

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

a. Fatal Accidents (Continued)

TABLE I

FATAL ACCIDENT RECORD
THE CLEVELAND-CLIFFS IRON CO. AND CLIFFS POWER & LIGHT CO.
1898 - 1948, inclusive

<u>YEAR</u>	<u>NO. MEN EMPLOYED</u>	<u>NUMBER FATALITIES</u>	<u>FATALITY RATE</u>
1898	1065	6	5.63
1899	1174	4	3.41
1900	1427	4	2.80
	<u>3,666</u>	<u>14</u>	<u>3.79</u>
1901	1317	9	6.83
1902	1485	8	5.38
1903	1551	8	5.15
1904	1338	4	2.97
1905	2038	12	6.54
	<u>7,729</u>	<u>41</u>	<u>5.30</u>
1906	2418	10	4.13
1907	2843	17	6.00
1908	2340	6	2.52
1909	2520	13	5.15
1910	2907	20	6.88
	<u>13,028</u>	<u>66</u>	<u>5.06</u>
1898 - 1910		121	4.99
1911	2633	5	1.90
1912	2335	4	1.71
1913	2521	11	4.19
1914	2435	10	4.10
1915	3308	5	1.51
	<u>13,332</u>	<u>35</u>	<u>2.70</u>
1916	3063	8	2.61
1917	3457	6	1.73
1918	3765	13	3.45
1919	3938	11	2.79
1920	4125	5	1.21
	<u>18,348</u>	<u>43</u>	<u>2.36</u>
1921	2309	6	2.60
1922	2301	1	.43
1923	2728	6	2.20
1924	2472	5	2.02
1925	2472	2	.81
	<u>12,282</u>	<u>20</u>	<u>1.61</u>

(Cont'd.)

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYa. Fatal Accidents (Continued)

TABLE I (Cont'd.)

<u>YEAR</u>	<u>NO. MEN EMPLOYED</u>	<u>NUMBER FATALITIES</u>	<u>FATALITY RATE</u>
1926	2119	55	25.96
1927	1969	4	2.03
1928	1784	4	2.25
1929	2000	4	2.00
1930	2566	5	1.95
	10,438	72	6.90
1931	1651	3	1.82
1932	630	0	0.00
1933	631	2	3.17
1934	1073	4	3.74
1935	1313	2	1.53
	5,298	11	2.05
1936	2125	2	.94
1937	2763	1	.36
1938	2590	3	1.17
1939	2457	1	.41
1940	2756	5	1.88
	12,691	12	.94
1941	3570	5	1.40
1942	3562	2	.56
1943	3609	4	1.11
1944	3584	3	.84
1945	3078	1	.32
	17,403	15	.86
1946	2791	0	0.00
1947	3942	7	1.78
1948	4305	3	.70
1911 - 1948	100,830	218	2.16

BASED ON PER THOUSAND
EMPLOYEES

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYa. Fatal Accidents (Continued)

TABLE II

CLASSIFICATION OF CAUSES OF FATAL ACCIDENTS
FROM DECEMBER 1, 1898 TO DECEMBER 31, 1948

A.	Fall of ground	110	
	Run of mud or sand	60	
	Fall of chunk of ore from chute	2	
	Stray chunk or stick down raise or stope	<u>4</u>	176
B.	<u>Shaft Accidents:</u>		
	Falling down shaft	15	
	Rock or timber falling down shaft	3	
	Struck or caught by cage, skip, bucket, tool	8	
	Falling from cage, skip or bucket	11	
	Falling from ladder in shaft	5	
	Carried or pushed into shaft by car	3	
	Jumping on or off cage, skip or bucket	3	
	Struck by crosshead	5	
	Struck by falling material	<u>2</u>	55
C.	<u>Use Of Explosives:</u>		
	Explosion of powder	16	
	Premature blast	3	
	Fall of ground or timber due to a blast	4	
	Overcome by gas	3	
	Miscellaneous Causes	<u>2</u>	28
D.	<u>Mine and Railroad Cars:</u>		
	Caught by haulage cars	15	
	Riding or attempting to ride cars	6	
	Falling with car from trestle	4	
	Run over by railroad car	8	
	Struck by locomotive	2	
	Miscellaneous causes	<u>1</u>	36
E.	<u>Miscellaneous Causes:</u>		
	Falling in raise, stope or pocket	9	
	Electric shock	11	
	Falling from ladder strage, trestle, etc.	8	
	By moving machinery	7	
	Mine fires	3	
	Stockpile slide	3	
	Miscellaneous causes	<u>3</u>	44
			<hr/>
	TOTALS		339

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

a. Fatal Accidents (Continued)

TABLE III

CLASSIFICATION OF FATAL ACCIDENTS 1911 TO 1948, INCLUSIVE,
BY THE CENTRAL SAFETY COMMITTEE

I.	<u>Trade Risk</u>		121
II.	<u>Negligence Of The Company</u>		
	Violation of rules	6	
	Failure to provide safety devices	6	
	Improper method of doing work	12	
	Failure to provide tools or safe places to work	5	
	Failure to instruct men	5	
	Improper act or selection of improper method of doing work by foreman	<u>1</u>	35
III.	<u>Negligence Of Workmen</u>		
	A. Injured Men:		
	Improper method of work	24	
	Violation of rules	10	
	Failure to use tools or appliances provided	4	
	Failure to use safety devices	<u>3</u>	41
	B. Other Workmen:		
	Improper method of doing work	14	
	Violation of rules	4	
	Failure to use tools or appliances provided	<u>1</u>	19
A-B.	Injured Men and Other Workmen:		
	Improper act or selection of improper method of doing work	<u>1</u>	1
II.			
III.			
A-B.	Failure to instruct men by foreman and violation of rules by injured man and partner	<u>1</u>	<u>1</u>
	TOTALS		218

474

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

b. Non-Fatal Injuries

During the year we had eight fewer compensable injuries than in 1947 and worked 717,416 more hours of labor. Our frequency rating for all properties covering all lost-time injuries (one or more days) is 45.01, which is only slightly better than 1947, but our severity rating of 3.57 is considerably better than the 6.12 of 1947.

Falls of ground again caused the greatest number of compensable injuries underground with 24, followed by persons slipping and falling (14) and falling or moving materials (14) rolling chunks (11) and falling chunks (in shafts, raises and chutes) (8). Our rules concerned with falls of ground, I believe, are the best in the district. Nearly every man injured by falls of ground has caused his own accident or it has been caused by his partner. When driving raises we shall always have at least a temporary exposure hazard to falling chunks from the breast of the raise, but men employed on this work are usually our best miners who recognize the hazards and are very careful. Raise mining requires more skill than any other mining job and is done with surprisingly few injuries.

Better housekeeping will help to prevent some of the slipping and falling accidents but the individual himself must take some of this responsibility. Some of these injuries have occurred where the conditions have been about perfect. Haste on the part of the individual when walking conditions were poor, such as over newly broken ground, has been the cause of many falls.

Better planning and cooperation on the part of men will help prevent injuries caused by Falling or Moving material.

Rolling chunks, which caused 11 injuries, is a hazard which can be seen easily and can also be handled easily. Most of these injuries have happened in scraping troughs when employees have entered the trough without barring down the chunks on the side, or used a pick to take down the chunks rather than a bar. Supervisors are continually warning miners and scraper operators of the hazards but they still take chances when supervisors are not close-by.

On surface at underground mines one-third of all injuries were caused by slipping and falling. This, I believe, is a surface hazard which we must expect because of weather conditions which we cannot control. The total of 12 injuries at all underground mines surface properties is a very good record. Much credit for these records must go to the surface supervisors who are doing a fine job. These supervisors do have a better opportunity to see their men more often than underground supervisors so should have better accident records.

Open pits had 19 compensable injuries which gives them a good record. Total lost time injuries at open pits was 53 with a fre-

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYb. Non-Fatal Injuries (Continued)

quency of 30.90 and severity of 0.594. This, of course, is much below the average for most companies in the district. Not much comment can be made about the causes of injuries in the open-pit mining. Much of the work is done under very difficult conditions in the pits and the constant repairing and replacement of equipment in the wash-plants is hazardous. Machinery is becoming faster and heavier, which means much foresight must be used to prevent injury.

TABLE IV
CLASSIFICATION OF COMPENSABLE ACCIDENTS

11. ACCIDENTS AND PERSONAL INJURY

	ATHENS	MAAS	NEGAUNEE	CLIFFS SHAFT	LLOYD	SPIES-VIRGIL	MATHER "A"	MATHER "B"	CAMBRIA-Jack.	HOLMAN CLIFFS	HILL-TRUMBULL	ATKINS	HAWKINS	SARGENT	AGNEW	STHSE. & SHOPS	TILDEN	CANISTEO	TOTALS	
I. <u>Trade Risk, Incidental And Non-Preventable</u>	5	2	2	2	1	1	11		1	2			1	4	2	1		2	37	
II. <u>Negligence Of Company:</u>																				
1. Failure To Use Safety Devices Provided																				0
2. Failure To Use Proper Tools Provided																				0
3. Violation Of Rules																				0
4. Improper Act Or Selection of Method Of Doing Work - (By Foreman)								1	1											2
5. Failure To Instruct Men As To Method, Hazards, etc.									2						1					3
6. Failure To Provide Safety Devices				1																1
7. Failure To Provide Tools, Appliances Or Places To Work											1				1					2
III. <u>Negligence Of Workman:</u>																				
A. <u>Injured Workman</u>																				
1. Failure To Use Safety Devices Provided																				0
2. Failure To Use Proper Tools, etc. provided																				0
3. Violation Of Rules				1		1	1		2											5
4. Improper Act Or Method Of Doing Work	7	9	5	9	3		14	1	5	2	3			2	4		1	3		68
B. <u>Other Workman</u>																				
1. Failure To Use Safety Devices Provided																				0
2. Failure To Use Proper Tools, etc. Provided																				0

Year 1948
 Annual Report
 Safety Department

(Continued - Next Page)

TABLE IV (Continued from previous page)

CLASSIFICATION OF COMPENSABLE ACCIDENTS

	ATHENS	MAAS	NEGAUNEE	CLIFFS SHAFT	LLOYD	SPIES-VIRGIL	MATHER "A"	MATHER "B"	CAMBRIA-JACK.	HOLMAN CLIFFS	HILL-TRUMBULL	ATKINS	HAWKINS	SARGENT	AGNEW	STHSE. & SHOPS	TILDEN	CANISTEO	TOTALS	11. ACCIDENTS AND PERSONAL INJURY	
3. Violation Of Rules																				0	
4. Improper Act Or Method Of Doing Work		1		1		2							2							6	
<u>COMBINED CLASSIFICATIONS:</u>																					
III-A-4 and III-B-4	1	3		2		4		3						1						14	
II-6 and III-A-4						1					1									2	
II-5 and III-A-4							1		1											2	
II-5 and III-A-4 and III-B-4		1																		1	
II-5 and III-A-3 and III-B-3									1											1	
III-A-3 and III-B-3						3		1												4	
TOTALS (This Page And Previous Page)	13	16	7	15	5	2	36	3	16	5	5	0	3	7	8	1	1	5		148	

Safety Department
 Annual Report
 Year 1948

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

b. Non-Fatal Accidents (Continued)

TABLE V

NUMBER OF MAN-SHIFTS WORKED
AND TONS OF ORE PRODUCED PER FATALITY

<u>Year</u>	<u>Number Of Fatalities</u>	<u>Number Of Man-Days Worked Per Fatality</u>	<u>Number Of Tons Of Ore Mined Per Fatality</u>
1931	3	165,137	529,680
1932	0	189,000 *	486,750 **
1933	2	94,689	398,357
1934	4	80,477	451,046
1935	2	196,883	1,136,215
1936	2	283,945	1,850,898
1937	1	765,702	5,216,879
1938	3	163,434	385,954
1939	1	564,433	3,713,389
1940	5	142,878	1,156,387
1941	5	182,340	1,456,528
1942	2	512,356	3,808,258
1943	4	269,351	1,624,315
1944	3	331,090	1,995,787
1945	1	915,666	5,970,577
1946	0	747,079 *	4,416,253 **
1947	7	153,031	1,130,679
1948	3	386,965	2,869,090
<hr/>			
TOTALS	48	11,820,215	74,975,331
<hr/>			
18 Year Average -	2.67	246,252	1,561,986

