" "	" " " " Co.
1 Lathe, 14" swing, 8' bed.	" "	" " " " "
1 48" Radial drill.	Rebuilt.	" Hill, Clark & Co.
1 20" Shaper.	"	" " " " "
1 Power hacksaw.	New	" " " " "
1 36" Band saw.	Rebuilt	" Chicago Mach'y Exchange.
1 Variety saw-tilt table.	"	" " " " "
1 12" Jointer.	New	" Oliver Machinery Co.

Most of the above machines have been received and installed.

The washing plant track was into site by August 10th. The E. W. Coons Co. received contract for concrete work. They started excavating for piers the first week in August and completed their work on November 1st. The Worden-Allen Co., who received the contract for steel work on this job, had their crew at the site on September 15th and completed their work by November 16th.

The following equipment is being installed at the washing plant:

1 - 8' Pan conveyor, 60'5" long.	from Lake Shore Engine Works.
1 - 5' " " " 22' "	" " " "
1 - 42" x 40" Jaw crusher.	Allis-Chalmers Mfg. Co.
2 - 4' Symons cone crushers.	Nordberg Manfg. Co.
1 - 36" x 225' Belt conveyor.	Stephens-Adams Co.
2 - 24" x 40' " conveyors.	" " " "
2 - 18" x 30' " " "	" " " "
2 - 16' wide x 30' long Washers.	The Dorr Co.
2 - 20' dia. x 4' rake Bowl classifiers.	" " "
2 - 2000 G.P.M., 200' head, Centrifugal pumps.	Allis-Chalmers Mfg. Co.
1 - 150 K.W. Motor-generator set.	General Electric Co.

The erecting work is being carried on by the Hill-Trumbull washing plant crew and should be almost completed by February 1st. The original plan was to start the Plant on May 1st, but due to new ore schedule it will now start July 1st.

Equipment now purchased for the Pit operation is as follows:

1 - 120-B Electric shovel.	The Bucyrus-Erie Co.
17 - 30-yd. Air dump cars.	Western Wheeled Scraper Co.
1 - 50-ton Locomotive crane.	Brownhoist Industrial Crane Co.
2 - 19" x 26" American locomotives (second hand)	Oliver Iron Mining Co.
3 - 19" x 26" " " " " "	Boeing Mine.
1 - Steam Track lifter.	A. Guthrie Co.
2 - #29 Armstrong churn drills (new)	Armstrong Manfg. Co.

A 6" well was drilled, 186' deep, near the shops to supply water for the Location. An "Oil-rite" plunger pump of 10 G.P.M. capacity was installed until decision was made as to permanent pump equipment for the Location.

A 6" well was also drilled at the washing plant to supply water for mill crew and caretaker's residence.



MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

HILL-TRUMBULL MINE:

In addition to mine machinery repairs, the shops overhauled the seven second-hand locomotives purchased from the Oliver Iron Mining Co. These second-hand locomotives were overhauled for the Canisteo and Holman-Cliffs mines. Besides the firebox repairs, these locomotives had the cylinders bored, the valves refaced, the cabs patched and any other necessary repairs on driving equipment. New steel arch bars were added to the 20-yd. cars, which eliminates the stretching of the old arch bar straps.

At the washing plant the tables and turbos were removed; two concrete piers were installed, 10' sq. x 46' high, by Coons & Co. in February and March, as foundations for two 4' Symons cone crushers. Two Dorr bowl classifiers, with 17' dia. bowls and 8' rakes, were installed in time to start ore washing by May 1st. The 18" belt conveyors to and from the cone crushers were completed in June, and the changes in building to house this extra equipment were finished in August. The secondary crushing equipment is used only part time, when the shovels strike locations in the Pit where the ore requires this additional equipment. Washing ore started May 1st and finished September 29th, with 502,288 tons of crude ore hauled from the pit to the washing plant.

To eliminate taling sand from blowing into Calumet when the wind blew from the southeast a water curtain was installed along the northwest and north boundary. This was made up of 10" pipe laid along the ground on the west and north sides of tailings pond, and 2" pipe risers 40' high welded to the 10" pipe at intervals of 40' and guyed near the top. At the tops of each 2" riser a shop-made spray was put on, and when the outfit was connected to one 2,000 G.P.M., 200' head, pump a water curtain was formed that dampened the dust as it hit the curtain and stopped it from blowing further. It was also found that if the sprays were operated when the wind was from the northwest the sand on tailings pond was sprayed sufficiently to keep it from blowing away.

A 6" fresh water well was drilled near the caretaker's cottage, which will furnish fresh drinking water on all floors of the washing plant next season.

Most of the crude ore from the Pit was dug with a new 120-B electric shovel, our number #33, which gave no trouble during the season. The steam shovels were placed in the east end of pit on small tonnage jobs of removing rock, etc., but after trying out the 120-B electric shovel it was decided that this machine could do the loading faster and cheaper than the steam machine. After shipping was completed in September, stripping was started the first part of October with the 350-ton shovel and continued up to the middle of December with only minor delays. The Layne & Bowler pump in Pit gave no trouble during the year. It was run when the electric shovel was idle and kept the water level below all working levels.

HOLMAN-CLIFFS MINE:

Erection work at the washing plant was completed in time to cause no delay to pit operations. Due to heavy rains washing out tracks, the plant did not start until May 16th. It finished the season October 21st, washing 657,538 tons of concentrates. Due to the unusual sticky condition of ore, some rebuilding of chutes was necessary, and due to the very abrasive nature of the crude more repairs were needed in the Fall than was expected.

Some delays occurred during the season. The motor-generator set was put out of commission by lightning on June 12th, and it was necessary to send the generator to Minneapolis for repairs. During the interim an idle set at the Boeing Mine was installed, which reduced the delay to 24 hours. One June

HOLMAN-CLIFFS MINE: (Cont'd)

14th the Symons cone crusher stripped the top nut on main shaft, but repairs were secured from Hill-Trumbull crushers and only a short delay occurred.

The biggest saving at this plant was made when 4' x 5' Hummer screens were added to the discharge of the 25' logs. This change reduced the moisture of the concentrate by over 2 points, and made a saving of over \$75,000.00 on an investment of \$3,000.00 in screens.

When the plant started it was found the steel work bracing was not sufficient to hold the Symons crusher, and additional steel was necessary to stop the excessive vibration on log washer floor. The Worden-Allen Co. installed the extra steel during the July 4th holiday period and this additional material and labor cost the Worden-Allen Co. approximately \$1,600.00.

The 42" x 40" jaw crusher pitman gave trouble all season. By August the bearing was so far gone that a new pitman from the Canisteo crusher was installed. During the Fall the main shaft was turned smooth and the pitman re-babbitted and bored so this should give no trouble next year.

A well was drilled near the caretaker's cottage, but not in time to supply drinking water at the plant. It will be ready for next season.

In the Holman pit the two new 120-B electric shovels, our numbers 32 and 33, loaded the crude ore. No. 33 caused three delays due to coils burning out in the generator, but the last burn-out was repaired by a General Electric expert coil man from Minneapolis and he stopped the trouble. The only other short delays were due to cable trouble caused from blasting or careless handling. Two new #29 Armstrong churn drills were purchased for the Canisteo pit and equipped with structure drill attachments. After completing the work at the Holman-Cliffs Mine one was moved to the Canisteo pit.

Plans were made to drain the pit by sinking a shaft and driving drifts under the ore body, but this proved too expensive and it was decided to use the sump and ditch method of drainage. A hoe type shovel was secured from the Dohm Mining Company in the Fall to dig the sump, but it has made slow headway on the job due to breakdowns and cold weather. It is still digging on the ditch draining pit water into sump.

At the shops a small lathe from the Crosby Mine was added and a new Armstrong drill sharpener installed in the blacksmith shop. The heating system was overhauled and unit heaters put in to replace the pipe coils. As the shops are too small to hold a locomotive, as much repair work as possible was completed on them and then they were moved to the Hill-Trumbull shops for completion.

A four-stall steel garage was built near the shops in December.

WADE MINE:

After cleaning out drifts and re-timbering subs, this mine started production in January and was in full production in February. All the equipment necessary to get 18 double drum hoists and slushers in operation was made up in the shop. A new 1½" power bolt threading machine was added in January and the shaper formerly used at the Boeing Mine was returned to this shop. All machine shop work required on the Bucyrus "70" shovel and other equipment at the Alexandria Mine was taken care of in this shop during the year.

WADE MINE: (Cont'd)

A new endless belt was purchased for compressor in April and is still in good condition. The pressure on this machine was raised from 70 lbs. to 100 lbs. per sq. inch.

The Marion "36" shovel was repaired in the Spring and used to load out the stockpile.

The switch tracks west of the shaft were caved and a new switch system worked out for the shaft. This required a Lima locomotive to transfer the cars. It was found that one locomotive was able to care for both the shaft and stockpile loading during the Summer.

In June three cars of scrap iron were shipped to clean up the surface. This included the steam double drum hoist and compressor from the Meadow Mine, which were stored here, as well as some steam pumps and #24 shovel.

A timber shaft was sunk in June and the electric cage hoist formerly at the Boeing Mine was installed. A timber shafthouse was built and the cage from the Boeing mine was reduced in size for use in the shaft.

Stockpile storage was changed in October from endless rope haulage to 6-ton electric locomotive and dump cars, and has given no trouble.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

447

THE CLIFFS POWER & LIGHT CO.

The two decades during which the development of our Electric Plant has been under way have shown a continuous advance in the use of electricity and the expansion of utility companies throughout the country. Our plants have met this condition of economical expansion as shown by an average increase in sale of electricity of 14,000,000 Kilowatt Hours every five years, the average increase in the last ten years being over 2,000,000 Kilowatt Hours per year. During the year 1930 our total sales were over 57,000,000 Kilowatt Hours.

There has been a decided increase in the amount of current sold to other industries not a part of our own operations. (In 1930 this amounted to about 30% of our total output.)

The operation of The Cliffs Power & Light Co. in the year 1930 has been very satisfactory, our output exceeding any previous year by 8%.

There were no interruptions in our service of any consequence. The transmission line failures and breakdown of generating equipment or substation apparatus were practically negligible, being less than in any previous year in the history of the plants. Considering the extensions that have been made, and the increase in plants and substation equipment, we think that this indicates sound engineering in expansion and a proper operating maintenance program.

The first half of 1930 found us with ample water and considerable overflow run-off. In the last half we had sub-normal precipitation, and this required decided use of stored water at the close of the year. There appears to be sufficient stored water now to carry us through to the Spring break-up period.

The principal maintenance work done during the year was the general repair of the Au Train-Munising circuit, which was built 20 years ago. Fourteen miles of the Gwinn-Au Train line was dismantled. New insulators were put on all our 30,000 volt lines as required.

A portion of the Garp Plant wood stave pipe line was repaired by a reinforced concrete shell over the pipe, made with collapsible forms. This is an entirely original method and now appears very satisfactory and economical. The principal advantage is that it is not necessary to de-water the line and shut down the Plant while repairs are under way. (It is expected that this work will be continued next year and until all deteriorated portions are covered.)

The 66,000 volt line built primarily to serve the Inland Lime & Stone Co. operations east of Manistique was completed and put in service on June 24th. This line is 107 miles long, extending from Gwinn to Munising and from Munising to the Inland dock. The normal span is 400 feet, with 50' butt treated Western Cedar poles. The conductor is #3/0 A.C.S.R. from Gwinn to Munising and #2/0 from Munising to the dock. Normal vertical spacing 6'0", horizontal 10'0", with 4" x 5½" Fir crossarms. Ohio Brass suspension insulators were used, with four sections per string on straightaway and five sections per string at angles and inaccessible portions of the line.

Substation at Gwinn is 3,750 K.V.A., 33,000/66,000 volts, connected delta star. Substation at Munising is 2,000 K.V.A., 66,000/13,200/2,300 volts. Substation at the Inland quarry is 1,500 K.V.A., 66,000/2,300 volts, and a duplicate of this at the dock. Substation structures are all galvanized steel construction, with all equipment outdoor type. Circuit breakers with suitable relay equipment, and oxide film lightning arresters. All substation equipment was furnished by the General Electric Co. and is satisfactory in every respect.

The transmission line was built under contract by the Hoosier

THE CLIFFS POWER & LIGHT CO. (Cont'd)

Engineering Co. of Chicago. The substations were erected by our own organization. It has been reported by outside engineers that the installation as a whole is practically a perfect piece of work, and that the line is unusually fine.

Adjacent to this line, developments were made at Seney, Germfask and Blaney Park. Practically full development in service is had at each place, including street lights.

A 30,000 volt circuit was built from the North Lake Substation to the new Greenwood Mine of the Inland Steel Co. This is on Northern Cedar poles 40', with 7'0" Fir cross arms and #2 copper wire. The necessary reliable service was supplied for this mine during the compressed air sinking operations and proved fully adequate. Our organization is making the electrical installation for them at this mine. The substation is a standard steel structure with three 150 K.V.A. transformers, 30,000/2,300 volts, furnished by the General Electric Co.

A new substation was installed at Clarksburg to serve the Wisconsin-Michigan Power Co. for Champion and Michigamme. This is a bank of three 37½ K.V.A. transformers, 30,000/13,200 volts. Pole structure was used and equipment is General Electric.

The substation at Seney is 25 K.V.A. single phase transformer, 66,000/2,300 volts, mounted on pole.

Service to Blaney Park and Germfask is through three 25 K.V.A. transformers, 6600 volts, located at Inland quarry substation.

The contract which was made with the Munising Paper Co. last year became effective with the completion of their 5,000 K.V.A. steam turbine plant. This assures us stable steam reserve power and is so located as to be of material benefit in maintaining continuous service in the Eastern area.

We have placed a maintenance lineman at Seney and one at Munising in order to secure systematic patrolling and quick repairs in the event of trouble.

The improvement of the Au Train Water Power Plant was authorized under E. & A. #10 and work was started early in the summer. This contemplated building a new dam about one-quarter of a mile up stream from the original dam, which was a temporary structure built in 1910. The pipe line was extended 1,400 feet up stream to connect with this new dam. This results in an additional head of about 35 feet, corrects the excessive leakage at the old dam and gives a very appreciable storage above the new dam. This stored water backs up stream six miles and makes a levee necessary at the south end to keep this water from going over the divide to Lake Michigan. This work is now practically complete with the exception of the levee, which is now being built. The dam and pipe line extension were completed during December. Work is progressing on the levee and it will be completed early next summer. It is not contemplated to fill this basin next Spring but partially, as it is desirable to let the levee thoroughly settle before putting it under water pressure. This improvement will more than double the output of this plant and will allow its full capacity to be applied to the peak of our load, which we could not do before owing to lack of storage capacity above the old dam, which made it necessary to operate strictly on the flow of the stream without any control.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

449

THE CLIFFS POWER & LIGHT CO. (Cont'd)

The Archibald Mine at Gwinn closed down mining operations just before the close of the year. They still maintain the pumping and maintenance force, and our revenue loss will not be serious as the pumping is a considerable percentage of their load. It is expected that operations will be resumed in about sixty days.

The transfer of the Holmes Mine to the Oliver Iron Mining Co. does not appreciably affect us as the use of electric power with their operations must be substantially the same as before.

We are optimistic as to the year 1931 and anticipate a normal business for The Cliffs Power & Light Co., regardless of the present general business conditions.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)Summary of Operating Conditions - 1930.

Month	-	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.		
Precipitation	-	1.11	1.15	.90	1.48	2.86	6.28	2.27	.87	2.69	1.66	1.42	.45		
Total Precipitation at Ishpeming during 1930	-	23.14"													
Average	"	"	"	Marquette										32.8"	(46 year record)

CARP RIVER PLANT:

Drainage area above Intake Dam,	66.66 sq. miles
Cubic feet Precipitation in 1930,	3,586,662,000
Kilowatt Hours generated in 1930,	9,993,500
Cubic feet water utilized (90 cu. ft. = 1 KWH)	899,415,000
" " " in Carp Storage Basin Jan. 1, 1930,	299,510,300
" " " " " " " Dec.31, "	215,812,400
" " " taken from storage in 1930,	83,697,900
" " " wasted over Intake Dam in 1930,	1,513,728,000
Total run-off for the year 1930,	2,329,445,100
Run-off per square mile of drainage area,	34,945,171

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

	<u>1922</u>	<u>1923</u>	<u>1924</u>	<u>1925</u>	<u>1926</u>	<u>1927</u>	<u>1928</u>	<u>1929</u>	<u>1930</u>
Total Precipitation,	33.67	21.90	22.95	20.71	35.69	29.86	36.06	32.28	23.14
Sec.ft.per sq.mi. run-off,	1.06	.59	.50	.25	.85	.98	1.11	.67	1.108

McCLURE PLANT:

Drainage area above Intake Dam	140.52 sq. miles
Cu. ft. Precipitation in 1930, (Hoist Plant - 30.81")	10,058,111,331
Kilowatt Hours generated at McClure Plant in 1930,	37,661,000
Cubic feet water utilized, (125 cu. ft. = 1 KWH.)	4,707,625,000
" " " wasted over Intake Dam in 1930,	3,101,760,000
" " " in Hoist Storage Basin Jan. 1, 1930,	1,841,548,400
" " " " " " " " Dec.31, "	694,301,400
" " " taken from Hoist Storage in 1930,	1,147,247,000
" " " in Silver Lake on Jan. 1, 1930,	639,045,000
" " " " " " " " Dec.31, "	403,934,500
" " " taken from Silver Lake in 1930,	235,110,500
Total run-off for the year 1930,	6,427,027,500
Run-off per square mile of drainage area,	45,737,400

	<u>1920</u>	<u>1921</u>	<u>1922</u>	<u>1923</u>	<u>1924</u>	<u>1925</u>	<u>1926</u>	<u>1927</u>	<u>1928</u>	<u>1929</u>	<u>1930</u>
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

THE CLIFFS POWER & LIGHT CO.

SUMMARY OF OPERATIONS - 1930.

KILOWATT HOURS GENERATED & PURCHASED

	<u>McClure</u>	<u>Carp</u>	<u>Hoist</u>	<u>Au Train</u>	<u>Republic</u>	<u>Escanaba</u>	<u>Purchased</u>	<u>TOTAL</u>	<u>Used by Auxilia- ries</u>	<u>Delivered to Line</u>	<u>KWH. Sold</u>	<u>Transmission Losses</u>	
												<u>K.W.H.</u>	<u>%</u>
Jan.	2,911,500	515,700	1,059,000	126,160	119,000	271,000	0	5,002,360	18,606	4,983,754	4,406,184	577,570	11.58
Feb.	3 116 400	876 600	1 040 000	87 180	110 200	235 000	0	5 465 380	15 746	5 449 634	4 778 932	670 702	12.30
March	3 090 200	678 600	1 021 000	200 660	127 500	291 000	0	5 408 960	17 198	5 391 762	4 727 443	664 319	12.32
April	2 936 500	758 300	816 000	246 310	122 500	300 000	0	5 179 610	14 936	5 164 674	4 511 740	652 934	12.64
May	3 066 500	985 800	751 000	283 040	124 700	285 000	0	5 496 040	13 060	5 482 980	4 848 091	634 889	11.57
June	3 045 700	1 056 300	735 000	283 320	197 400	269 000	0	5 586 720	13 390	5 573 330	4 857 913	715 417	12.83
July	3 018 800	1 009 900	707 000	210 260	300 900	226 000	0	5 472 860	12 790	5 460 070	4 652 251	807 819	14.79
Aug.	3 414 000	860 900	1 217 000	75 080	132 400	115 000	0	5 814 380	15 710	5 798 670	4 976 741	821 929	14.17
Sept.	3 274 600	749 100	1 156 000	69 990	44 000	129 000	0	5 422 690	15 410	5 407 280	4 610 195	797 085	14.74
Oct.	3 502 100	796 900	1 201 000	77 160	26 500	198 000	64,100	5 865 760	16 268	5 849 492	5 008 279	841 213	14.38
Nov.	3 148 000	884 700	1 054 000	114 370	43 600	233 000	398 000	5 875 670	16 082	5 859 588	5 054 494	805 094	13.73
Dec.	3 137 300	820 700	1 024 000	71 170	73 500	215 000	102 000	5 443 670	15 596	5 428 074	4 677 375	750 699	13.82
<b>TOTAL</b>	<b>37,661,600</b>	<b>9,993,500</b>	<b>11,781,000</b>	<b>1,844,700</b>	<b>1,422,200</b>	<b>2,767,000</b>	<b>564,100</b>	<b>66,034,100</b>	<b>184,792</b>	<b>65,849,308</b>	<b>57,109,638</b>	<b>8,739,670</b>	<b>13.27</b>

Au Train Plant shut down from Nov. 22nd to Dec. 16th in order to connect in new pipe line.



MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)

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

	INSTALLED TO JAN. 1, 1930	INSTALLED IN 1930	TAKEN OUT IN 1930	CONNECTED JAN. 1, 1931 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	500	750	500	
Underground Plunger Pump #1	180			
" Centrifugal Pump	250			
Allis-Chalmers Compressor	175			
Hoist for "B" Shaft	500	750	500	
Underground Plunger Pump #2	200			
Laboratory Crusher	5			
Coal Crushing Plant Exhaust Fan	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			
Underground Haulage Set #2	215			
Small Hoist in Crusher Building	15			
Conveyor Belts - New Crushing Plant - 2 motors	40	(1 out)	20	
Jaw Crusher - " " "	75			
Feeder Belt - " " "	5	(stored in barn)	5	
Magnetic Separator " " "	1 1/2			
Underground Scrapers - 52 - 25 HP. motors	1175	125		
Lower Tram #3	30			
Battery Charging Set, 2nd level "A" Shaft	7 1/2			
Grinder in Drill Sharpening Shop	7 1/2			
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		
				5,295 3/4
BROWNSTONE SUBSTATION:				
Test Set	1/2			
Oil Filter Press (Stored at Cliffs Shaft)	1/4		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			
				87 3/4
fwd.	5,007 3/4 HP.	1,651 HP.	1,025 1/4 HP.	5,633 1/2 HP.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)

	INSTALLED TO JAN. 1, 1930	INSTALLED IN 1930	TAKEN OUT IN 1930	CONNECTED JAN. 1, 1931 TOTALS
	5,007 $\frac{3}{4}$ HP.	1,651 HP.	1,025 $\frac{1}{4}$ HP.	5,633 $\frac{1}{2}$ HP.
brt. fwd.				
<b>HARD ORE SHOPS:</b>				
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	10 $\frac{1}{2}$			
Water Supply Pump	7 $\frac{1}{2}$			
Blacksmith Shop Blower	1/4			
Hacksaw	1/2			
Small Grinder	1/4			
Portable Drill (Stanley)		<u>1</u>		62 $\frac{1}{4}$
<b>HOLMES MINE: (Sold to Oliver Iron Mining Co. 11/1/30)</b>				
Air Compressor	340		340	
" " Cooling Water Pump	3		3	
Skip Hoist - 2 - 400 HP. motors	800		800	
Cage "	400		400	
Underground Haulage Converter	150		150	
Top Tram	25		25	
No. 6 Crushers - 2 - 40 HP. motors	80		80	
Screens	20		20	
Laboratory Crusher	2		2	
Underground Plunger Pump	250		250	
" Centrifugal Pump	400		400	
Boiler Feed Pump	5		5	
Machine Shop	25		25	
Auxiliary Compressor for Hoist Brakes	7 $\frac{1}{2}$		7 $\frac{1}{2}$	
5th level Pump - Aldrich Sinker	35		35	
" " " - Dean	10		<u>10</u>	2,880
<b>ISHPEMING HOSPITAL:</b>				
Passenger Elevator	7 $\frac{1}{2}$			
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 "	1 $\frac{1}{8}$			
Vacuum Pump	<u>3</u>			29 $\frac{1}{2}$
fwd.	7,651 $\frac{1}{4}$ HP.	1,652 HP.	3,577 $\frac{3}{4}$	5,725 $\frac{1}{2}$ HP.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)

	INSTALLED TO JAN. 1, 1930	INSTALLED IN 1930	TAKEN OUT IN 1930	CONNECTED JAN. 1, 1931 TOTALS
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	brt.	fwd.	HP.	HP.	HP.	HP.
<b>TILDEN MINE:</b>						
Compressor			150			
Centrifugal Pump			275			
Scraper on Coal Dock				15		
#29 Shovel - Motor-Generator Set			110			
"    - Air Compressor			4 $\frac{1}{2}$			
"    - Oil Pump			1/4			
"    - Trip Motor			2			
"    - Exciter Motor			10			
Cyclone Drills - 2 - 10 HP.			20			
"    "    - 3 - 15 HP.			45			
Car Dumper			30			
Large Crusher			250			
Car Fuller			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			7 $\frac{1}{2}$			
"    Trip    "			1 $\frac{1}{4}$			
"    Air Compressor			5 $\frac{1}{2}$			
Drill Shappener			15			
Pump for Drills			15			
Synchronous Condenser from P.C.F.P.			625			
Exciter Motor-Generator Set (to Storehouse)			15		15	
Water Supply Pump (to Au Train Dam)			5		5	
Shop Motor			5			
"    "    #2				3		
Scraper				50		
Armstrong Drill				15		
						2,030 $\frac{1}{4}$
<b>ATHENS MINE:</b>						
Cage Hoist			400			
Compressor - Nordberg			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			
Battery Charging Motor-Generator Set			1/4			
Underground Ventilating Fan #2			50			
Ingersoll-Rand Compressor			450			
Rock Tram			50			
						3,311 $\frac{1}{4}$
	fwd.		12,929 $\frac{3}{4}$ HP.	1,735 HP	3,597 $\frac{3}{4}$ HP	11,067 HP.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

455

Electrical Department (Cont'd)

	INSTALLED TO JAN. 1, 1930	INSTALLED IN 1930	TAKEN OUT IN 1930	CONNECTED JAN. 1, 1931 TOTALS
	12,929 $\frac{3}{4}$ HP	1,735 HP	3,597 $\frac{3}{4}$ HP	11,067 HP.
<b>MAAS MINE:</b>				
	brt. fwd.			
(Circulating Pump	40			
Turbine Auxiliaries (Injection "	25			
(Exciter	33			
Underground Haulage Set	215			
Shop	10			
Underground Centrifugal Pump	350			
" Hoist	50			
" Plunger Pump #1	325			
Compressor Cooling Water Pump	5			
Ore Tram - 2 - 50 HP. motors	100			
Coal Crushing Plant	15			
Underground Plunger Pump #2	250			
Ingersoll-Rand Compressors 2 - 400 HP motors	800			
Rock Tram (to Athens Mine)	50		50	
Skip Hoist	700			
Cage "	400			
Boiler Room Fan	1/2			
Skip Hoist Rheostat Pump	2	3	2	
Carpenter Shop Saw	15			
Auxiliary Compressor for Hoist Brakes	7 $\frac{1}{2}$			
4th Level Pump	50			
Cooling Water Pump	5			
Triplex Pump, 4th Level	50			
Centrifugal Pump, 4th Level	40			
Saw Gumming Outfit in Carpenter Shop	2			
Underground Haulage Set #2 (from Negaunee Mine)		215		
Return Water Pump in Heating Plant		2		
Aldrich Pump, 4th Level (from Boeing Mine)		100		
Centrifugal Pump, 3rd Level (from Francis Mine)		400		
" " " " - primer (From Stephenson)		50		
				4,258
<b>NEGAUNEE MINE:</b>				
Underground Haulage Set #1	215	300	215	
"Ilgner" Hoist Set	450			
Top Tram - 2 - 50 HP. motors	100			
Laboratory Crusher	5			
Auxiliary Compressor for Hoist Brakes	3			
Udg. Plunger Pumps - 2 - 300 HP. motors	600			
" Centrifugal Pump	350			
" Suction Pumps - 2 - 15 HP. motors	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. motors	150			
Exciters for 10th level Pump Motors (2)	40			
Signal System Motor-Generator Set	1/2			
Timber Hoist - #2 Shaft	25			
Ventilating Fan - #2 Shaft	150			
Gravel Hoist	15			
Saw in Carpenter Shop	15			
Skip Pit Pump	3			
Underground Haulage Set #2	220			
	fwd.			
	16,469 $\frac{3}{4}$	2,505	3,649 $\frac{3}{4}$	15,325 HP.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)

	brt.	fwd.	INSTALLED TO JAN. 1, 1930	INSTALLED IN 1930	TAKEN OUT IN 1930	CONNECTED JAN. 1, 1931 TOTALS
			16,469 $\frac{3}{4}$ HP.	2,505 HP.	3,649 $\frac{3}{4}$ HP.	15,325 HP.
NEGAUNEE MINE:		brt. fwd.				
New Flywheel Set for Hoists			3,154 $\frac{1}{2}$	300	215	
Oil Pump on #2 Flywheel Set				800		
" " " " " "				1		
" " " Nordberg Compressor				1		
				<u>1</u>		4,042 $\frac{1}{2}$
MAAS CRUSHING PLANT:						
Jaw Crusher			100			
Belt Conveyer			50			
Fan Conveyer Motor-Generator Set			<u>50</u>			200
SOUTH JACKSON CRUSHING PLANT:						
Hoist			75			
Crusher			<u>150</u>			225
BARNES-HAEKER MINE:						
Skip Hoist			<u>400</u>			400
LLOYD MINE:						
Skip Hoist			400			
Cage "			400			
Top Tram			40			
Ore Crusher			25			
Water Supply Pump installed underground			50			
Auxiliary Compressor for Hoist Brakes			5			
Top Tram			<u>50</u>			970
MORRIS MINE:						
Skip Hoist			600			
Cage "			400			
Shop			25			
Ingersoll-Rand Compressor #1			250			
4th level Plunger Pumps - 2 - 350 HP. motors			700			
7th " " Pump			100			
" " Centrifugal Pump			175			
Laboratory Crusher			5			
Carpenter Shop			25			
Nordberg Air Compressor			325			
Compressor Cooling Water Pump			5			
Top Tram - 2 - 50 HP. motors			100			
Underground Haulage Set #1			150			
Centrifugal Water Supply Pump			50			
Heating Plant Condensing Water Pump			2			
Ingersoll-Rand Compressor #2			500			
Planer in Carpenter Shop			15			
Crusher			25			
Underground Haulage Set #2			215			
Aldrich Triplex Pump			50			
8th level Pump			<u>100</u>			3,817
SECTION 6 SHAFT:						
Hoist			200			
Water Supply Pump			<u>3</u>			203
			<u>25,439<math>\frac{1}{4}</math></u>	<u>3,608</u>	<u>3,864<math>\frac{3}{4}</math></u>	<u>25,182<math>\frac{1}{2}</math> HP.</u>
	fwd.					