* Man-Days Worked During Year Without Fatality

** Amount Of Ore Mined During Year Without Fatality

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

b. Non-Fatal Accidents (Continued)

TABLE VI

RESUME OF ALL INJURIES

<u>Mine Or Plant</u>	<u>Slight</u>	<u>Less Than 7 Days</u>	<u>7 Days Or More</u>	<u>Fatalities</u>	<u>TOTAL</u>
AGNEW	113	13	8		134
ATHENS	93	32	13		138
ATKINS	12	0	0		12
CAMBRIA-JACKSON	36	14	15	1	66
CANISTEO	95	7	5		107
C.P.& L. CO.	5	0	0		5
CLIFFS SHAFT	74	18	15		107
GENERAL ROLL	5	0	0		5
HAWKINS	40	4	3		47
HILL-TRUMBULL	57	10	5		72
HOLMAN CLIFFS	97	12	5		114
LLOYD	34	7	5		46
MAAS	95	37	16		148
MATHER "A"	219	65	35	1	320
Mather "B"	13	8	2	1	24
MISCELLANEOUS	8	1	0		9
NEGAUNEE	37	15	7		59
SARGENT	123	19	7		149
SPIES-VIRGIL	32	4	2		38
STHSE. & SHOPS	17	3	1		21
TILDEN	2	1	1		4
WANLESS	1	0	0		1
	---	---	---	---	---
TOTALS	1,208	270	145	3	1,626

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYb. Non-Fatal Accidents (Continued)

TABLE VII

CAUSES OF COMPENSABLE INJURIES (Including Fatalities)UNDERGROUND

<u>CAUSE</u>	<u>AGNEW</u>	<u>ATHENS</u>	<u>CAMBRIA-JACKSON</u>	<u>CLIFFS SHAFT</u>	<u>LLOYD</u>	<u>MAAS</u>	<u>MATHER "A"</u>	<u>MATHER "B"</u>	<u>NEGAUNEE</u>	<u>SARGENT</u>	<u>SPIES-VIRGIL</u>	<u>TOTAL</u>
Falls of ground	1	2	6			5	7			2	1	24
Falling chunks (shafts, chutes and raises)		1	2	1	1	1	1		1			8
Rolling chunks		1	2	3		2	2			1		11
Persons falling (raises, shafts and scaffolds)		2		1			2				1	6
Persons falling, slipping, etc.	2	2	1	2		2	4		1			14
Haulage			1	2		2	3					8
Drilling Equipment			1	1								2
Loading Equipment				1			1		1			3
Machinery (moving)					1		1					2
Hand Tools	1	1		1			2					5
Flying Objects		1		1			3					5
Handling Materials							1		1			2
Lifting Or Pulling	2								1	2		5
Burns		1										1
Falling Or Moving Materials		1	1	2	2	2	3	1	2			14
Wire Ropes						1				1		2
Miscellaneous			2			1	1					4
TOTALS	6	12	16	15	4	16	31	1	7	6	2	116

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

b. Non-Fatal Accidents (Continued)

TABLE VII (Cont'd.)

SURFACE (Underground Mines)

<u>CAUSE</u>	<u>AGNEW</u>	<u>ATHENS</u>	<u>LLOYD</u>	<u>MATHER</u> <u>"A"</u>	<u>MATHER</u> <u>"B"</u>	<u>SARGENT</u>	<u>TOTAL</u>
Persons falling, slipping or stumbling	2		1	1			4
Machinery (moving)				1		1	2
Hand Tools				1			1
Handling Materials					1		1
From Sharp Objects				1			1
Bumping Against Objects				1			1
Falling Or Moving Materials		1			1		2
TOTALS	2	1	1	5	2	1	12

OPEN PITS

<u>CAUSE</u>	<u>CANISTEO</u>	<u>HAWKINS</u>	<u>HILL-TRUMBULL</u>	<u>HOLMAN</u>	<u>TILDEN</u>	<u>TOTAL</u>
Persons falling, slipping or stumbling			2	1		3
Haulage	2		1	1	1	5
Machinery (moving)	1			1		2
Hand Tools			1			1
Lifting or Pulling	1			1		2
Burns			1			1
Falling Or Moving Material		3		1		4
Miscellaneous	1					1
TOTALS	5	3	5	5	1	19

OTHER OPERATIONS

<u>CAUSE</u>	<u>GARAGE - STOREHOUSE AND SHOPS</u>	<u>TOTAL</u>
Falling Or Moving Material	1	1
TOTALS	1	1

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYb. Non-Fatal Accidents (Continued)

TABLE VIII

FREQUENCY RATES
ALL COMPENSABLE INJURIES

<u>Year</u>	<u>Total Man Days Worked</u>	<u>Number Of Compensable Injuries</u>		<u>Frequency *</u> <u>Rate</u>
		<u>NON-FATAL</u>	<u>FATAL</u>	
1935	393,967	35	2	11.74
1936	567,891	33	2	7.70
1937	765,701	58	1	9.65
1938	491,303	46	3	12.49
1939	564,542	44	1	9.96
1940	714,391	59	5	11.19
1941	918,300	79	5	11.43
1942	1,024,713	75	2	9.39
1943	1,077,402 $\frac{1}{4}$	171	4	20.30
1944	993,272 $\frac{1}{2}$	121	3	15.61
1945	915,665 $\frac{3}{4}$	107	1	14.74
1946	747,079	101	0	16.89
1947	1,071,219	149	7	18.20
1948	1,160,896 $\frac{1}{4}$	145	3	15.94

* Based On 1-Million Man-Hours Of Labor

TABLE VIII-A

SEVERITY RATES
ALL COMPENSABLE INJURIES

<u>Year</u>	<u>Non-Fatal Days Lost</u>	<u>Rate</u>	<u>Fatal Days Lost</u>	<u>Days Lost All Injuries</u>	<u>Rate *</u>
1935	3,225	1.023	12,000	15,225	4.830
1936	3,509	.772	12,000	15,509	3.413
1937	7,881	1.286	6,000	13,881	2.266
1938	6,290	1.600	18,000	24,290	6.181
1939	3,264	.723	6,000	9,264	2.051
1940	3,442	.602	30,000	33,442	5.852
1941	5,403	.735	30,000	35,403	4.819
1942	5,851	.500	12,000	17,851	2.177
1943	10,355	1.201	24,000	34,355	3.986
1944	7,759	.976	18,000	25,759	3.242
1945	7,624	1.041	6,000	13,624	1.860
1946	7,994	1.337	0	7,994	1.337
1947	9,946	1.161	42,000	51,946	6.062
1948	14,526	1.564	18,000	32,526	3.502

* Based On Days Lost By Injuries Per 1,000 Man-Hours Of Labor

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYb. Non-Fatal Accidents (Continued)

TABLE IX

COMPARISON OF COMPENSABLE ACCIDENTS, INCLUDING FATALITIES
BY MINES

<u>Mine Or Plant</u>	<u>Frequency</u>		<u>Severity</u>	
	<u>1947</u>	<u>1948</u>	<u>1947</u>	<u>1948</u>
Agnew	19.09	37.05	.458	21.978
Athens	32.65	16.07	1.429	.784
Atkins	14.83	--	.682	--
Cambria-Jackson	26.83	31.49	12.727	12.806
Canisteco	2.72	13.26	2.043	.482
C.P.& L. Co.	--	--	--	--
Cliffs Shaft	15.48	14.13	21.101	1.010
General Roll	--	--	--	--
Hawkins	11.99	10.48	.176	.887
Hill-Trumbull	2.36	13.76	.028	.636
Holman Cliffs	9.46	9.24	.305	.276
Lloyd	27.76	18.55	1.101	11.847
Maas	24.65	17.74	14.625	.630
Mather "A"	26.84	27.29	7.295	5.626
Mather "B"	11.77	13.82	.176	27.903
Miscellaneous	7.82	--	.250	--
Negaunee	20.90	14.14	1.012	.927
Sargent	14.95	27.85	1.525	1.803
Spies-Virgil	11.32	7.14	.744	.614
Sthse. & Shops	5.90	2.62	.109	.819
Tilden	--	23.98	--	2.877
ALL PROPERTIES	17.39	15.94	6.062	3.502

TABLE X

COMPENSABLE INJURIES INCLUDING FATALITIES

<u>Mine Or Plant</u>	<u>Tons Of Ore Mined</u>	<u>Hours Of Labor</u>	<u>No. Of Comp. Injuries</u>	<u>No. Of Fatalities</u>	<u>Days Lost Comp.</u>	<u>Time Charges</u>	<u>Total Days Lost</u>	<u>Frequency</u>	<u>Severity</u>	<u>Av. Days Lost Per Accident</u>
AGNEW	327,136	215,886 $\frac{1}{2}$	8		245	4,500	4,745	37.05	21.978	593.1
ATHENS	506,600	808,851 $\frac{1}{2}$	13		633		633	16.07	.784	48.7
CAMBRIA-JACKSON	491,817	508,094 $\frac{1}{2}$	15	1	507	6,000	6,507	31.49	12.806	406.7
CLIFFS SHAFT	602,453	1,061,617 $\frac{1}{2}$	15		1,072		1,072	14.13	1.010	71.5
LLOYD	98,284	269,499	5		193	3,000	3,193	18.55	11.847	638.6
MAAS	673,126	901,618	16		568		568	17.74	.630	35.5
MATHER "A"	1,001,001	1,319,265 $\frac{1}{2}$	35	1	896	6,525	7,421	27.29	5.626	206.1
MATHER "B"		217,068 $\frac{1}{2}$	2	1	55	6,000	6,055	13.82	27.903	2018.3
NEGAUNEE	382,076	495,168 $\frac{3}{4}$	7		459		459	14.14	.927	65.6
SARGENT	370,256	251,299	7		153	300	453	27.85	1.803	64.7
SPIES-VIRGIL	197,256	280,330 $\frac{1}{2}$	2		172		172	7.14	.614	86.0
TOTALS	4,651,805	6,328,698	125	3	4,953	26,325	31,278	20.22	4.942	244.3
ATKINS	483,705	106,057						0.00	0.000	0.0
CANISTEO	908,833	377,030	5		182		182	13.26	.482	37.3
HAWKINS	660,037	286,157	3		254		254	10.48	.887	84.6
HILL-TRUMBULL	768,394	363,384	5		231		231	13.76	.636	46.2
HOLMAN CLIFFS	993,805	540,990	5		74	75	149	9.24	.276	29.8
TILDEN	140,692	41,693 $\frac{3}{4}$	1		120		120	23.98	2.877	120.0
TOTALS	3,955,466	1,715,311 $\frac{3}{4}$	19	-	861	75	936	11.08	.545	49.3
MISCELLANEOUS		148,686 $\frac{1}{2}$						0.00	0.000	0.0
STHSE. & SHOPS		381,095 $\frac{1}{2}$	1		312		312	2.62	.819	312.0
C.P. & L. CO.		145,019						0.00	0.000	0.0
GENERAL ROLL		502,092 est.						0.00	0.000	0.0
MISC. OPEN-PIT		66,268						0.00	0.000	0.0
TOTALS		1,243,161	1	-	312	-	312	.80	.251	312.0
GRAND TOTALS	8,607,271	9,287,170 $\frac{3}{4}$	145	3	6,126	26,400	32,526	15.94	3.502	219.8