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

457

Electrical Department (Cont'd)

	brt. fwd.	INSTALLED		CONNECTED
		TO JAN. 1, 1930	IN 1930	TOTALS
		25,439 $\frac{1}{4}$ HP.	3,608 HP.	3,864 $\frac{3}{4}$ HP.
				25,182 $\frac{1}{2}$ HP.
<b>GWINN CRUSHING PLANT:</b>				
Crusher		85		
Fan Conveyor		50		
Belt Conveyor		40		
Compressor		15		
" Cooling Water Pump		<u>3</u>		193
<b>FRANCIS MINE STOCKPILE:</b>				
Triplex Pump		<u>7<math>\frac{1}{2}</math></u>		7 $\frac{1}{2}$
<b>GARDNER MINE:</b>				
Hoist		400		
Top Tram		50		
Laboratory Crusher		<u>3</u>		453
<b>MACKINAW MINE:</b>				
Hoist		400		
Shop		7 $\frac{1}{2}$		
Top Tram		50		
Underground Haulage Set		150		
Air Compressor		325		
Compressor Cooling Water Pump		7 $\frac{1}{2}$		
Underground Quintuplex Pump		350		
" Triplex "		75		
5th level Pump			30	
Winze Hoist (from Morris Mine)			<u>200</u>	1,595
<b>PRINCETON MINE #2:</b>				
Hoist		200		
Top Tram	-	<del>200</del> 50		
Stockpile Loader		<u>25</u>		275
<b>PRINCETON MINE #3:</b>				
Hoist		<u>75</u>		75
<b>STEPHENSON MINE:</b>				
Skip Hoist		<u>400</u>		400
<b>PRINCETON CENTRAL POWER PLANT:</b>				
(Circulating Pump)		50		
Turbine Auxiliaries (Injection)		40		
(Exciter)		33		
Boiler Room Fan		50		
Coal Handling Machinery		10		
" " "		<u>5</u>		188
<b>PRINCETON CENTRAL SHOPS:</b>				
Shop Motor		<u>25</u>		25
<b>PRINCETON CENTRAL PUMP STATION:</b>				
Centrifugal Pump		100		
Automatic Pump		<u>30</u>		130
	fwd.	28,550 $\frac{3}{4}$	3,838	3,864 $\frac{3}{4}$
				28,524 HP.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

458

Electrical Department (Cont'd)

	INSTALLED TO JAN. 1, 1930	INSTALLED IN 1930	TAKEN OUT IN 1930	CONNECTED JAN. 1, 1931 TOTALS
	28,550 $\frac{3}{4}$	3,838	3,864 $\frac{3}{4}$	28,524
	HP.			HP.
	brt. fwd.			
<b>REPUBLIC MINE:</b>				
Auxiliary Compressor for Hoist Brakes	5			
#9 Shaft Hoist Motors - 2 - 500 HP.	1,000			
" " Ore Tram - 2 - 50 "	100			
Booster Compressor	<u>200</u>			1,305
<b>CARP PLANT:</b>				
Auxiliaries - 2 - 15 HP. pump motors	30			
Water Supply Pump	1			
Air Compressor	<u>5</u>			36
<b>HOIST PLANT:</b>				
Exciter Motor-Generator Set	20			
Oil Pump	3			
Air Compressor	<u>5</u>			28
<b>McCLURE PLANT:</b>				
Water Supply Pump	2			
Exciter Motor-Generator Set	17 $\frac{1}{2}$			
Air Compressor	<u>5</u>			24 $\frac{1}{2}$
<b>ESCANABA PLANT:</b>				
Air Compressor	5			
Oil Pump	5			
Valve Operating Motor	<u>1</u>			11
<b>AU TRAIN DAM: (Construction Job)</b>				
Air Compressor		50		
Centrifugal Pump		100		
" "		20		
Concrete Hoist		50		
" Mixer		10		
Centrifugal Pump		125		
Water Supply Pump		<u>5</u>		360
	<u>29,955<math>\frac{1}{2}</math></u>	<u>4,198</u>	<u>3,864<math>\frac{3}{4}</math></u>	<u>30,288<math>\frac{1}{2}</math></u> HP.
<b>TOTAL MINING DEPARTMENT</b>				
and				
<b>CLIFFS POWER &amp; LIGHT CO.</b>				

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

459

Electrical Department (Cont'd)

	INSTALLED TO JAN. 1, 1930	INSTALLED IN 1930	TAKEN OUT IN 1930	CONNECTED JAN. 1, 1931 TOTALS
TOTAL MINING DEPARTMENT. and CLIFFS POWER & LIGHT CO.	29,955 $\frac{1}{2}$	4,198	3,864 $\frac{3}{4}$	30,288 $\frac{1}{2}$
PIONEER FURNACE: Furnace & Sawmill	<u>1,195</u>			1,195
L. S. & I. RR. CO. Shops, Sawmill, Ore Dock & Pumps	<u>800</u>			800
LAND DEPARTMENT: Grand Island - 3 motors	10 $\frac{1}{2}$	<u>5</u>		15 $\frac{1}{2}$
LUMBERING DEPARTMENT: (Dixon) Location Water Supply Pump	5			
Tie Mill Saw (to Maas Mine)	75		75	
" " Conveyors	37			
" " Shop	<u>10</u>			52
MICHIGAN GAS & ELECTRIC CO.: Ishpeming	2,170			
Munising	250			
Munising City Pumping	<u>125</u>			2,545
REPUBLIC TOWNSHIP: Water Supply Pump	<u>25</u>			25
OLIVER IRON MINING COMPANY: Pumps at Angeline & Section 16 Mines	525			
Air Compressor at Section 16 Mine	700			
Holmes Mine	<u>2,552<math>\frac{1}{2}</math></u>			3,777 $\frac{1}{2}$
CITY OF ISHPERING: Booster Pump at Brownstone	<u>15</u>			15
CITY OF NEGAUNEE:	<u>435</u>			435
THE CLIFFS ELECTRIC CO.	<u>100 Est.</u>			100
PALMER MINING COMPANY: Volunteer Mine, Palmer	<u>800</u>			800
EMPIRE-QUINN MINING COMPANY: Archibald Mine, Gwinn	<u>1,952</u>			1,952
MUNISING WOODENWARE CO.	<u>695</u>			695
FORD MOTOR COMPANY: Blueberry Mine	<u>1,165</u>			1,165
INLAND STEEL CO., Greenwood Mine		<u>400</u>		400
INLAND LIME & STONE CO., Quarry & Dock		<u>4,000</u>		4,000
<u>TOTAL OUTSIDE LOAD</u>	<u>13,642</u>	<u>4,405</u>	<u>75</u>	<u>17,972 HP.</u>
<u>GRAND TOTAL CONNECTED LOAD</u>	<u>43,597<math>\frac{1}{2}</math> HP. 8,603 HP. 3,939<math>\frac{3}{4}</math> HP. 48,260<math>\frac{1}{2}</math> HP.</u>			



MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)

The following motors are not connected to our Power System:

	INSTALLED TO JAN. 1, 1930	INSTALLED IN 1930	TAKEN OUT IN 1930	CONNECTED JAN. 1, 1931 TOTALS
<u>SPIES-VIRGIL MINE:</u>				
Underground Triplex Pump	50 HP.			
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			
Undg. Plunger Pumps, 8th level (2)	300			
Underground Haulage Converter	<u>150</u>			1,391
<u>MESABA RANGE:</u>				
<u>BOEING MINE:</u>				
Air Compressor	225			
Underground Haulage Set (to Homan-Cliffs)	150		150	
Top Tram	50			
Blacksmith Shop Fan	<u>1/4</u>			275 1/4
<u>CANISTEO MINE:</u>				
Centrifugal Pumps	2 - 600 HP. motors	1,200		
Priming Pump		3		
Shop			10	
Tailings Pump			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 Drill			15	
Centrifugal Pumps	2 - 25 " "		50	
Portable Drill			1/2	
Hacksaw			1/2	
Wood Planer			3	
Band Saw			3	
Circular Saw			5	
Shaper			3	
Dorr Classifiers	2 - 5 " "		10	
Clear Water Pump			3	
Motor-Generator Set on Shovel			250	
Exciter Set	" "		20	
Dipper Trip			2	
Fan			3	
Heater Motors	6 - 1/2 " "		3	
" "	8 - 1/8 " "		<u>1</u>	
		<u>3,019 1/4</u>	<u>1,287</u>	<u>150</u>
fwd.				4,156 1/4 HP.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

461

Electrical Department (Cont'd)

		INSTALLED			CONNECTED
		TO JAN. 1,	INSTALLED	TAKEN OUT	JAN. 1, 1931
		1930	IN 1930	IN 1930	TOTALS
	brt. fwd.	3,019 $\frac{1}{4}$ HP.	1,287 HP.	150 HP.	4,156 $\frac{1}{4}$ HP.
<b>GROSBY MINE:</b>					
Log Washer		40			
Screen		20			
Picking Belt		3			
Chip Screen		3			
Tables		20			
Stockpile		7 $\frac{1}{2}$			
Centrifugal Pump		85			
#2 Turbo		20			
Feeder		20			
					218 $\frac{1}{2}$
<b>HELMER MINE:</b>					
Hoist	(to Dohm Mining Co.)	200		200	0
<b>HOLMAN CLIFFS MINE:</b>					
Layne & Bowler Pump		350			
Bench Grinder		1/4			
Portable Drill		1/4			
Belt Conveyor		75			
Symons Crusher	- 2 - 100 HP. motors	200			
Jaw Crusher		100			
Dorr Classifiers	2 - 10 " "	20			
Air Compressor		50			
Screen		25			
Centrifugal Pumps	2 - 125 " "	250			
Picking Belts	2 - 5 " "	10			
Centrifugal Pump		85			
Carpenter Shop (to Canisteo)		10		10	
Machine Shop		30			
Priming Pump		2			
Exhaust Fan		1/2			
Centrifugal Pump		275			
Blacksmith Forge Fan		1/2			
Motor-Generator Set		225			
Blacksmith Shop	Boeing			10	
Udg. Haulage Set	(from Wads Mine)			150	
Locomotive Water Tank Pump				3	
Clear Water Pump, Washing Plant				3	
Armstrong Drills	2 - 15 HP. motors			30	
Hummer Screen				5	
Bench Grinder				1/4	
Portable Grinder				1	
Shop Heaters	2 - 1/2 " "			1	
" "	10 - 1/8 " "			1 $\frac{1}{4}$	
Roll Motor in Main Laboratory				3	
Fulverizer " " "				1	
Fan " " "				1/8	
Ro-Tap " " "				1/2	
Air Compressor " "				1 $\frac{1}{2}$	
Roll Motor in Washing Plant Laboratory				5	
Fulverizer " " " "				1	
Fan				1/8	
Motor-Generator Sets in Shovels-	2 - 250 HP.			500	
Exciter Sets	" " 2 - 20 HP.			40	
Dipper Trip	2 - 2 HP.			4	
Fans	2 - 3 HP.			6	
					2,465 $\frac{1}{2}$
	fwd.	5,146 $\frac{1}{4}$	2,053 $\frac{3}{4}$	360	6,840 HP.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