Underground

Open-Pit

Indep. Unit

Safety Department
Annual Report
Year 1948

TABLE XI

ACCIDENT STATISTICS FOR 1948

MINE OR PLANT	Tons Of Ore Mined	Hours Of Labor	No. Of Comp. Injuries	No. Of Fatalities	Days Lost, Compensable	Time Charges	Total Days, Lost - Compensable	Non-Compensable 1 - 7 Days	Days Lost, Non-Compensable	Total - All Injuries And Fatalities	Total Days Lost - All Injuries And Fatalities	Frequency	Severity	Average Days Lost Per Accident
Agnew	327136	215886½	8		245	4500	4745	13	25	21	4770	97.26	22.093	227.1
Athens	506600	808851½	13		633		633	32	73	45	706	55.63	0.873	15.7
Cambria-Jackson	491817	508094½	15	1	507	6000	6507	14	37	30	6544	59.04	12.879	210.8
Cliffs Shaft	602453	1061617½	15		1072		1072	18	26	33	1098	31.09	1.034	33.3
Lloyd	98284	269499	5		193	3000	3193	7	20	12	3213	44.53	11.922	267.7
Maas	673126	901618	16		568		568	37	87	53	655	58.78	0.726	12.3
Mather "A"	1001001	1319265½	35	1	896	6525	7421	65	163	101	7584	76.57	5.749	75.1
Mather "B"		217068½	2	1	55	6000	6055	8	27	11	6082	50.69	28.030	553.0
Negaunee	382076	495168½	7		459		459	15	31	22	490	44.42	0.917	22.4
Sargent	370256	251299	7		153	300	453	19	43	26	496	103.46	1.974	19.0
Spies-Virgil	197256	280330½	2		172		172	4	8	6	180	21.43	0.643	30.0
TOTALS	4651805	6328698	125	3	4953	26325	31278	232	540	360	31818	56.88	5.027	88.7
Atkins	483705	106057										0.00	0.000	
Canisteeo	908833	377030	5		182		182	7	16	12	198	31.83	0.525	16.5
Hawkins	660037	286157	3		254		254	4	5	7	259	24.47	0.906	37.0
Hill-Trumbull	768394	363384	5		231		231	10	29	15	260	41.28	0.715	17.3
Holman Cliffs	993805	540990	5		74	75	149	12	28	17	177	31.42	0.327	10.4
Tilden	140692	41693½	1		120		120	1	4	2	124	47.96	2.973	62.0
TOTALS	3955466	1715311½	19		861	75	936	34	82	53	1018	30.90	0.594	19.2
Miscellaneous		148686½						1	2	1	2	6.73	0.013	2.0
Sthse. & Shops		381095½	1		312		312	3	10	4	322	10.49	0.847	80.5
C.P.& L. Co.		145019										0.00	0.000	
General Roll		502092 est.										0.00	0.000	
Misc. O.P. Mines		66268										0.00	0.000	
TOTALS		1243161	1		312		312	4	12	5	324	4.02	0.261	64.8
GRAND TOTALS	8607271	9287170½	145	3	6126	26400	32526	270	634	418	33160	45.01	3.571	79.3

Frequency Rate = No. Of Injuries X $\frac{1,000,000}{\text{Man Hours Of Exposure}}$

Severity Rate = Total Time Charges In Days X $\frac{1,000}{\text{Man-Hours Of Exposure}}$

UNDERGROUND

OPEN PIT

UNIT

485

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYb. Non-Fatal Accidents (Continued)

TABLE XII

COMPARISON OF FREQUENCY - SEVERITY RATINGS
TAKEN FROM AVAILABLE STATISTICS, N.S.C.

	<u>Frequency</u>	<u>Severity</u>
1947 National Rating, All Mining (Except Coal)	50.54	6.17
1947 " " , Underground Metal Mining	67.66	7.90
1947 " " , Open-Cut Metal Mining	10.81	1.23
1947 Lake Superior District, All Mines	22.10	4.39
1948 The Cleveland-Cliffs Iron Co., Compensable Accidents	15.94	3.502
1948 " " " " " , All Accidents	45.01	3.571
1948 " " " " " , Open-Cut Mining	24.87	.549
1948 " " " " " , Concentrating Plants	80.22	.952
1948 " " " " " , Top Slicing	62.47	2.662
1948 " " " " " , Stoping	31.66	2.787
1948 " " " " " , Sub-Level Caving	59.04	12.879
1948 " " " " " , Low-Head Block Caving	76.57	5.749
1948 " " " " " , General Shops	10.49	.847
1948 " " " " " , General Roll	0.00	0.000
1948 " " " " " , Miscellaneous	6.73	.013
1948 " " " " " , C.P.& L. Co.	0.00	0.000

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

b. Non-Fatal Accidents (Continued)

TABLE XII (Cont'd.)

Our frequency rating compared to the Lake Superior District Mines is high but this is due more to methods used by some companies in classifying lost-time injuries. A lost-time injury according to the American Standards Association, the U.S. Bureau Of Mines and the National Safety Council is when the injured cannot report for duty the day following the injury. We use this method, but some companies are a little lax in doing so. Our severity rating is better than that for all reporting companies who are members of the Lake Superior Mines Safety Council and considerably better than the National Ratings for all mining except coal, underground metal mining and open-cut metal mining.

One of the main reasons for a high frequency at some mines is the kind of employee which had to be hired. At one mine in particular, young men just out of the armed services with no industrial work experience, trained by the armed services to be reckless, have been hired. The supervisors of this mine have had a difficult time trying to train these men to work safely and effeciently. They must be given credit for a tough job well done.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

b. Non-Fatal Accidents (Continued)

TABLE XIII

SHOWING TIME PERIODS WHEN
COMPENSABLE INJURIES OCCURRED

<u>TIME</u>	<u>NUMBER</u>	<u>WORKING PERIOD</u>
8:00 A.M. TO 12:00 NOON	38	FIRST HALF OF DAY SHIFT
12:00 NOON TO 4:00 P.M.	44	SECOND HALF OF DAY SHIFT
4:00 P.M. TO 8:00 P.M.	26	FIRST HALF OF AFTERNOON SHIFT
8:00 P.M. TO 12:00 M.N.	18	SECOND HALF OF AFTERNOON SHIFT
12:00 M.N. TO 4:00 A.M.	9	FIRST HALF OF NIGHT SHIFT
4:00 A.M. TO 8:00 A.M.	2	SECOND HALF OF NIGHT SHIFT
NO TIME STATED	11	
TOTALS	148	

TABLE XIV
PERCENTAGES OF COMPENSABLE INJURIES OF THE VARIOUS AGE GROUPS
MESABA RANGE PROPERTIES, 1948

<u>AGE GROUPS</u>	<u>No. Of Comp. Injuries</u>	<u>Percentage Of Employees</u>	<u>Percentage Of Injuries</u>	<u>Percentage Of Time Lost</u>	<u>Frequency Rating</u>	<u>Severity Rating</u>
18 to 19 yrs., incl.	1	2.86	3.03	.42	1	2
20 to 24 yrs., "	3	16.52	9.09	.80	3	3
25 to 29 yrs., "	1	12.10	3.03	1.51	1	5
30 to 34 yrs., "	3	13.41	9.09	1.56	3	6
35 to 39 yrs., "	3	11.45	9.10	75.62	3	10
40 to 44 yrs., "	5	11.12	15.15	2.26	4	7
45 to 49 yrs., "	2	7.20	6.06	.93	2	4
50 to 54 yrs., "	1	8.09	3.03	.18	1	1
55 to 59 yrs., "	6	9.16	18.18	10.63	5	9
60 to 70 yrs., "	8	8.09	24.24	6.09	6	8
	<u>33</u>	<u>100%</u>	<u>100%</u>	<u>100%</u>		

b. Non-Fatal Accidents (Continued)

Safety Department
Annual Report
Year 1948

b. Non-Fatal Accidents (Continued)

Safety Department
Annual Report
Year 1948

TABLE XV

PERCENTAGES OF COMPENSABLE INJURIES INCLUDING FATALITIES OF THE VARIOUS AGE GROUPS
UNDERGROUND PROPERTIES - MARQUETTE AND MENOMINEE RANGES - 1948

<u>Age Groups</u>	<u>Percentage Of Employees</u>	<u>Percentage Of Injuries</u>	<u>Percentage Of Time Lost</u>	<u>Position Frequency Rating</u>	<u>Position Severity Rating</u>
18 to 19 yrs., incl.	1.82 %	1.80 %	.08 %	1	1
20 to 24 yrs., "	9.51 %	7.21 %	26.41 %	4	10
25 to 29 yrs., "	11.95 %	9.92 %	24.66 %	5	8
30 to 34 yrs., "	14.40 %	18.01 %	26.18 %	10	9
35 to 39 yrs., "	15.02 %	10.81 %	2.23 %	6	5
40 to 44 yrs., "	12.34 %	13.51 %	1.92 %	8	4
45 to 49 yrs., "	10.00 %	5.41 %	1.13 %	3	3
50 to 54 yrs., "	7.57 %	17.12 %	3.95 %	9	6
55 to 59 yrs., "	8.15 %	12.61 %	13.08 %	7	7
60 to 70 yrs., "	9.24 %	3.60 %	.36 %	2	2
	<u>100 %</u>	<u>100 %</u>	<u>100 %</u>		

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYb. Non-Fatal Accidents (Continued)

TABLE XV-A

<u>Age Group</u>	<u>COMPENSABLE INJURIES INCLUDING FATALITIES</u> <u>PERCENTAGES OF INJURIES AND TIME CHARGES IN THE VARIOUS AGE GROUPS</u> <u>ALL PROPERTIES</u>		
	<u>Percentage</u> <u>Of</u> <u>Employees</u>	<u>Percentage</u> <u>Of</u> <u>Injuries</u>	<u>Percentage</u> <u>Of</u> <u>Time Lost</u>
18 to 19 yrs., incl.	2.04	2.04	0.15
20 to 24 " "	11.40	7.48	21.29
25 to 29 " "	11.52	8.16	20.00
30 to 34 " "	13.80	15.65	21.25
35 to 39 " "	13.64	10.20	15.85
40 to 44 " "	11.78	14.29	2.33
45 to 49 " "	9.41	5.44	1.08
50 to 54 " "	7.92	14.29	4.16
55 to 59 " "	8.62	13.60	12.45
60 to 70 " "	9.87	8.85	1.44
	<hr/> 100 %	<hr/> 100 %	<hr/> 100 %

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYb. Non-Fatal Accidents (Continued)

TABLE XV-B

PERCENTAGES OF EMPLOYEES IN VARIOUS AGE GROUPS

<u>Mine Or Plant</u>	<u>Years (Inclusive)</u>									
	<u>18-19</u>	<u>20-24</u>	<u>25-29</u>	<u>30-34</u>	<u>35-39</u>	<u>40-44</u>	<u>45-49</u>	<u>50-54</u>	<u>55-59</u>	<u>60-70</u>
AGNEW	4.20	20.17	10.92	1.68	10.08	9.24	8.41	10.93	12.61	11.76
ATHENS	.87	8.38	14.16	11.27	15.03	13.01	10.69	9.83	7.51	9.25
ATKINS	2.90	24.63	15.94	21.74	11.59	4.35	4.35	4.35	4.35	5.80
CAMBRIA-JACKSON	.88	8.89	7.56	16.89	18.22	15.56	8.89	6.22	8.89	8.00
CANISTEO	2.30	20.74	8.29	13.83	15.21	12.44	5.07	8.76	6.91	6.45
C.P.& L. CO.	—	1.89	3.77	9.43	18.87	20.75	9.43	15.10	5.66	15.10
CLIFFS SHAFT	1.51	7.74	12.04	13.12	16.56	12.91	8.60	7.74	7.74	12.04
GENERAL ROLL	1.07	9.14	10.75	12.37	12.37	9.68	9.14	5.38	10.75	19.35
HAWKINS	1.89	15.72	15.09	18.24	6.29	6.92	6.92	11.32	9.43	8.18
HILL-TRUMBULL	—	5.26	14.74	9.47	8.42	15.79	11.58	11.58	7.37	15.79
HOLMAN CLIFFS	3.75	17.50	12.75	14.00	13.25	13.50	7.25	5.00	8.00	5.00
LLOYD	3.85	6.92	6.15	8.46	7.69	16.92	10.77	13.08	13.85	12.31
MAAS	.78	4.13	10.85	15.50	13.18	11.63	10.34	9.30	11.89	12.40
MATHER "A"	4.00	16.80	15.36	18.24	14.72	9.92	8.96	4.32	5.12	2.56
MATHER "B"	2.06	14.44	20.62	14.43	15.47	11.34	11.34	4.12	4.12	2.06
MISCELLANEOUS	2.33	13.95	9.30	10.47	8.14	4.65	19.77	8.14	9.30	13.95
NEGAUNEE	—	2.48	4.95	11.88	16.34	14.36	13.86	8.41	8.41	19.31
O.P. MISCELLANEOUS	4.44	15.56	8.89	22.22	11.11	15.56	13.34	2.22	4.44	2.22
SARGENT	2.52	7.56	10.92	10.92	9.24	6.72	5.88	11.76	19.34	15.12
SPIES-VIRGIL	—	10.68	9.71	12.62	15.53	8.74	11.65	9.71	10.68	10.68
STHSE. & SHOPS	1.31	7.23	6.58	11.84	10.53	9.21	10.53	12.50	10.53	19.74
TILDEN	—	12.00	—	4.00	16.00	24.00	16.00	12.00	8.00	8.00
MESABA PROPERTIES	2.86	16.52	12.10	13.41	11.45	11.12	7.20	8.09	9.16	8.09
MARQ. & MEN. RANGES	1.72	9.38	11.29	13.95	14.51	12.04	10.28	7.85	8.40	10.58
ALL PROPERTIES	2.04	11.40	11.52	13.80	13.64	11.78	9.41	7.92	8.62	9.87