462

Electrical Department (Cont'd)

	brt. fwd.	INSTALLED			CONNECTED
		TO JAN. 1, 1930	INSTALLED IN 1930	TAKEN OUT IN 1930	JAN. 1, 1931 TOTALS
		5,146 $\frac{1}{4}$ HP	2,053 $\frac{3}{4}$ HP.	360 HP.	6,840 HP.
HILL-TRUMBULL MINE:					
Log Washer		25	50	25	
" "		40			
Belt Conveyors	4 - 5 HP. motors	20			
Crusher		100			
Sand Pump		10		10	
Sample Crusher		10			
Prescott Plunger Pump		125			
Gentrifugal Pump		150			
Tables		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			
Keystone Drill		15			
Tailings Pump (to Canisteo)		50		50	
Blacksmith Shop Fan		3			
Picking Belt		5			
Car Puller		7 $\frac{1}{2}$			
Portable Grinder		1			
North Pit Pump		30			
Air Compressor at Washing Plant		25			
Churn Drill		10			
Boiler Feed Pump		5			
Blacksmith Shop Fan (to Wade)		3		3	
Chhp Screens	2 - 2 HP. motors	4			
Layne & Bowler Pump		125			
Tool Post Grinder		1/4			
Locomotive Water Tank Pump (to Holman-Cliffs)		3		3	
Electric Welder		15			
Armstrong Drill		15			
Laboratory Heater (to Holman-Cliffs)		1/8		1/8	
Clear Water Pump			3		
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			250		
Exciter			20		
Dipper Trip			2		
Fan			3		
					1,560
	fwd.	6,245 $\frac{3}{4}$	2,605 $\frac{1}{4}$	451	8,400 HP.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)

	INSTALLED	INSTALLED	TAKEN OUT	CONNECTED
	TO JAN. 1,	IN 1930	IN 1930	JAN. 1, 1931
	<u>1930</u>	<u>IN 1930</u>	<u>IN 1930</u>	<u>TOTALS</u>
brt. fwd.	6,245 $\frac{3}{4}$ HP	2,605 $\frac{1}{4}$ HP	451 HP	8,400 HP.
<b>WADE MINE:</b>				
Hoist	125			
Air Compressor	150			
Compressor Cooling Water Pump	2			
Underground Haulage Set	150			
Machine Shop	10			
Underground Triplex Pump	50			
" Centrifugal Pump	100			
Top Tram	50			
Clear Water Pump	15			
Blacksmith Shop Fan	3			
Sump Pump	7 $\frac{1}{2}$			
Sinking Hoist	35			
Underground Centrifugal Pump	125			
" Fan		<u>15</u>		<u>837<math>\frac{1}{2}</math></u>
<b><u>TOTAL SPIES*VIRGIL &amp; MESABA RANGE,</u></b>	<u>7,068<math>\frac{1}{4}</math></u>	<u>2,620<math>\frac{1}{4}</math></u>	451	9,237 $\frac{1}{2}$ HP.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)

The following A.C. motors are on hand, (Dec. 31, 1930), but are not installed:

<b>CLIFFS SHAFT MINE:</b>		
Top Tram (stator only)		50 HP.
Spare Top Tram		50
" " "		50
Small Conveyor Motor		2
Scraper Motors 8 - 25 HP.		200
Crusher		25
Battery Charger from Republic		30
Oil Filter Motor		1/2
		407 1/2 HP.
<b>GENERAL STOREHOUSE &amp; BARN:</b>		
Centrifugal Pump from D.R. Storage Dam		3
Spare from Republic concrete mixer		5
" General Electric pump		50
" " " Motor-Generator Set (Morris-Lloyd)		150
" 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
" Haulage Converter from Francis		150
" Plunger Pump " "		35
" Motor		40
Portable Hoist from Republic Mine		7 1/2
Pump Motor " " "		10
2 - 500 HP. Hoist Motors from Cliffs Shaft Mine		1,000
Hoist Stator only " " " "		500
Feeder Belt " " " "		5
Conveyor Belt " " " "		20
Motor-Generator Set from Tilden Mine		15
		2,206
<b>LAKE MINE CHANGE HOUSE:</b>		
Ventilating Fan from Salisbury Mine		7 1/2
		7 1/2
<b>ISHPEMING HOSPITAL:</b>		
Spare for Dumb Waiter		3
" " Hot Water Return		5
		8
<b>ATHENS MINE:</b>		
Pump Motor		35
Fan "		40
		75
<b>MAAS MINE:</b>		
Winze Pump		15
Pump (from Morris Mine)		50
" ( " Boeing " )		100
Hoist Motor from Stephenson Mine		75
Pump Motor		75
		315
<b>NEGAUNEE MINE:</b>		
Flywheel Hoist Set Motor		350
		350
<b>MORRIS-LLOYD MINE:</b>		
Centrifugal Pump Motor (from McClure Plant)		50
Top Tram		40
		90
<b>PRINCETON MINE:</b>		
Underground Pump		150
		150
fwd.		3,609 HP.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

465

Electrical Department (Cont'd)

	brt. fwd.	
		3,609 HP.
<b>TILDEN MINE:</b>		
Cyclone Drill	15	
Conveyor Belt	50	
Trip Motor for Shovels	1 $\frac{1}{4}$	
Water Supply Pump	2	
		68 $\frac{1}{4}$
<b>PRINCETON CENTRAL SHOPS &amp; CENT. POWER PLANT:</b>		
Grinder	3	
Austin Hoist Motor	200	
" Top Tram	25	
Fire Pump from Mackinaw	20	
Top Tram " Stephenson	50	
Rock " " "	25	
Ore " " "	50	
		373
<b>GWINN STORAGE SHED &amp; STEPHENSON TRANSFER:</b>		
Stephenson 5th level Plunger Pump	250	
" " " " "	250	
" 8th " " "	50	
" 6th " Centrifugal Pump	125	
Top Tram from Gardner	25	
		700
<b>GARDNER-MACKINAW MINE:</b>		
Prescott Centrifugal Pump	400	
		400
<b>REPUBLIC MINE:</b>		
Spare	10	
"	30	
Screen from #9 Shaft	25	
Crusher	100	
Pump from Engine House	7 $\frac{1}{2}$	
Centrifugal Pump from Engine House	20	
Coal Tram	7 $\frac{1}{2}$	
Pump from bottom level #9 Shaft	20	
" " 3rd level	50	
" " Pascoe Shaft cross-over	50	
Screen from Crusher	10	
Carpenter Shop	20	
Underground Hoist	100	
" " "	50	
Pump from 11th level	7 $\frac{1}{2}$	
		507 $\frac{1}{2}$
<b>TOTAL</b>		5,657 $\frac{3}{4}$ HP.
<b>Spare motors at Spies-Virgil Mine:</b>		
Underground Haulage Set	150	
Grinder Motor	3	
		153 HP.
<b>Spare motors on Mesaba Range:</b>		
<b>HILL-TRUMBULL MINE:</b>		
Log Washer	25	
Screen	20	
Pump	3	
Shop	5	
Picking Belt	2	
Spare	3	
fwd.		58

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)

	brt. fwd.	58 HP.
HOLMAN-CLIFFS MINE:		
Shaft Pump	<u>150</u>	150
WADE MINE:		
Pump Motor	<u>125</u>	<u>125</u>
	<u>TOTAL</u>	333 HP.

Total C.G.I.Co. & C.P.&L.Co. load connected to Power System - 12/31/30, 30,286½ HP.

" outside " " " " " " " 6517.972 "

TOTAL CONNECTED LOAD 48,260½ HP.

Total connected load at Spies-Virgil Mine - 1,391 HP.

" " " at Mesaba Range mines - 7,846½ "

Total spare motors on hand Dec. 31, 1930 - Ishpeming District - 5,657½ HP.

" " " " " " " " - Spies-Virgil Mine - 153 "

" " " " " " " " - Mesaba Range mines - 333 "

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

467

Electrical Department (Cont'd)

The following direct current generators and exciters are installed and operating asneeded:

		INSTALLED TO JAN. 1, 1930	INSTALLED IN 1930	TAKEN OUT IN 1930	JAN. 1, 1931 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
MAAS PLANT:					
Motor Driven Exciter		22½			
Turbo " "		22½			
Compressor Motor Exciters	(2)	20			65
ESCANABA PLANT:					
Exciter		28			28
PRINCETON CENTRAL POWER PLANT:					
Motor Driven Exciter		22½			
Turbo " "		22½			45
REPUBLIC MINE:					
Exciter in #5 Engine House		7½			
" " Water Power Plant		17			24½
REPUBLIC PLANT:					
Exciter		18			
"		15			33
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			18
HOLMES MINE:					
Compressor Motor Exciter		10			10
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
	fwd.	1,339½			1,339½ K.W.



MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)

		INSTALLED TO JAN. 1, 1930	INSTALLED IN 1930	TAKEN OUT IN 1930	JAN. 1, 1931 TOTALS
brt. fwd.		1,339½ KW.			1,339½ KW.
<b>MAAS CRUSHING PLANT:</b>					
Pan Conveyor Generator		35			
" " " Exciter		<u>1½</u>			36½
<b>NEGAUNEE MINE:</b>					
Skip Hoist Generator		400			
Cage " "		150			
Flywheel Set Exciter		25			
Exciters for Underground Pump Motors (2)		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			<u>35</u>		1,258½
<b>MORRIS MINE:</b>					
Ingersoll-Rand Compressor Motor Exciter		12			
Nordberg " " "		10			
Ingersoll-Rand " " "		<u>10</u>			32
<b>MACKINAW MINE:</b>					
Compressor Motor Exciter		<u>10</u>			10
<b>TILDEN MINE:</b>					
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			<u>15</u>		237
<u>TOTAL</u>		<u>2,913½ KW</u>	<u>650 KW</u>		<u>2,913½ KW.</u>

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)

Underground Haulage Generators:

	INSTALLED TO JAN. 1, 1930	INSTALLED IN 1930	TAKEN OUT IN 1930	JAN. 1, 1931 TOTALS
<b>CLIFFS SHAFT MINE:</b>				
Motor-Generator Set #2	100 KW.			
" " Charging Set	5			
" " Set #1	<u>100</u>			
				205 KW.
<b>HOLMES MINE:</b>				
Rotary Converter	100		<u>100</u>	0
<b>ATHENS MINE:</b>				
Rotary Converter	<u>100</u>			100
<b>MAAS MINE:</b>				
Motor-Generator Set #1	100			
" " " #2 (from Negaunee)		<u>100</u>		200
<b>NEGAUNEE MINE:</b>				
Motor-Generator Set #1	100	200	100	
" " " #2	<u>150</u>			350
<b>MORRIS-LLOYD MINE:</b>				
Motor-Generator Set #1	100			
" " " #2	<u>100</u>			200
<b>MACKINAW MINE:</b>				
Rotary Converter	<u>100</u>			<u>100</u>
<u>TOTAL</u>	<u>1,055 KW</u>	<u>300 KW</u>	<u>200 KW</u>	<u>1,155 KW.</u>

Direct Current Motors:

<b>AU TRAIN WATER POWER PLANT:</b>				
Governor Control Motors	(2)	1/4 HP.		1/4 HP.
<b>CARP RIVER WATER POWER PLANT:</b>				
Rheostat Control	(2)	1/4		
Governor " "	(2)	1/4		1/2
<b>McCLURE PLANT:</b>				
Valve Control	(2)	2		
Rheostat " "	(2)	1/2		2 1/2
<b>CLIFFS SHAFT MINE:</b>				
Portable Hoist		10		
Car Fuller		6 1/2		
9 Scrapers		<u>75</u>	60	<u>151 1/2</u>
fwd.		<u>94 3/4</u>	60	<u>154 3/4 HP.</u>

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

470

Electrical Department (Cont'd)

		INSTALLED TO JAN. 1, <u>1930</u>	INSTALLED <u>IN 1930</u>	TAKEN OUT <u>IN 1930</u>	JAN 1, 1931 <u>TOTALS</u>
	brt. fwd.	<u>94<math>\frac{3}{4}</math> HP.</u>		60 HP.	<u>154<math>\frac{3}{4}</math> HP.</u>
<b>HOLMES MINE:</b>					
Sturtevant Fan		1 $\frac{1}{2}$		1 $\frac{1}{2}$	
Scrapers	7 - 15 HP. motors	105		<u>105</u>	0
<b>TILDEN MINE:</b>					
Hoist Motor on Electric Shovel #29		100			
Swing " " " " "		20			
Thrust " " " " "		20			
Swing " " " " #31		20			
Thrust " " " " "		20			
Hoist " " " " "		<u>100</u>			280
<b>ATHENS MINE:</b>					
Skip Hoist		900			
Ventilating Fans	6 - 5 HP. motors	25	5		
Sullivan Scrapers	2 - 6 $\frac{1}{2}$ " "	13			
" " "	10 - 15 " "	90	60		
Ventilating Fans	2 - 15 " "	30		15	
Sullivan Scrapper			<u>20</u>		1,128
<b>MAAS MINE:</b>					
Timber Hoist - 2nd level		10			
" " - 4th "		10			
Bilge Pump		5			
Ventilating Fan (from Athens)			15		
Sullivan Scrapers	11 - 15 HP. motors	120	45		
" " "	7 - 6 $\frac{1}{2}$ " "	45 $\frac{1}{2}$			
Denver " "	2 - 7 $\frac{1}{2}$ " "	15		15	
Scraper Slide		15			
Ventilating Fans	4 - 5 " "	5	15		
Scraper		25			
" "		<u>22</u>	20		
Conway Loader			50		
Ingersoll-Rand Scrapers	4 - 15 HP motors		<u>60</u>		440 $\frac{1}{2}$
<b>MAAS CRUSHING PLANT:</b>					
Fan Conveyor		<u>40</u>			40
<b>NEGAUNEE MINE:</b>					
Skip Hoist		500			
Cage "		200			
Timber Hoist - tunnel		10			
" " - 10th level		10			
Ventilating Fan		7 $\frac{1}{2}$			
Scrapers	12 - 7 $\frac{1}{2}$ HP motors	75	15		
Sullivan Scrapers	10 - 6 $\frac{1}{2}$ " "	65			
" " "	3 - 25 " "	50	25		
Ventilating Fan		5			
Denver Scrapers	3 - 10 " "	30			
Sullivan "	7 - 15 " "	105			
Ingersoll-Rand Scrapers	3 - 15 HP		<u>45</u>		1,142 $\frac{1}{2}$ HP
	fwd.	<u>2,887<math>\frac{1}{2}</math></u>	435	136 $\frac{1}{2}$	3,185 $\frac{3}{4}$ HP.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

471

Electrical Department (Cont'd)

		INSTALLED			
		TO JAN. 1,	INSTALLED	TAKEN OUT	JAN. 1, 1931
		1930	IN 1930	IN 1930	TOTALS
	brt. fwd.	2,887 $\frac{1}{4}$ HP.	435 HP.	136 $\frac{1}{2}$ HP.	3,185 $\frac{3}{4}$ HP.
<b>MORRIS MINE:</b>					
Ventilating Fan, 6th level		15			
Sullivan Scrapers	7 - 6 $\frac{1}{2}$ HP.	45 $\frac{1}{2}$			
Denver Rock Drill Scrapers	7 - 7 $\frac{1}{2}$ "	52 $\frac{1}{2}$			
Sullivan Scrapers	2 - 10 "	20			
" "	5 - 7 $\frac{1}{2}$ "	37 $\frac{1}{2}$			
" "	7 - 15 "	90	15		
Scraper Slide		15			
Timber Hoist			7 $\frac{1}{2}$		
Scrapers	3 - 25 "		75		
Ingersoll-Rand Scrapers	3 - 15 "		45		
					<u>418</u>
	<u>TOTAL</u>	3,162 $\frac{3}{4}$ HP.	577 $\frac{1}{2}$ HP	136 $\frac{1}{2}$ HP	3,603 $\frac{3}{4}$ HP.

Spare Generators and Exciters on hand December 31st, 1930:

GENERAL STOREHOUSE:

Oil Hoist Exciter 22 KW  
22 KW.

NEGAUNEE MINE:

Skip Hoist (Armature only) 500 HP.

TOTAL 22 KW.

Spare Underground Haulage Generators on hand December 31st, 1930:

GENERAL STOREHOUSE:

Motor-Generator Set (from Morris) 100  
Rotary Converter ( " Francis) 100

TOTAL 200 KW.

Spare Direct Current Motors on hand December 31st, 1930:

ATHENS MINE:

Timber Hoist Motor 10  
Fan 15

25 HP.

MORRIS-LLOYD MINE:

Crane Motor 10

10

GENERAL STOREHOUSE:

Pump Motor 20  
Spare Hoist Motor for Shovel 105  
" Swing " " " 20  
Small Motor-Generator Set 10

155

TOTAL 190 HP.

Electrical Department (Cont'd)

MESABA RANGE:

Exciters and Generators installed up to December 31st, 1930:

BOEING MINE:			
Compressor Motor Exciter		6 KW	
			6 KW
CANISTEO MINE:			
Hoist Generator on Shovel		137½	
Swing " " "		40	
Thrust " " "		39	
			216½
HILL-TRUMBULL MINE:			
Hoist Generator on Shovel		137½	
Swing " " "		40	
Thrust " " "		39	
			216½
HOLMAN-CLIFFS MINE:			
Hoist Generators on Shovels	(2)	275	
Swing " " "	(2)	80	
Thrust " " "	(2)	78	
			433
<u>TOTAL</u>			872 K.W.

Underground Haulage Generators installed up to Dec. 31st, 1930:

HOLMAN-CLIFFS MINE:			
Motor-Generator Set			115 KW
HILL-TRUMBULL MINE:			
Motor-Generator Set			55
WADE MINE:			
Rotary Converter			100
<u>TOTAL</u>			270 K.W.

Direct Current Motors installed up to December 31st, 1930:

CANISTEO MINE:			
Rack Drives on Classifiers	2 - 5 HP.		10 HP.
Hoist Motor on Shovel			187½
Swing " " "			40
Thrust " " "			40
			277½ HP.
HILL-TRUMBULL MINE:			
Feeder Motor			60
Hoist Motor on Shovel			187½
Swing " " "			40
Thrust " " "			39
Dorr Bowl Classifiers	2 - 5 HP.		10
			336½
HOLMAN-CLIFFS MINE:			
Pan Conveyor			40
Log Washers	3 - 40 HP.		120
Hoist Motors on Shovels	2 - 187½ HP.		375
Swing " " "	2 - 40 "		80
Thrust " " "	2 - 40 "		80
			695
<u>TOTAL</u>			1,309 HP.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)

MESABA RANGE:

Total Exciters and Generators installed to December 31st, 1930 -	872 K.W.
" Haulage Generators " " " " " -	270 K.W.
" Direct Current Motors " " " " " -	1,309 H.P.

SPIES-VIRGIL MINE:

Exciters installed to December 31st, 1930\*

Compressor Motor Exciter	10 K.W.
Underground Haulage Generators installed to December 31st, 1930 -	150 K.W.
Top Tram Larry Cars 2 - 20 HP.	40 H.P.

ISHPEMING DISTRICT:

Total D.C. Generators and Exciters installed to Dec. 31st, 1930 *	2,913 $\frac{3}{4}$ K.W.
" Underground Haulage Generators " " " " " -	1,155 K.W.
" Direct Current Motors " " " " " -	3,603 $\frac{3}{4}$ H.P.
Total Spare D.C. Generators and Exciters on hand " " " " -	22 K.W.
" " Underground Haulage Generators " " " " " -	200 K.W.
" " Direct Current Motors " " " " " -	190 H.P.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

474

Electrical Department (Cont'd)

Substation Transformers installed up to December 31st, 1930:

<u>66,000/2,300 Volts</u>	<u>Phase</u>	<u>No.</u>	<u>K.V.A.</u>	<u>TOTAL K.V.A.</u>	
Munising Substation	1	3	667	2,000	
Seney "	1	1	25	25	
Inland #1 "	1	3	500	1,500	
" #2 "	1	3	500	<u>1,500</u>	5,025 K.V.A.
<u>33,000/66,000 Volts</u>					
Gwinn Substation	1	3	1,250	<u>3,750</u>	3,750 "
<u>33,000/13,200 Volts</u>					
Clarksburg Substation	1	3	37½	<u>112½</u>	112½ "
<u>33,000/6,600 Volts</u>					
Eben Substation	1	1	25	<u>25</u>	25 "
<u>33,000/2,300 Volts</u>					
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	
" " Dam	1	3	75	225	
Palmer "	1	3	625	1,875	
Hoist Plant "	1	3	667	2,000	
Greenwood "	1	3	150	450	
Chatham "	1	2	15	<u>30</u>	37,235 "
<u>6,600/2,300 Volts</u>					
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	<u>15</u>	3,350 "
<u>6,600/115-220 Volts</u>					
Germfask	1	1	15	15	
" "	1	2	1.5	3	
" "	1	2	3	<u>6</u>	24 "
<u>TOTAL</u>					<u>49,521½</u> K.V.A.

Transformers used for Underground Haulage installed to 12/31/30:

Athens Mine converter	1	3	35	105	
Mackinaw " "	1	3	35	<u>105</u>	210 K.V.A.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

475

Electrical Department (Cont'd)

Distribution Transformers installed up to December 31st, 1930:

<u>2300/220/110 Volts</u>	<u>PHASE</u>	<u>NO.</u>	<u>K.V.A.</u>	<u>TOTAL K.V.A.</u>
<b>ANGELINE MINE:</b>				
Hoist Control	1	1	<u>7½</u>	7½
<b>CLIFFS SHAFT MINE:</b>				
Office Lights	1	1	10	
" "	1	1	15	
Laboratory	1	1	5	
"A" Shaft Hoist	1	1	7½	
"B" " "	1	1	10	
Coal Crusher	1	2 (7½)	15	
Pump Station Lights	1	1	1	
Crusher House Lights	1	2 (1)	2	
Crushers	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	11 (1½)	16½	
Scraper Lights	1	1	2	
" "	1	1	<u>3</u>	547
<b>HARD ORE, BROWNSTONE, ETC.</b>				
Light & Power	1	1	15	
Light	1	1	3/4	
Light & Power	1	1	7½	
Shop	1	1	30	
Manager's Residence	1	2 (10)	20	
" "	1	2 (5)	<u>10</u>	83½
<b>LAKE MINE:</b>				
Engine House Lights	1	1	5	
Shaft Lights	1	1	<u>3/4</u>	5¾
<b>TILDEN MINE:</b>				
Pump	1	2 (10)	20	
Lights & Power	1	1	10	
" " "	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	
Drills	1	3 (10)	30	
Scrapers	1	3 (15)	<u>45</u>	207
			fwd.	850½



Electrical Department (Cont'd)

Distribution Transformers (Cont'd)

	PHASE	NO.	K.V.A.	TOTAL K.V.A.
brt. fwd.				850½
<b>ATHENS MINE:</b>				
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
<b>MAAS MINE:</b>				
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	
Bell Signal at 55 Winze	1	1	1	
Cage Hoist Control	1	1	10	
Skip Hoist Control	1	1	2	
" " "	1	1	3	
Rock Tram "	1	1	1	
Heaters in Engine House	1	1	7½	
Top Tram	1	1	2	
4th level Pump	1	3 ( 5)	15	
Shop	1	1	15	
				117
<b>MAAS CRUSHING PLANT:</b>				
Lights	1	1	7½	
				7½
<b>NEGAUNEE MINE:</b>				
Shop Light & Power	1	2 (10)	20	
Engine House Lights & Power	1	1	10	
" " " " "	1	1	5	
Signal System	1	1	1/2	
Pump Station Lights, etc.	1	3 (7½)	22½	
12th Level Pump	1	3 ( 5)	15	
Barn	1	1	5	
Gravel Pit	1.	1	7½	
Hoist & Lights - #2 Shaft	1	3 (10)	30	
Engine House Lights & Power	1	2 (15)	30	
Undg. Haulage	1	1 (	3	
				148½
<b>SOUTH JACKSON CRUSHING PLANT:</b>				
Hoist Brake	1	1	5	
Lights	1	1	2	
				7
<b>BARNES-HECKER MINE:</b>				
Engine House Lights	1	1	5	
" " "	1	1	7½	
				12½
		fwd.		1,253

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

177

Electrical Department (Cont'd)

Distribution Transformers (Cont'd)		PHASE	NO.	K.V.A.	TOTAL K.V.A.
brt. fwd.					1,253
<b>LLOYD MINE:</b>					
Cage Hoist Control	1	1		7½	
Skip Hoist Control	1	1		7½	
Water Supply Pump House Lights	1	1		2	
Engine House Lights & Bell Signal	1	1		5	
Shaft House Lights	1	1		<u>5</u>	27
<b>MORRIS MINE:</b>					
Skip Hoist Control & Lights	1	1		10	
Cage " " " "	1	1		7½	
Signal System Lights	1	1		1/2	
Shop & Lights	1	3 (10)		30	
7th level Pump Station Lights	1	1		2	
Location Lights	1	1		10	
Club House Lights	1	1		<u>5</u>	65
<b>SECTION 6 SHAFT:</b>					
Hoist Control	1	1		7½	
Lights	1	2 (2)		<u>4</u>	11½
<b>REPUBLIC MINE:</b>					
G.E. Tram	1	1		15	
Lighting	1	2 (2)		4	
Engine House Lights	1	1		7½	
Hoist Control	1	1		25	
Top Tram Controls	1	2 (1)		2	
Office Lights	1	1		3	
Water Power Plant Lights	1	1		<u>1½</u>	58
<b>AUSTIN MINE:</b>					
Shop	1	1		<u>10</u>	10
<b>GARDNER MINE:</b>					
Cage Hoist Control	1	1		10	
Top Tram	1	1		1	
Power & Lights	1	2 (10)		<u>20</u>	31
<b>MACKINAW MINE:</b>					
Machine Shop	1	2 (5)		10	
Hoist Control	1	1		10	
Top Tram	1	1		<u>1</u>	21
<b>PRINCETON MINE #2:</b>					
Top Tram Lights	1	1		3	
Stockpile	1	2 (10)		<u>20</u>	23
<b>PRINCETON MINE #3:</b>					
Lighting & Bell System	1	1		<u>1½</u>	1½
<b>PRINCETON CENTRAL POWER PLANT:</b>					
Coal Crusher	1	3 (7½)		22½	
Power Plant Lights	1	1		<u>10</u>	<u>32½</u>
fwd.					1,533½

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)

Distribution Transformers: (Cont'd)		<u>PHASE</u>	<u>NO?</u>	<u>K.V.A.</u>	<u>TOTAL K.V.A.</u>
	brt. fwd.				1,533 $\frac{1}{2}$
PRINCETON CENTRAL SHOPS:					
Power & Light	1	2	(10)	<u>20</u>	20
GWINN DISTRICT OFFICE:					
Lights	1	1		<u>10</u>	10
PRINCETON PUMP STATION:					
Power	1	2	(15)	30	
Lights	1	1		<u>5</u>	35
GWINN DISTRICT CRUSHER:					
Power & Lights	1	2	(10)	<u>20</u>	20
AUSTIN BARN:					
Lights	1	1		<u>3</u>	3
GWINN SUBSTATION:					
Lights	1	1		<u>1</u>	1
AU TRAIN WATER POWER:					
Power Plant Lights	1	1		1	
Operator's Dwelling Lights	1	1		2	
Control	1	1		2	
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)	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)	<u>5</u>	74
CARP RIVER WATER POWER PLANT:					
Power & Lights	1	1		10	
" " "	1	1		20	
Pump	1	2	(1)	<u>2</u>	32
HOIST PLANT:					
Power & Light	1	1		7 $\frac{1}{2}$	
" " "	1	2	(5)	<u>10</u>	17 $\frac{1}{2}$
MCCLURE PLANT:					
Power & Light	1	2	(10)	<u>20</u>	20
ESCANABA RIVER PLANT:					
Power & Light	1	3	(5)	<u>15</u>	15
				<u>15</u>	
				<u>GRAND TOTAL</u>	1,781

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)

## Distribution Transformers:

	<u>PHASE</u>	<u>NO.</u>	<u>K.V.A.</u>	<u>TOTAL K.V.A.</u>
<b>THE CLIFFS ELECTRIC COMPANY:</b>				
Austin Location Lighting	1	1	10	
Gwinn Street Lights	1	2 (1)	2	
" " "	1	1	2	
" Lighting near Depot	1	1	$\frac{1}{2}$	
" " Poplar Alley	1	1	30	
" Power - Club House	1	2 (5)	10	
" Lighting - " "	1	1	10	
" " - Mineral St.	1	1	10	
" " - Pine St.	1	1	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	$7\frac{1}{2}$	
Chatham Lighting & Power	1	2 ( $7\frac{1}{2}$ )	15	
" " "	1	1	10	
" " "	1	1	5	
" " "	1	1	1	
Eben Lighting	1	1	$7\frac{1}{2}$	
Seney " "	1	1	10	
" " "	1	1	5	
	<u>TOTAL</u>			222 $\frac{1}{2}$

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

Electrical Department (Cont'd)

Spare Transformers on hand December 31st, 1930:

	<u>PHASE</u>	<u>NO.</u>	<u>K.V.A.</u>	<u>TOTAL K.V.A.</u>
<b>ANGELINE MINE:</b>				
General Electric	1	1	<u>1</u>	1
<b>ATHENS MINE:</b>				
Spare	1	1	3	
Spare	1	1	<u>3</u>	6
<b>REPUBLIC MINE:</b>				
General Electric	1	1 (10)	10	
" "	1	1	4	
Lights & Pump	1	1	<u>10</u>	24
<b>GENERAL STOREHOUSE:</b>				
General Electric for 440 shaft pump	1	1	100	
From Francis Mine converter	1	2 (35)	70	
General Electric	1	1	10	
" "	1	1	5	
" " from Republic	1	1	20	
" " " "	1	3 (3)	9	
" " " "	1	1	15	
" " " "	1	2 (7½)	15	
" " " "	1	1	<u>10</u>	254
<b>GWINN SUBSTATION:</b>				
Spare	1	1	<u>10</u>	10
<b>ESCANABA RIVER PLANT:</b>				
Spare	1	1	<u>10</u>	10
<b>PRINCETON MINE ENGINE HOUSE:</b>				
Surface Lighting	1	1	<u>5</u>	5
<b>PRINCETON CENTRAL POWER PLANT:</b>				
From Injection Pump	1	2 (15)	30	
Spare	1	1	10	
"	1	1	<u>½</u>	30½
<b>GWINN STORAGE SHED:</b>				
Princeton Pump House Lights	1	1	2½	
Spare	1	1	2½	
"	1	1	3	
"	1	1	<u>2</u>	10
<u>TOTAL</u>				350½ K.V.A.