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYc. Safety Inspection

Safety inspections are made continuously by members of the Safety Department and reports, recommendations and suggestions are made to the superintendents and other supervisors. Certain foremen are also appointed to make inspections, such as hoisting ropes, skip and cage roads, safety catches on cages and many others which are listed separately in this report.

With but very few exceptions cooperation of supervisors has been very good but we still need more of their help to put across our safety program. As can be noted under Table XVII there are still many violations of rules. These figures show only those reported by the Safety Inspector in the Michigan mines and do not include those the Ventilation Engineer and myself have found, nor do they include our recommendations or suggestions.

The company policy for safety inspections is to allow the supervisor to make corrections first when in company of members of the Safety Department. If he fails to do this he is verbally notified and the inspector makes a report.

Members of the department inspected all active properties including the Cliffs Power & Light Company plants. All second outlets were also inspected and considerable repair work was done to keep these outlets in good condition for travel. With the exception of the Athens Mine, all underground mines now have one or more outlets besides the hoisting shaft. The Athens Mine would require approximately 700 feet of raising from the 4th Level to the 1000 foot level to acquire a second outlet. It is my recommendation that a second outlet for the Athens Mine be made.

Idle Properties

Inspection of idle properties is made twice a year, usually in early spring and during the fall when there are no leaves on the trees and inspection is easy to make. Repairs to fences and old shafts and test pits are made by a crew under the supervision of Mr. Julien Payen.

Fire Patrol Inspections

Fire patrol inspections are made after the last shift preceding an idle period and once every 24 hours thereafter until the mine resumes normal operation. These inspections are made either by the shift bosses or some other person appointed by the mining captain or superintendent. The surface inspections are made by policemen or watchmen. The purpose is to check for incipient fires and see that all power switches are open. These inspections have been of real value and will be continued in the future.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYc. Safety Inspection (Continued)TABLE XVII
1948

<u>Mine Or Plant</u>	<u>Violations Of Standards</u>	<u>Safety Suggestions</u>	<u>Recommendations</u>	<u>Fire Hazard</u>	<u>TOTAL</u>
ATHENS	52	26	8	1	87
CAMBRIA-JACKSON	3	2	4		9
CLIFFS SHAFT	15	31	5		51
DIAMOND DRILLS	1	2	1		4
LLOYD	2	9	2		13
MAAS	9	9	2		20
MATHER "A"	12	18	7	2	39
MATHER "B"	1	2	2		5
NEGAUNEE		1	1		2
NEGAUNEE DISPENSARY			3	1	4
RESEARCH LABORATORY		2	5	1	8
SPIES-VIRGIL	1	1	2	1	5
STHSE. & SHOPS	1		1	3	5
	<u>97</u>	<u>103</u>	<u>43</u>	<u>9</u>	<u>252</u>

TABLE XVIII
1947

<u>Mine Or Plant</u>	<u>Violations Of Standards</u>	<u>Safety Suggestions</u>	<u>Recommendations</u>	<u>Fire Hazard</u>	<u>TOTAL</u>
ATHENS	58	31	4	1	94
CAMBRIA-JACKSON	13	18	2		33
CLIFFS SHAFT	10	30	1	1	42
DIAMOND DRILLS		1			1
ISHPEMING HOSPITAL	3	2	1	5	11
LLOYD	1	10	2	1	14
MAAS	27	29	3	3	62
MATHER "A"	6	20	4	2	32
MATHER "B"	1	2		1	4
MATHER INN				20	20
NEGAUNEE	4	15		1	20
PRINCETON					0
SPIES-VIRGIL	2	3			5
STHSE. & SHOPS		3			3
TILDEN				1	1
	<u>125</u>	<u>164</u>	<u>17</u>	<u>36</u>	<u>342</u>

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

c. Safety Inspection (Continued)

Blasting Inspections

Our safety rules require that shift bosses inspect and report the blasting procedures used by each mining contract of the mines at least six times a year. During 1948, 1,230 such inspections were made and 188 minor violations reported. This is an excellent rule and continually keeps the miners on the alert. We have had no injuries from blasting accidents for a number of years and we believe they can and should be eliminated completely. Considerably more blasting is now done with electricity than in past years. This is a safer method but also requires more training for the men in charge. The use of primacord has increased and this also is safer than fuse blasting but requires education of the men. During 1948 we have experienced very little trouble with blasting supplies such as hot-wire fuse lighters and detonators.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

c. Safety Inspection (Continued)

TABLE XIX

NUMBER OF INSPECTIONS MADE DURING THE BLASTING
PROCEDURE IN VARIOUS MINING CONTRACTS

<u>Mine</u>	<u>No. Of Inspections</u>	<u>No. Of Violations Reported</u>
Athens	1	1
Cambria-Jackson	157	77
Cliffs Shaft	397	3
Lloyd	11	5
Maas	246	61
Mather "A"	295	8
Negaunee	88	33
Spies-Virgil	35	0
TOTALS	1,230	188

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

c. Safety Inspection (Continued)

Rules And Regulations

During the year a total of 82 surface rule books and 339 underground rule books were distributed at Michigan properties to new employees and to replace lost and worn-out books of old employees.

The Mesaba Range mines have used a different method of distributing rules. Instead of a rule book, rules are printed on cardboard and posted in shops, trucks, tractors, washing plants, etc. In this way, rules can be changed at any time to care for the continually changing conditions due to new types of equipment, without much expense. The underground mines are now using most of the Michigan Mines rules and in time will probably adopt all of our rules if mining conditions permit.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

c. Safety Inspection (Continued)

TABLE XX

RULE BOOKS DISTRIBUTED AT MICHIGAN MINES AND PLANTS

<u>Mine Or Plant</u>	<u>Surface</u>	<u>Underground</u>	<u>Total</u>
Athens	0	30	30
Cambria-Jackson	0	11	11
C.P.& L. Co.	4	0	4
Cliffs Shaft	0	50	50
Diamond Drills	2	0	2
Gen. Stmse. & Shops	26	0	26
Lloyd	4	26	30
Maas	3	36	39
Mather "A" Shaft	16	168	184
Mather "B" Shaft	16	8	24
Negaunee	2	0	2
Spies-Virgil	1	10	11
Tilden	8	0	8
TOTALS	82	339	421

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYc. Safety Inspection (Continued)Inspection Reports By Mine And Plant Foremen

There are twelve different inspections made by foremen at the mines. These include:

- Hoisting Ropes (daily)
- Skip And Cage Roads (twice a week)
- Safety Catches On Cages (monthly)
- Ladder Roads (weekly)
- Slack Rope Alarm (monthly)
- Hoisting Engines (monthly)
- Fire Extinguishers (twice a year)
- Fire Equipment (four times a year)
- Fire Prevention (once a year)
- Blasting Inspections
 - Old Stope Inspections (Cliffs Shaft Mine)
- Fire Patrol Inspections (underground)

These inspection reports are sent to the mine superintendent and the Safety Department for checking.

c. Safety Inspection

(Continued)

Following are tables showing the kind and number of safety inspection reports made by the mine and plant foremen, which were received and checked by this department.

TABLE XXI

<u>Type Of Inspection</u>	<u>Ag- new</u>	<u>Ath ens</u>	<u>Camb. Jack.</u>	<u>Cliffs Shaft</u>	<u>Lloyd</u>	<u>Maas</u>	<u>Math- er"A"</u>	<u>Math- er"B"</u>	<u>Nega- nee</u>	<u>Sar- gent</u>	<u>Spies- Virgil</u>	<u>TOTAL</u>
Hoisting Ropes	167	303	299	307	536	292	301	15	297	150	284	2,951
Skip & Cage Roads	52	104	138	80	68	47	50		53		61	653
Ladder Road	52	53	11	68	18	38	50		49	52	51	442
Cage Safety Catches	12	14	8	24	22	12	11	3	12		14	132
Slack Rope Alarm		11	7	13	6	10	13		12		14	86
Hoist Inspection	27	24	16	24	24	24	24	12	24	27	24	250
Fire Extinguishers	2	2	2	2	2	2	2	2	2	2	2	22
Fire Equipment	2	3	3		2	3	3	1	4	2		23
Fire Prevention	2	17	11	14	6	19	5	4	23	6	11	118
TOTALS	316	531	495	532	684	447	459	37	476	239	461	4,677

<u>Mine Or Plant</u>	<u>Fire Extinguishers</u>	<u>Fire Prevention</u>	<u>Fire Equipment</u>	<u>TOTAL</u>
Atkins	2	3	2	7
Canisteco	2	8	2	12
C.P.& L. Co.	2	7		9
General Office (Ishpeming)	3			3
Hawkins	2	29	2	33
Hibbing Office	2	2		4
Hill-Trumbull	2	16	2	20
Holman Cliffs	2	17	2	21
Ishpeming Hospital	2	2		4
Negaunee Dispensary	2	2		4
Princeton		2		2
Rented Buildings	2			2
Sthse. & Shops	2	13		15
Tilden	1	14		15
TOTALS	26	115	10	151

11. ACCIDENTS
AND
PERSONAL
INJURY

Safety Department
Annual Report
Year 1948

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYc. Safety Inspection (Continued)

TABLE XXII

NUMBER OF FIRE EXTINGUISHERS INSPECTED

Mine Or Plant	2½Gal.	2½Gal.	2½	1 Gal.	15-30	150	2-3 Gal.	TOTAL
	Soda Acid	Non- Freezing	Gal. Foam	1-1½ Car-Tet. Chloride	Dry Powder Type	Dry Powder Type			Car-Tet. Chloride
AGNEW	2			5	4		3	14
ATHENS	10			36	10		4	60
ATKINS				15	9	2		26
CAMBRIA-JACKSON	22			28	16			66
CANISTEO	12		2	36	37			87
C.P.& L. CO.			5	22	18	2	16	63
CLIFFS SHAFT	28	2	6	73	6		4	119
GEN. OFFICE (ISHPEMING)	12			24				36
HAWKINS	18			24	16		9	67
HIBBING OFFICE	7						2	9
HILL-TRUMBULL				28	64		2	94
HOLMAN CLIFFS				63	47			110
ISHPEMING HOSPITAL	17			21				38
LLOYD	18	4	2	52	6		8	90
MAAS	14			56	10		10	90
MATHER "A"	8			70	38			116
MATHER "B"	10			30	10			50
NEGAUNEE	13			31	12		10	66
NEGAUNEE DISPENSARY	6			10				16
RENTED BUILDINGS	2			31				33
SARGENT	9			6	3		3	21
SPIES-VIRGIL		6		40	22		8	76
STHSE. & SHOPS	47	4		66			3	120
TILDEN	8			74	6		4	92
TOTALS	263	16	15	841	334	4	86	1,559

All Carbon Tetra-chloride Type Fire Extinguishers Are Tested and Inspected Twice annually.