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

COMPARATIVE TABLES.

<u>YEAR</u>	<u>TONS COAL BURNED</u>	<u>TONS ORE &amp; ROCK HOISTED</u>	<u>CU. FT. AIR USED</u>	<u>CUBIC FT. AIR PER TON HOISTED</u>	<u>GALLONS OF WATER PUMPED</u>
<u>CLIFFS SHAFT MINE</u>					
1921	2,094	67,454	273,648,228	4,057	274,901,402
1922	891	138,702	419,382,000	3,023	399,874,439
1923	2,359	305,727	734,645,710	2,403	377,383,675
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
<u>HOLMES MINE</u>					
1921	832	191,147	275,057,000	1,439	38,456,053
1922	911	231,306	346,466,000	1,497	73,009,389
1923	704	289,984	431,820,000	1,489	82,640,803
1924	879	170,228	296,460,000	1,741	75,235,295
1925	679	172,507	253,125,000	1,446	56,962,287
1926	768	178,296	267,795,000	1,502	83,223,451
1927	816	186,436	333,180,000	1,787	79,829,181
1928	716	207,754	484,785,000	2,333	82,552,319
1929	712	209,519	348,795,000	1,664	108,313,916
1930	754	199,058	318,465,000	1,599	97,639,162
/(11 months)					
<u>ATHENS MINE</u>					
1921	515	177,065	359,055,000	2,027	73,114,028
1922	683	193,711	456,615,000	2,357	86,235,708
1923	971	246,704	635,535,000	2,576	103,329,157
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	121,785,145
<u>MAAS MINE</u>					
1921	735	211,616	373,275,000	1,764	517,238,661
1922	628	219,676	458,010,000	2,083	516,431,109
1923	548	228,528	472,220,000	2,066	509,330,141
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

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

COMPARATIVE TABLES


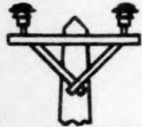

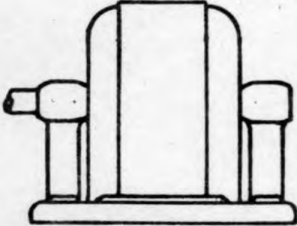
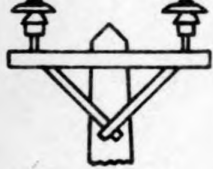

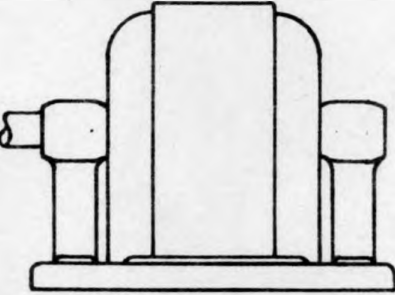
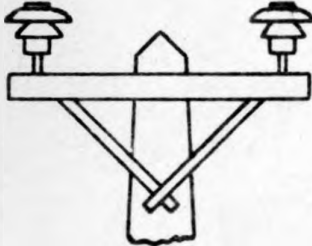
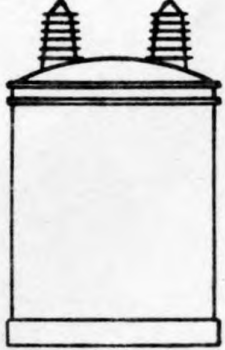
<u>YEAR</u>	<u>TONS COAL BURNED</u>	<u>TONS ORE &amp; ROCK HOISTED</u>	<u>CU. FT. AIR USED</u>	<u>CUBIC FT. AIR PER TON HOISTED</u>	<u>GALLONS OF WATER PUMPED</u>
<u>NEGAUNEE MINE</u>					
1921	838	258,967	306,315,000	1,183	597,401,853
1922	1 075	300 041	414 765 000	1 392	613 603 672
1923	996	383 914	655 695 000	1 708	582 912 109
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	12254	597 364	1 044 270 000	1 748	556 227 893
<u>TILDEN MINE</u>					
1929	625	441,769	---	---	---
1930	498	287 043	---	---	---
<u>MORRIS-LLOYD MINE</u>					
1921	848	234,809	681,918,000	3,067	321,064,176
1922	931	241 065	596 225 500	2 473	276 149 791
1923	1 031	273 124	826 038 000	2 460	267 210 477
1924	894	229 968	381 573 000	1 659	221 874 604
1925	919	258 062	611 836 920	2 371	172 168 518
1926	1 190	291 852	469 265 000	1 608	203 411 761
1927	1 096	333 736	688 545 000	2 062	223 631 596
1928	1 295	364 123	693 360 000	1 904	227 752 992
1929	1 243	456 119	947 560 000	2 077	236 012 174
1930	1 314	490 395	1 058 670 000	2 158	224 981 368
<u>HILL TRUMBULL MINE</u>					
1922	3,447	352,651	---	---	---
1923	4 096	311 012	---	---	---
1924	3 049	322 823	---	---	---
1925	3 364	521 382	---	---	---
1926	3 738	522 017	---	---	---
1927	4 149	544 405	---	---	---
1928	---	495 748	---	---	---
1929	---	521 845	---	---	---
1930	---	392 598	---	---	---
<u>SPIES-VIRGIL MINE</u>					
1921	350	46,878	87 360 300	---	---
1922	192	5 432	---	---	---
1923	495	19 732	---	---	---
1924	272	55 953	---	---	---
1925	313	72 542	---	---	---
1926	392	92 407	---	---	---
1927	424	163 911	---	---	---
1928	366	184 141	---	---	---
1929	292	168 913	---	---	---
1930	318	146 027	---	---	---

MECHANICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1930

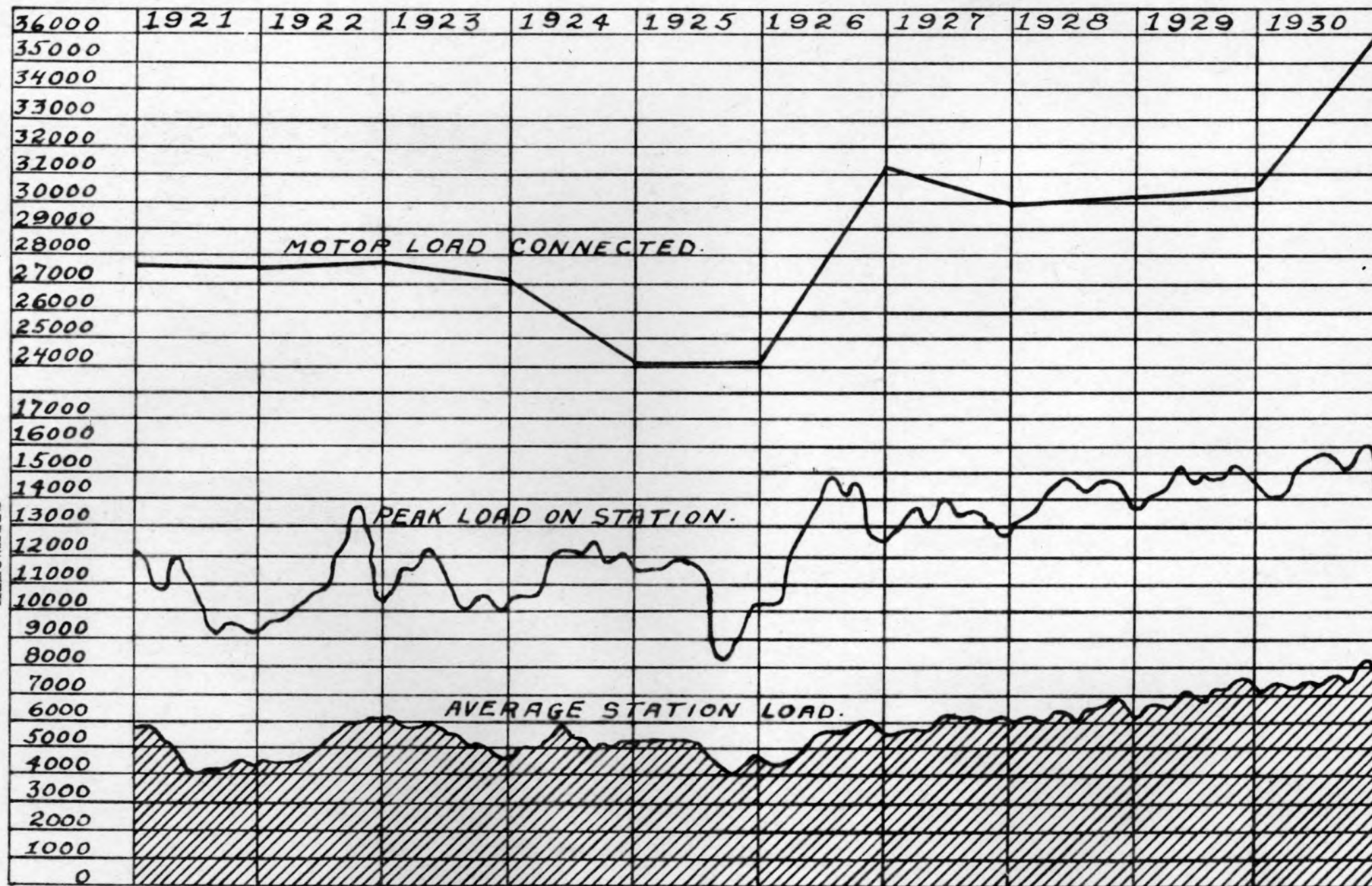
COMPARATIVE TABLES.

<u>YEAR</u>	<u>TONS COAL BURNED</u>	<u>TONS ORE &amp; ROCK HOISTED</u>	<u>CU. FT. AIR USED</u>	<u>CUBIC FT. AIR PER TON HOISTED</u>	<u>GALLONS WATER PUMPED</u>
<u>GARDNER-MACKINAW MINE.</u>					
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
<u>WADE MINE</u>					
1929	---	162,595	---	---	---
1930	---	165 853	---	---	---
<u>ALEXANDRIA MINE</u>					
1930	---	322,102	---	---	---
<u>HOLMAN &amp; CLIFFS MINE</u>					
1930	---	673,048	---	---	---



YEAR	GENERATORS	TRANSMISSION LINES	SUB STATIONS
1910	 2900 KVA	 WIRE 228 MILES	 5720 KVA
1920	 19750 KVA	 WIRE 536 MILES	 33100 KVA
1930	 32800 KVA	 WIRE 768 MILES	 45980 KVA

KILOWATTS



DISTRIBUTION OF ELECTRIC POWER 1926-1927-1928-1929-1930