Soda Acid Type, Discharged and Recharged Once Annually.

All Other Types Inspected Once Annually.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYc. Safety Inspection (Continued)Disciplinary Action

The report in Table Number XXIII covers only the Michigan properties. Action was taken in 146 cases but does not include 146 men as a number of men were disciplined a number of times. It can be noted that excessive absenteeism accounted for 71 cases out of the total. This is not unusual in an organization of our size. There were 19 cases of disciplinary action taken due to men reporting to work under the influence of alcohol and 14 due to excessive absenteeism due to alcoholism. Investigation of these cases shows that a majority of these men are very good workers on the job but that they play as hard as they work and cause supervisors considerable trouble to make replacements.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYc. Safety Inspection (Continued)

TABLE XXIII

<u>Cause</u>	<u>CAUSES AND NUMBER OF DISCIPLINARY ACTION</u>									<u>Total</u>
	<u>Athens</u>	<u>Cambria-Jackson</u>	<u>Cliffs Shaft</u>	<u>Gen. Sthse.</u>	<u>Lloyd</u>	<u>Maas</u>	<u>Mather "A"</u>	<u>Negaunee</u>	<u>Spies-Virgil</u>	
Excessive absenteeism due to alcoholism			2		2	2	6	1	1	14
Reporting to work in under the influence of liquor			2				15		2	19
Excessive absenteeism without reason	19	6	7			13	23		3	71
Fighting underground						2				2
Being abusive to supervisor			1							1
Violation of rules		1	3				7			11
Leaving job without authority	1	2		1			1		1	6
Negligence in performing duties							1			1
Sleeping on the job						1	6			7
Carelessness in burning company records				1						1
Violation of "No Smoking" rules			2				3			5
Carelessness		1				1	1			3
Not obeying orders		2					2			4
Laying down on the job			1							1
TOTALS	20	12	18	2	2	19	65	1	7	146

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

c. Safety Inspection (Continued)

Central Safety Committee

This committee, which is made up of superintendents and heads of departments, met once each month during the year. All accidents are classified as to causes and responsibility and steps taken to prevent other accidents from the same cause and also there are discussions on prevention of accidents from new equipment and methods.

A brief summary of subjects handled by the committee follows:

Rubber Bottoms For Cars

The Mather "A" Mine were experimenting with rubber bottoms for underground haulage cars. The purpose is to rid the car of any sticky ore in the bottom.

Mather "B" Mine, Communications

The subject of reliable methods of communicating between the bottom of the shaft and surface was discussed and suggestions were the use of either a mine-rescue telephone, an automobile horn or a system of light signals.

Standard Telephone Bell Signals At All Mines

A committee was appointed to make up this standard code and it is now in use at all mines.

Accident Statistics

The committee members were presented with a paper on frequency and severity rates for all properties and the percentages of compensable injuries including fatalities of the various age groups.

Metatarsal Guards and Hard-Toed Gold Seals

The need for protection of the instep and toes was referred to the purchasing agent, who was to contact the manufacturers. The metatarsal guards were later tried out and proved too cumbersome in damp iron ore. Gold Seals with fiber toe caps are not available on the market today.

Ventilation Doors

A near serious accident which happened at one of the mines prompted the building of an improved catch to hold the doors open in case of the cables being broken.

Cage Hoist Drum Chipped From Strain

The committee was told of a near disaster when a hoist drum had chipped on the inside of the drum where the hoisting cable came through and is attached to the shaft. It was recommended that this part of the drum be included as a part of the rope inspection to prevent a reoccurrence.

(Continued)

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

c. Safety Inspection (Continued)

Central Safety Committee (Cont'd.)

Guards For Operators Of Scraper Hoists At Cliffs Shaft Mine

Metal mesh-screen guards are to be placed in front of all scraper hoists at the Cliffs Shaft Mine

Glasaire Ventilation Tubing

This type of ventilation tubing was tried out on two different occasions and failed within two weeks time.

Treatment Of Manila Rope

Suggested that all manila rope to be used underground be treated to resist moisture and fungi.

Ventilation Problems

Elimination of air recirculation and use of water curtains and water blasts and wet drilling were recommended for all mines. For raise ventilation: High pressure fan, a standard steel pipe of either 6 or 8 inch diameter, preferably the latter, carried to within 6 feet of the breast of the raise.

Grounding Of Electric Hand Tools

The grounding of electric hand tools was discussed and recommended. Statistics revealing 9 fatalities that have occurred in California in one year as a result of electric hand tools that were not grounded brought on this discussion. Nearly all electric hand tools are equipped with a ground wire.

Trolley-Wire Guards

A new type trolley-wire guard of flexible rubber was demonstrated to the committee. This type of guard to be used in front of loading chutes underground.

Rubber Gloves

Because of a number of contact dermatitis cases which were believed due to use of a chemical in the rubber gloves now stocked, purchase of pure rubber gloves was recommended and they are now available in stock.

Care Of Cables For Electric Shovels

Discussion showed the hazards in the handling of electric trailing cables for power shovels. Recommended that the proper carrying tongs be used in handling cable. Trucks and other vehicles should not be permitted to drive over cables without proper protection. Cables should be carried on a reel or cable boat when being dragged behind power shovels.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Central Safety Committee (Cont'd.)

Care Of Cables For Electric Shovels (Cont'd.)

Surface foremen and shovel engineers are to be given proper instruction regarding care of cables by the electrical engineer.

Carbon Monoxide Alarms On Compressor Lines

To prevent damage to compressors and receivers and possibility of pumping carbon-monoxide into the underground compressed-air lines, it was recommended that carbon-monoxide alarms be installed. This device gives an alarm by ringing a bell and turning on a red light should the carbon-monoxide content reach .02%.

Introduction Of Glycol Into Ventilation System

This suggestion was discussed and a committee appointed to investigate. It was found that the high moisture content of air in the mines prevented its use.

Underground Fire Doors

It was suggested and recommended that concrete frames and steel doors be set up on all levels in all mines so as to be able to isolate the entire shaft in case of fire.

Fog Nozzles

It was recommended that all mines be equipped with at least two fog nozzles to combat fires.

Carbon-Tetrachloride

Hazards of carbon-tetrachloride were discussed and it was recommended that no person be permitted to use carbon-tetrachloride in any confined place without proper ventilation or respiratory protection. Persons should have respiratory protection when paint spraying.

Fumes From Arc Welding

It was recommended that all arc welders be given proper ventilation while arc welding. Certain rods used in arc welding give off toxic fumes.

Guaging Shaft Runners

Two or three weeks notice requested by mine superintendents before schedule is drawn up for shaft guaging.

Water Lines And Pressure Testing

It was recommended that 2 inch lines be maintained on every level underground and the same tested for water pressure and kept high enough to combat underground mine fires.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

c. Safety Inspection (Continued)

Central Safety Committee (Cont'd.)

Use Of Acetylene Torches Underground

It was recommended that the following procedure be followed:

- 1. - Check and be sure water has been piped into the area or is close enough to be available for fire fighting.
- 2. - Check water pressure and be sure that it is adequate for fire fighting purposes.
- 3. - After cutting has been completed wet down entire area as well as debris and blocking in the back.
- 4. - Set man to watch place for the remainder of the shift. He, in turn, to notify the oncoming shift.

Purchase Of Fire-Fighting Hose

It was recommended that superintendents and heads of departments order fire-fighting hose through the Purchasing Department which has a sample coupling which is sent with order to insure proper fit and proper thread.

Mill Raise Injuries

Mather "A" Mine is experimenting with new type of grizzly with guards for the protection of employees. This experiment will be used at a number of new grizzly subs in the block caving area at the Mather Mine.

Plasticaire Ventilation Tubing

Samples of Plasticaire ventilation tubing were examined during one of the meetings. This type of tubing was poor in comparison to regular ventilation tubing after a trial in one of the mines.

Bell Signals

Discussion of slip-shod methods of bell ringing at the various properties reported. Superintendents to check and see to it that the signals are rung clearly.

Chemical Toilets

Again chemical toilets were recommended for trial at underground properties. This type of toilet has been in use in two mines on the Menominee Range for a considerable time and have been proved satisfactory.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYc. Safety Inspection (Continued)Lake Superior Mines Safety Council

The council is becoming more important to the mining companies of the Lake Superior District as time goes on. Attendance at sectional meetings has increased each year until it has reached 155 persons at the Virginia, Minnesota meeting. The annual meeting at Duluth, Minnesota attracted over 600 mining men. Programs for the sectional meetings on the various mining ranges are handled by the local safety personnel and the annual meeting by committees for the district.

Meetings held during the year and the attendance are as follows:

January 22, 1948, Iron River, Michigan -	Attendance -	108
February 19, 1948, Hibbing, Minnesota -	" "	100
March 25, 1948, Ironton, Minnesota -	" "	53
April 8, 1948, Ironwood, Michigan -	" "	119
May 20, 1948, Duluth, Minnesota -	" "	18
June 20 - 21, 1948, Duluth, Minnesota -	" "	631
September 9, 1948, Duluth, Minnesota -	" "	30
November 9, 1948, Ely, Minnesota -	" "	57
December 8, 1948, Ishpeming, Michigan -	" "	119

TOTAL ATTENDANCE -

1,235

I was elected President of the council at the annual meeting on June 21, 1948 and will serve in this capacity until the next annual meeting in 1949. I also served as Chairman of the Exhibits Committee and as a member of the Executive Committee.

Our company had an exhibit of safety devices and photographs which was the third largest by mining companies.

Mr. H. F. Rogers, Safety Inspector, Mr. T. W. Hill, Ventilation Engineer and myself of our company together with Mr. A. Guscatt, Supt., North Range Mining Company, Mr. Emil Kronquist, Safety Director, Jones & Laughlin Steel Corporation and Mr. John Strome, Safety Director, Inland Steel Company, arranged the program for the Ishpeming, Michigan meeting. Mr. W. R. Atkins, Supt., Cambria-Jackson Mine and Mr. Hugo Korpinen, Operations Engineer of our company presented papers at the Ishpeming meeting.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

c. Safety Inspection (Continued)

National Safety Council

We are members of the National Safety Council and receive good service from this organization. I have been Chairman of the Poster and Visual Aids Committee during the past two years. This has given me the opportunity to get more mining posters which had been lacking before. Also, we have made up a film strip on drilling and blasting which will be available this coming summer for the mining industry.

The annual meeting was held last October when Mr. L. C. Moore, Chief Mechanical Engineer, presented a paper on "Hoisting Rope Records". This paper was well presented and very well received.

Our company was represented at the meeting by T. W. Hill, Ventilation Engineer, S. W. Sundeen, Supt., Cliffs Shaft Mine, Ted Anderson, Capt., Mather "A" Mine, L. C. Moore, Chief Mech. Engr., John Trosvig, Supt., Athens Mine and myself from the Marquette Range and Hugh Leach, Supt., Hill-Trumbull Mine, Alfred Hurley, Safety Inspector and George Whittington, Safety Supervisor of the Mesaba Range properties.

SAFETY BANNER FLAG AWARDS

Each year the Safety Banner Flag is awarded to the underground mine, open-pit and independent unit which has the best severity rating in its class. They were awarded for 1948 as follows:

Underground Operation - Spies-Virgil Mine, Iron River, Michigan with a severity rating of 0.643. There was a total of six lost-time injuries causing 180 days lost-time or an average of 30 days per injury.

Open-Cut Operation - Atkins Mine, Kinney, Minnesota with a severity rating of 0.00. There were no lost-time injuries of any kind, which is a very good record for this type of operation.

Independent Unit - The Cliffs Power & Light Company also with a 0.00 severity rating is doing a grand job of accident prevention in a very hazardous industry. The company has now operated 63 months (through January, 1949) without a lost-time injury.

CLEVELAND-CLIFFS "ORBIT"

Only three issues of the "Orbit" were published during the year. Material for the "Orbit" has been furnished mainly by Mr. Walter F. Gries and myself with some help from Mr. William Newett of the "Iron Ore". I am not satisfied with the amount of material and photographs we have furnished to date and feel that because of the limited amount of time we have for this purpose the paper is not quite what it should be. Also, many photographs furnished have been lost at the "Iron Ore" new print shop. We are now attempting to obtain more photographs for future publications and have been a little more successful. Very little material has been furnished by the various properties and this material is very essential to make the publication interesting and a success. To bring it up to the standards of publications similar to the Calumet & Hecla's "News & Views", Jones & Laughlin's "Men Of Steel", etc., would require a full-time employee.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYc. Safety Inspection (Continued)Foremens' Safety Bonus

The Safety Bonus for foremen is of real help in the prevention of accidents. A total of \$6,216.14 was paid to 89 foremen during the year and penalties imposed were \$234.64. I feel that some superintendents were a little too lenient about imposing penalties because of some of the conditions I have seen in the mines. Also, I still believe that shaft foremen, who have small crews and hazardous shaft and other repair work, do not receive a fair share of the bonus compared to, for example, a surface foreman who has a large crew, can watch over his men most of the time, and the work is not near so hazardous.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYc. Safety Inspection (Continued)

TABLE XXIV

SAFETY BONUSSES PAID TO FOREMEN

<u>Mine Or Plant</u>	<u>Amount</u>	<u>Men Participating</u>	<u>Amount Of Penalties Imposed</u>
Athens	\$ 877.74	11	\$ 46.23
Cambria-Jackson	548.85	10	46.51
C.P.& L. Co.	91.92	2	—
Cliffs Shaft	1,226.78	14	6.69
Lloyd	226.90	7	11.58
Maas	880.61	11	87.30
Mather "A"	1,289.50	16	34.56
Mather "B"	226.22	5	—
Negaunee	561.21	9	1.77
Spies-Virgil	286.41	4	—
TOTALS	\$ 6,216.14	89	\$ 234.64

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYc. Safety Inspection (Continued)

TABLE XXV

OCCUPATIONS OF MEN PARTICIPATING IN BONUS

<u>TITLE</u>	<u>#Athens</u>	<u>#Cambria-Jackson</u>	<u>#C.P.& L. Co.</u>	<u>#Cliffs Shaft</u>	<u>#Lloyd</u>	<u>#Maas</u>	<u>#Mather "A"</u>	<u>#Mather "B"</u>	<u>#Negaunee</u>	<u>#Spies-Virgil</u>	<u>TOTAL</u>
Shift Boss	8	7		10	4	8	13	3	6	2	61
Timber Foreman	1	1		1	1	1			1		6
Mech. Foreman	1	1		1	1	1	1	1	1	1	9
U.G. Mech. Foreman				1							1
Electrical Foreman							1				1
Surface Foreman	1	1		1	1	1	1	1	1	1	9
District Electrical Foreman			2								2
TOTALS	11	10	2	14	7	11	16	5	9	4	89

Safety Department
Annual Report
Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

d. Ventilation

Underground mine ventilation has ranged from poor to excellent. Because of certain unforeseen occurrences the ventilation system in one of the mines was badly short-circuited for a time. In two cases where development work was done, the ventilation was not kept up with development so conditions were poor for a short time.

A summary of ventilation conditions with a few comments on each mine follows:

Athens Mine

At the present time the ventilation system at this mine is fairly good. It did have serious short-circuits for a time because of caving ground in the main airways.

Because air for this mine must be taken down the cage compartment and exhausted up the skip compartment of the same shaft, the ventilation system can never be made perfect under the conditions because some recirculation must occur. Also, until recently some of the supervisory force did not seem to realize the value of ventilation and often allowed air control doors to be left open, which caused recirculation of air.

The last survey shows that the main mine fan was handling 74,380 C.F.M. against 5.2" W.G. Fresh air intake was only 23,655 C.F.M. which means 50,725 C.F.M. was recirculated. Since this survey, air doors have been improved on all levels and all leaks checked and it can be assumed that recirculating air does not amount to more than 35%.

Distribution of air through the mine is good.

Cambria-Jackson Mine

The Jeffery fan handles 40,420 C.F.M. at 1.9" W.G. 3,100 C.F.M. is permitted to come through the Mather "A" Mine connection, which gives the mine a total of 43,520 C.F.M. 27,634 C.F.M. recirculates through the west end of the mine and from the hoisting shaft on the upper levels into the old mining areas. This air does not show any contamination as it must mix with plenty of fresh air from surface and travels a long distance through untimbered stopes. At the present time, air doors are being built on the upper levels to prevent recirculation and as a fire prevention. Air distribution is good in some sections of the mine but only fair in other places. In time, it may be necessary to relocate the fan on the 7th level in the west end of the mine to prevent recirculation.

Cliffs Shaft Mine

The new Jeffery fan unit located at the west end of the mine on the 6th level, taking air from surface through the inclined shaft, is handling approximately 100,000 C.F.M. Considerable work must be done in the mine to direct the air to all sections of the mine and this will take a long period of time. Air distribution is very good and will be improved as air control doors and brattices and stoppings are built.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYd. Ventilation (Continued)Lloyd Mine

Mine fan on 4th level and booster fan on above 9th level operations handling 18,658 C.F.M. Air is well distributed through workings which are confined to the 9th level.

Maas Mine

All air used to ventilate the Maas Mine is taken from the Negaunee Mine. The fan unit is located on #2 Negaunee Shaft and handles 82,170 C.F.M. The first split to the Maas Mine is on the 13th level, Negaunee 1390 cross-cut to the Maas 400 drift, and total volume of fresh air is 38,950 C.F.M. From the Negaunee 1450 cross-cut 21,870 C.F.M. enters the Maas 600 drift and approximately 2,500 C.F.M. enters the Maas 4200 drift from the Negaunee 1410 cross-cut for a total of 43,637 C.F.M., of which 24,370 C.F.M. is re-used air. All re-used air passes through a water misting curtain where most of the gases and dust is eliminated. Distribution of air is good except for the 4200 cross-cut.

Mather Mine, "A" Shaft

Fan is handling 93,832 C.F.M., of which 89,794 C.F.M. goes to the working places. 4,038 C.F.M. recirculates around the fan pillar. Of the total, 50,518 C.F.M. is fresh air from surface and the rest of the air is recirculated. Improvements in air-control doors and at the new workings on the 6½ level probably have increased the fresh air volume by this time. Distribution of air is good.

Mather Mine, "B" Shaft

Only shaft sinking is in progress and a Sturtevant fan furnishes almost 3,000 C.F.M. to the bottom of the shaft. (2,000')

Negaunee Mine

The main fan unit handles 82,170 C.F.M. which enters the 9th level and then passes down to the 10th, 11th, 12th to the 13th where 38,950 C.F.M. goes to the Maas Mine. Approximately 1,000 to 2,000 C.F.M. is used to ventilate each of the upper levels and shaft plats. 33,370 C.F.M. goes to the 14th level workings to ventilate the mining contracts. Two booster fans help ventilate the mining areas and air is very well distributed through the mine.

Spies-Virgil Mine

The fan unit, located on surface over the air shaft, handles 29,150 C.F.M., of which 3,561 C.F.M. is re-used air from the 6th level which has passed through a water spray. The main volume, 25,589 C.F.M., comes down the Spies shaft, enters the 4th level and goes through the mining places to surface through the air shaft. Distribution is very good. The 6th level development is

(Cont'd.)

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

d. Ventilation (Continued)

Spies-Virgil Mine (Cont'd.)

ventilated by use of three Sturtevant fans in tandem which handle 3,561 C.F.M. Exhaust is through metal vent-tube to the Spies shaft to the 6th level where it joins the fresh air from surface. Ventilation on the 6th level is fairly good but an air raise is now being driven to connect the 6th with the 4th level, at which time conditions will be excellent.

Dust Elimination And Analysis

The elimination or reduction of dust in and about our mines is of major importance and is not too difficult a job. Known methods, which are inexpensive can reduce the dust hazard to a minimum. During the past several years we have set up certain standards, rules and safe practices, which, if followed, will eliminate dust to the point where it is no longer a hazard.

The first step in the reduction of dust particles is the installation of a main mine fan large enough to handle a certain amount of air. The volume to be handled by the fan is decided by the size of the mine and the number of men employed per largest shift. Next step is to direct this air to the work places, and if this cannot be done, such as in dead-end drifts, raises or sub-levels, an auxiliary fan is set up with vent-tubing and air is either forced into the dead-end or is drawn out. When necessary, water misting nozzles are set-up in the airways or vent-tubing to knock down the dust and gases. In most cases of rock drifting two auxiliary fans are used, one to force air into the work place and sweep the breast and another to draw air from the heading to prevent the dust from settling in the drift or getting into the main air stream.

All dust samples taken during the year were taken under normal operating conditions. Those work places which seemed to offer the worst conditions were checked most frequently. Some of the samples were very high and others very low. The Athens, Cliffs Shaft, Mather "A", Negaunee, Spies-Virgil and Tilden Mines improved their dust counts over 1947. Mather, "B" Shaft shaft sinking was satisfactory with counts well below the maximum recommended limits. Average of samples taken at all other mines showed increased dust counts over the previous year.

Usually, the causes of high counts was lack of ventilation, starting holes dry and failure to provide enough water for the drill machines. Dry ores in some of the mines make it difficult to keep down dust. Scrapers being pulled over chunks and whipping scraper rope also raise dust. Water cannot be used in many places outside of the Cliffs Shaft Mine to wet down ore to eliminate dust because of the trouble of handling this wet ore in chutes and cars, also, it would probably create a much more serious hazard. The average of dust counts taken during the past years are listed in the following tables.

Safety Department
Annual Report
Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

d. Ventilation (Continued)

The tables on this and following pages give location and various occupations where dust counts were taken; also total averages of counts since 1933 when the first counts were taken.

TABLE XXVI

DUST SAMPLES COLLECTED IN ROCK AND ORE WORK

<u>Mine Or Plant</u>	<u>1948</u>		<u>1948</u>	<u>1933 - 1948</u>
	<u>In Ore</u>	<u>In Rock</u>	<u>TOTAL</u>	<u>TOTAL</u>
Athens	30	21	51	640
Cambria-Jackson	34	13	47	197
Cliffs Shaft	19	26	45	1,576
Lloyd	19	42	61	608
Maas	17	16	33	593
Mather "A"	7	69	76	509
* Mather "B"	-	50	50	52
Negaunee	22	1	23	769
** Princeton	-	-	-	85
Spies-Virgil	12	9	21	123
Tilden	8	-	8	50
Miscellaneous	-	-	-	111
TOTALS	168	247	415	5,313

* Started Operation, April, 1947.

** Closed Down.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYd. Ventilation

(Continued)

TABLE XXVII

VARIOUS OCCUPATIONS WHERE DUST SAMPLES WERE COLLECTED

OCCUPATION	ATHENS	CAMBERIA-JACKSON	CLIFFS SHAFT	LLOYD	MAAS	MATHER "A"	MATHER "B"	NEGAUNEE	SPIES-VIRGIL	TILDEN	TOTALS
Drilling	19	22	37	33	10	25	28	8	13	-	195
Scraping	12	12	-	12	10	6	-	5	-	-	57
Using air loader to fill cars	2	-	-	9	-	12	-	1	1	-	25
Blasting	2	2	-	2	1	4	-	-	-	-	11
Timbering	6	4	-	2	4	16	-	5	1	-	38
Hand Shoveling	-	-	-	-	-	4	15	1	1	-	21
Barring Back	-	1	2	1	-	1	-	-	-	-	5
Blowing Cars	4	-	-	-	6	-	-	-	-	-	10
Loading Cars At Chute	-	-	-	-	-	-	-	-	-	-	-
General Mine Air	3	6	1	2	2	3	5	2	4	-	28
Charging Holes	2	-	-	-	-	2	-	1	1	-	6
Rigging Machine	-	-	-	-	-	-	-	-	-	-	-
Breaking Chunks	1	-	-	-	-	-	-	-	-	-	1
Crushing Ore Sample	-	-	2	-	-	-	-	-	-	-	2
Pulverizing Ore Sample	-	-	3	-	-	-	-	-	-	-	3
Crushing Ore	-	-	-	-	-	-	-	-	-	4	4
Loading At Pocket	-	-	-	-	-	-	-	-	-	4	4
Blowing Holes	-	-	-	-	-	1	-	-	-	-	1
Cribbing Raise	-	-	-	-	-	2	-	-	-	-	2
Using Mech. Mucker	-	-	-	-	-	-	2	-	-	-	2
TOTALS	51	47	45	61	33	76	50	23	21	8	415

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYd. Ventilation

(Continued)

TABLE XXVIII

AVERAGE LIGHT FIELD COUNT OF ALL SAMPLES TAKEN

<u>Mine Or Plant</u>	<u>1933</u>	<u>1934</u>	<u>1935</u>	<u>1936</u>	<u>1937</u>	<u>1938</u>	<u>1939</u>	<u>1940</u>
ATHENS		32.90	14.12	28.32	26.69	12.85	12.59	9.89
* CAMBRIA-JACKSON								
CLIFFS SHAFT	17.94	14.56	8.29	8.98	15.53	9.86	10.36	7.77
LLOYD		9.90	12.42	39.25	20.25	10.84	13.47	11.73
MAAS		7.46	27.55	35.75	150.98	11.24	36.90	8.71
* MATHER "A"								
* MATHER "B"								
NEGAUNEE		53.80	17.77	33.25	59.06	56.26	25.49	10.79
* PRINCETON								
SPIES-VIRGIL					70.61	26.99	1.80	8.40
TILDEN				67.52	285.27	74.60	60.40	
GARDNER MACKINAW		27.77		8.61	48.53			
MISCELLANEOUS			8.66	3.00	6.80	14.73		

* Not in operation during this period

(Continued)

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

d. Ventilation

(Continued)

TABLE XXVIII (Cont'd.)

AVERAGE LIGHT FIELD COUNT OF ALL SAMPLES TAKEN

<u>Mine Or Plant</u>	<u>1941</u>	<u>1942</u>	<u>1943</u>	<u>1944</u>	<u>1945</u>	<u>1946</u>	<u>1947</u>	<u>1948</u>
ATHENS	7.28	25.80	4.90	8.33	6.64	4.17	7.39	7.49
CAMBRIA-JACKSON			12.10	6.21	17.05	11.99	9.30	13.81
CLIFFS SHAFT	8.18	7.55	5.99	6.23	8.18	6.34	8.64	5.12
LLOYD	8.05	6.95	5.01	14.45	6.49	9.38	11.17	12.97
MAAS	17.29	8.46	12.48	8.78	8.17	9.29	6.08	21.08
MATHER "A"	2.42	5.58	6.64	7.57	8.39	7.72	10.88	9.50
MATHER "B"							2.23	4.16
NEGAUNEE	14.02	17.02	4.65	11.81	11.92	6.67	7.05	5.48
* PRINCETON			10.59	6.32	8.48			
SPIES-VIRGIL	6.97			5.59	14.22	3.59	11.65	5.24
TILDEN	49.60				24.18	66.92	33.65	2.93
* GARDNER MACKINAW								
MISCELLANEOUS		3.00						

* No longer in operation.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYd. Ventilation (Continued)

TABLE XXIX

COMPARISON OF DUST COUNTS IN RAISING TO DRIFTING

<u>Mine</u>	<u>Average In Raising</u>	<u>Average In Drifting</u>	<u>General Average</u>
ATHENS	12.13	5.14	7.49
CAMBRIA-JACKSON	23.69	13.16	13.81
CLIFFS SHAFT	5.88	4.13	5.12
LLOYD	13.70	9.57	12.97
MAAS	32.42	30.25	21.08
MATHER "A"	10.18	9.80	9.50
MATHER "B"	--	--	4.16
NEGAUNEE	28.08	4.49	5.48
SPIES-VIRGIL	--	5.24	5.24

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYd. Ventilation

(Continued)

TABLE XXX

AVERAGES IN ORE COMPARED TO AVERAGES IN ROCK

<u>Mine</u>	<u>Average In Ore</u>	<u>Average In Rock</u>	<u>General Average</u>
ATHENS	8.26	6.48	7.49
CAMBRIA-JACKSON	11.09	25.45	13.81
CLIFFS SHAFT	6.89	4.37	5.12
LLOYD	21.26	9.41	12.97
MAAS	13.23	30.30	21.08
MATHER "A"	12.23	9.29	9.50
MATHER "B"	—	4.16	4.16
NEGAUNEE	5.87	1.34	5.48
SPIES-VIRGIL	3.48	6.22	5.24
TILDEN	2.93	—	2.93

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYd. Ventilation

(Continued)

TABLE XXXI

COMPARISON OF AVERAGE DUST COUNTS IN VARIOUS OPERATIONS

<u>Operation</u>	<u>Athens</u>	<u>Camb. Jack.</u>	<u>Cliffs Shaft</u>	<u>Lloyd</u>	<u>Maas</u>	<u>Math er-A</u>	<u>Math er-B</u>	<u>Neg.</u>	<u>Spies</u>
RAISING IN ROCK	8.53	31.79	3.55	10.52	44.52	10.18		1.34	
RAISING IN ORE	24.75	8.87	9.83	41.50	8.59			28.08	
DRIFTING IN ROCK	5.29	8.61	4.16	9.22	25.02	7.78			6.22
DRIFTING IN ORE	4.65	13.39	3.79	12.18	31.30	10.01		4.62	3.48
SLICING IN ORE	4.01							3.88	
STOPPING IN ORE			28.70	33.59				9.55	
BREAKING CHUNKS	4.41			7.42	9.69				
BLOWING OUT CARS	8.13				7.37				
SUB-LEVEL CAVING	11.35	9.25		22.15	5.80				
BLOCK CAVING	11.09					26.31			
SINKING SHAFT							4.16		
SINKING WINZE						2.69			
CUTTING PLAT						8.03			

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

e. Mine Rescue Training

During September and October the Safety Department with the assistance of U.S. Bureau of Mines engineers, R. O. Pynonen and Roy Stott trained 147 men in mine rescue and procedure. The very best of cooperation was received from mine superintendents in supplying men fitted for this work.

All new men received 24 hours training and men who had had previous training received an 8-hour refresher course. All these men received at least 2 hours training in a smoke and gas filled building while wearing oxygen breathing apparatus, Chemox apparatus or gas masks or the combination of all three. Not one man failed in the course this year.

Some of our men do not pass the Bureau of Mines physical examination because of poor teeth, poor vision or because of being overweight but we still can make good use of them either at the fresh air bases to direct operations or repair equipment. Men with only poor teeth can wear the Chemox apparatus or all-service gas masks because they are not required to hold a mouth-piece with this type of equipment. Some of the so-called overweight men are in good condition and have been approved by the Director of Industrial Hygiene. Twenty-eight of our men have had underground fire-fighting experience so we are well equipped with good personnel in the crews.

Plans to train men at the Spies-Virgil Mine were completed and this training took place after the first of the year.

The following table shows the number of men trained at each mine and the kind of training.

Safety Department
Annual Report
Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

e. Mine Rescue Training (Continued)

TABLE XXXII

MINE RESCUE TRAINING, SEPTEMBER 27 - OCTOBER 15, 1948

<u>Mine</u>	<u>Initial Training</u>	<u>Additional Training</u>	<u>Total Trained</u>
ATHENS	6	13	19
CAMBRIA-JACKSON	4	19	23
CLIFFS SHAFT	4	11	15
ENGINEERING DEPT.	1	3	4
LLOYD	2	5	7
MAAS	5	13	18
MATHER "A"	6	30	36
MATHER "B"	1	2	3
NEGAUNEE	5	13	18
	<u>34</u>	<u>109</u>	<u>143</u>

Four men who have had training in previous ^{YEARS} are available in case of emergency.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

e. Mine Safety And Mine Rescue Courses

Mine Rescue Station

We have one of the best mine rescue stations in the Lake Superior District according to the Bureau of Mines engineers. This makes our inspections and repair of equipment very simple and allows more time when training crews. Our equipment is inspected at least once every month by a member of the Safety Department, and to check any mistakes we may make we have the Bureau of Mines make an annual inspection.

Our equipment is all modern and kept in first-class condition. There is sufficient equipment to handle most any fire or other emergency. Also available is equipment kept at the U.S. Bureau of Mines station at Duluth, Minnesota.

Athens Mine Fire

On September 28th at 6:00 P.M. the Safety Department was notified that a fire had started in the main ventilation drift on the 7th level between the two main air raises leading to the 6th level.

In a matter of a half hour we had picked a mine rescue crew from the afternoon shift, including the mine foreman, a shift boss and Ventilation Engineer and we were ready to start underground.

This fire was discovered at about 5:00 P.M. and an attempt was made to extinguish it with fire-extinguishers (carbon-tet. type) but smoke from the fire started to close in on the men so the attempt was abandoned and the men in the mine were called out and the main mine fan was stopped. No trouble was experienced in taking employees out of the mine.

With the crew of mine rescue men equipped with McCaa and Chemox O₂ apparatus we were lowered first to the 4th level and then to the 6th level to check the amount of smoke and carbon monoxide. The return, or exhaust air, showed one-tenth of one per cent C.O. and timber stations on the intake air, .01 per cent of C.O. On the 7th level we had no difficulty in approaching the fire, as we were able to see 30 to 40 feet ahead until within 25 ft. of the fire. After making a check of conditions we connected up compressed-air hoses and a blower pipe to the one-inch water line and proceeded to put water on the fire. As pressure was low, we closed all water valves on all shaft plats except the 7th level and were able to get a good stream and the fire was put out in about one hour after turning the water on the fire. Reason for the amount of time used was because of difficulty in reaching fire which had burned high above the timber sets in the blocking and because of loose chunks in the back falling out as lagging burned off.

Mr. C. W. Allen, who was at the mine when we went underground, was advised that it would be impossible to operate the mine during the second half of the afternoon shift and the miners were sent home at 7:30 P.M.

(Cont'd.)

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURYe. Mine Safety And Mine Rescue Courses (Continued)Athens Mine Fire (Cont'd.)

As the pumps had not operated during the day due to power conservation, I took the pipe foreman to the 10th level where he started the pumps. Chemox apparatus was used on this job for a short period, but soon the air was cleared and there was no further need of the apparatus.

By 10:30 P.M. we had checked all of the 4th and 6th levels and all gases had been cleared and it was safe for the men. We arrived at surface at about 11:00 P.M. and the night shift was ready and did go down as usual. The mine foreman and shift bosses were given necessary instructions with orders to keep watch during the shift for any outbreak of fire which might occur.

The fire had been started by a crew during the day shift which had cut old rails in the back of the 7th level drift with an Oxy-Acetylene torch. These rails had been in place many years. The ground in this area, between the shaft and 700 air raise, has been sloughing recently and required repairs. Many steel sets had been put in to replace the wood timber. In the place where the fire was started there was approximately five old rails in the back which either had to be removed or cut to make room for the repairs. A number of places around these rails had been burned and the fire put out, but apparently a spark from the torch had got into the blocking which they could not detect and after the men had left at the end of the day shift this spark was fanned into a flame. There were no men employed on the afternoon shift in this contract nor anywhere on the 7th level so the fire had a chance to grow in size until smoke was detected on the level above at about 5:00 P.M.

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

e. Mine Safety and Mine Rescue Courses (Continued)

TABLE XXXIII

FIRST AID SUPPLIES DISTRIBUTED

<u>Material</u>	<u>Number Distributed</u>
Merthiolate Pads (Band-Aids)	44,500
Ounces Of Merthiolate	239
1" Roller Bandage	450
2" Roller Bandage	251
3" Roller Bandage	172
Rolls Of Adhesive Tape	56
Picric Gauze Pads	160
Plain Gauze Pads	416
Leather Finger Cots	129
Merthiolate Applicators	1,812
Ounces Of Aromatic Spirits Of Ammonia	16
Ounces Of Absorbent Cotton	14
Tubes Of Unguentine	27
Triangular Bandages	17
Pairs Of Scissors	1
Bottles (2 Oz. - Medicine)	8
TOTALS	48,268

Safety Department

Annual Report

Year 1948

11. ACCIDENTS
AND
PERSONAL
INJURY

f. Miscellaneous

Incipient Fires

Underground

None of any consequence.

Surface

April - 4 small grass fires extinguished by company police.

May - Small fire extinguished by police in ash and rubbish pit behind Cliffs Shaft Machine Shop.

June - Overheated electric switch box in boiler room of Engineering Building taken care of by policeman.

Grass fire started by sparks from boiler of drill rig in peat bog and grass at West Ishpeming put out by Ishpeming Fire Department.

Foremens' Meetings

Safety meetings were conducted for supervisors of all properties at the Central Office. Purpose of these meetings was to instruct supervisors of their responsibility to the company and men working under them. Response was very good. These meetings were called for 7:00 P.M. and lasted until 9:00 P.M. but in some cases did not close until 10:30 P.M. when the men took a real active part. A series of 12 meetings were held. Two meetings were also held for Mesaba Range supervisors.

FIRE PREVENTION MEETINGS

The first of a series of these meetings was held in December. Purpose is to acquaint supervisors with fire hazards at the mine, prevention, procedure in taking men out of the mine, equipment and fire fighting. These meetings will be held at the end of the day shift and will require two or three meetings for each mine.

Cliffs Club Meeting

This meeting was held June 19 and attended by 133 supervisors. Mr. C. J. Stakel, General Manager, and Dan Harrington, former Chief of the Health and Safety Division of the U.S. Bureau of Mines were the main speakers. I was the chairman.

Lake Superior Mines Safety Exchange

Purpose of the exchange to send all safety problems to members of the exchange who in turn will send methods used by them. This is new in the district and should be of real value. There will only be four meetings a year and these held the day before or after sectional meetings of the Lake Superior Mines Safety Council.

ANNUAL REPORT OF THE MINING ENGINEERING DEPARTMENT FOR THE YEAR ENDING
DECEMBER 31ST, 1948

This report is accompanied by books of photographic views, surface and underground maps and open pit cross-sections of all the mines operated by The Cleveland-Cliffs Iron Company either for itself, or as operating agent, for the other companies, during the year 1948. The underground maps show, in red, the areas mined during the year and the open pit cross-sections show, in color, the unmined formation at the end of the year as well as those portions removed in 1948.

The following table shows the mines included in the different books, the company for which the books were prepared, and the partners or affiliated companies interested. The Cleveland-Cliffs Iron Company books were bound and the others were loose-leaf.

<u>Company</u>	<u>Mines</u>	
	<u>For Itself</u>	<u>As Operating Agent</u>
The Cleveland-Cliffs Iron Company	Agnew Cambria-Jackson Canistec Cliffs-Shaft Hawkins Lloyd Maas Sargent Spies-Virgil Tilden Wanless-Woodbridge	Athens Atkins Hill-Trumbull Holman-Cliffs Mather "A" Shaft Mather "B" Shaft Negaunee.
The Mesaba-Cliffs Mining Company Partners: Hanna Iron Ore Company Inland Steel Company Jones & Laughlin Steel Corp. Pittsburg Steel Co. Republic Steel Co. Wheeling Steel Co.		Hill-Trumbull Holman-Cliffs
The Athens Iron Mining Company for Pickands, Mather & Co.		Athens
The Negaunee Mine Company Partner: Bethlehem Steel Company		Mather A Shaft Mather B Shaft Negaunee.

Loose-leaf books were prepared for other companies and fee-owners containing the mines in which they were interested.

<u>Company</u>	<u>Mine</u>
Arthur Iron Mining Company	Atkins, Hill-Trumbull and North Star and Bingham leases of Holman-Cliffs.
Inland Steel Company	Atkins.
International Harvester Company	Agnew, Hawkins and Sargent.

Other loose-leaf books were prepared for the various Company officials as shown below:

<u>Name</u>	<u>Mine</u>
W. A. Sterling, Manager	Agnew, Atkins, Canisteo, Hawkins, Hill-Trumbull, Holman-Cliffs, Sargent and Wanless-Woodbridge.
J. J. Foucault, Supt.	Agnew, Sargent.
E. L. Bemis, Supt.	Canisteo.
P. P. Swanson, Supt.	Hawkins.
H. J. Leach, Supt.	Hill-Trumbull.
W. A. Pakkala, Supt.	Holman-Cliffs.
J. Trosvig, Supt.	Athens.
W. R. Atkins, Supt.	Cambria-Jackson.
S. W. Sundeen, Supt.	Cliffs-Shaft.
O. Marjama, Supt.	Lloyd & Spies-Virgil.
H. O. Moulton, Supt.	Maas, Tilden.
F. J. Haller, Supt.	Mather A and B Shafts.
C. R. Sundeen, Supt.	Negaunee.

B. MAP REPORTS

Each month two sets of prints of the working maps of each of the soft ore mines in Michigan were prepared showing, in red, the work done on the various levels and sub-levels during that month. Similar sets for the Cliffs-Shaft Mine were made four times a year instead of monthly. One of these was for the Manager of Michigan Mines and the other for the Mine Superintendent. Besides these prints, each Mining Captain, Under-Captain and shift boss received monthly copies of these maps cut down and folded to fit the pocket, to be taken underground. There were other sets of maps prepared for fee-owners, etc. as follows:

ATHENS MINE

Two sets of prints of the working maps, scale 1" = 50', were sent monthly except December, to the Cleveland office, showing in red the work done during the month. One of these sets was forwarded to Pickands Mather & Company. Two sets of maps cut down to show the Corbit Lease and a small part of the adjacent territory were forwarded to the Detroit Trust Company, Detroit, Michigan. One set was for the first half of the year, January 1st to June 30th and the other set from July 1st to December 31st. These maps were colored in red to show the work done during each six months period.

At the request of the Jones & Laughlin Ore Company, two sets of maps were prepared showing the work done on the Corbit Lease and Lucky Star Mine in connection with the block caving operations along the Athens-Lucky Star boundary. One set of maps showed the work done between June 1st, 1947, when the development was first started on the Corbit Lease, and December 1st, 1948; the other set covered the work done during December, 1948. Accompanying these prints was an estimate of Lucky Star ore removed during that period. It is the intention to continue similar maps and estimates monthly until the block-caving on the Corbit Lease is completed.

CLIFFS-SHAFT MINE

One set of prints of the geological maps of the Bancroft and Section 10 Leases, scale 1" = 50', was forwarded to the Duluth office of the Oliver Iron Mining Company after each quarterly survey. These maps showed, in color, the work done since the previous survey, except that the set for the end of the year showed all the mining done during the year as well as the areas that were used in preparing the estimate of ore reserves for the Michigan State Tax Commission as of December 31, 1948. One set of calculations of these ore reserve estimates accompanied the set for the last quarter.

NEGAUNEE MINE

A set of whiteprints of the North-South cross-sections of the Negaunee Mine lease and the Maas Area was sent to Dr. Donald M. Fraser, Chief Geologist of the Bethlehem Steel Company, Bethlehem, Pennsylvania, showing the changes due to mining in 1948.

MICHIGAN STATE TAX COMMISSION

Estimates of ore reserves as of December 31st, 1948, remaining in the Athens, Cambria-Jackson, Cliffs-Shaft, Lloyd, Maas, Mather "A", Negaunee and Spies-Virgil Mines, were prepared for the Michigan State Tax Commission. Accompanying these estimates were loose-leaf books of annual report maps showing all of the levels and sub-levels of the above mines where mining was done or where there were areas used in making the ore estimates. There was no estimate of ore reserves for the Mather "B" Mine.

C. REMARKS ON MISCELLANEOUS DOCUMENTS AND ABSTRACTS

All documents affecting the Company's lands and rights passed through the hands of Mr. Brewer for recording and approval. Each one is entered on the Department records and is initialed. In certain instances, these documents are initialed by Mr. Derby where possible mineral values are involved.

The acquisition of lands in the Humboldt, Republic and Michigamme areas required many contacts with the Legal Department regarding title opinions, preparation of documents and other matters pertaining thereto.

The following table shows the number and classification of documents that passed through the Department during the year:

<u>Classification</u>	<u>Number Received</u>	<u>Last File No.</u>
Mining Leases	2	84
Miscellaneous Documents	103	1,734
Easements	22	462
Rights of Way	0	224
Surface Leases	75	6,193
Sales	61	4,081
Tax Histories	0	704

The following summary covers the various classifications of documents as shown above:

MINING LEASESLease No. 83

The NW $\frac{1}{4}$ of NW $\frac{1}{4}$ of Section 24, 43-35, Michigan, was leased as of January 1, 1948 to the James Mining Company, a subsidiary of Pickands Mather & Co.

Lease No. 84

Woodbridge - The E $\frac{1}{2}$ of NE $\frac{1}{4}$ of Section 16, 58-19 W., Minnesota, was leased from the State of Minnesota under date of June 9, 1948. This adjoins the Wanless Mine.

MISCELLANEOUS DOCUMENTS

All documents affecting land titles or rights relating to operating mines or mineral lands are included in this classification. There were 25 documents covering the purchases of lands in the Republic District, 34 for various types of easements and rights in Minnesota, 13 covering purchases in the City of Negaunee, 15 affecting mineral lands, 6 for purchases in the Humboldt District and the balance covered miscellaneous rights either granted or acquired.

EASEMENTS

These are transmission line rights of way for the Cliffs Power & Light Company. Three of these easements covered the new line from Humboldt to the Champion Mine and the balance were for rural service lines.

RIGHTS OF WAY

This file covers railroad rights of way and is used mostly for copies of documents that are used for reference purposes.

SURFACE LEASES

These leases originate in the Land Department and are sent to the Mining Department for approval and cover the use of Company lands for residence, gardens, camps, farms, etc.

SALES

These sales are conveyances of Company lands off the mineral formation and cover platted lots, metes and bounds parcels, farms, etc.

TAX HISTORIES

Quite a few tax histories were received in connection with the land purchases at Humboldt, Republic and Michigamme, but these have not yet been recorded.

ABSTRACTS OF TITLE

Abstracts of Title of the lands purchased in the Humboldt, Republic and Michigamme Districts have been obtained and title opinions thereon received from the Legal Department upon which purchases have been based. The custom of this Department that was inaugurated many years ago under Mr. Jopling, of copying Abstracts of Titles into loose-leaf books for record in this office was discontinued sometime ago. No attempt has been made to bring these books up to date. The Abstracts of Title obtained for the current acquisition of lands are brought up to date after the Company's title is perfected and are forwarded to the Cleveland office.

D. THE FORCE

The survey crews became more systematized as the year progressed. It was found that it was necessary for a surveyor to spend as much time in the office as he did underground or in the field in order to make the survey calculations and map plotting while the information was still fresh. Two surveyors and two helpers were therefore assigned to different mines or districts so there would be one surveyor and two helpers underground while the other surveyor was in the office. There were two surveyors and two helpers assigned to the Mather "A" Mine. Two surveyors and two helpers were assigned to the Athens, Cambria-Jackson, Maas and Negaunee mines, one surveyor and two helpers to the Cliffs-Shaft, Lloyd and Spies Mines and two surveyors and two helpers to the field work.

Mr. Stannard was put in charge of all office supplies and equipment and in planning all drafting in connection with maps, drawings, etc. as the office was called upon to supply.

One engineer, Mr. H. Walter Rembold, and four permanent helpers, entered the Department during the year. During the summer months, Mr. Kenneth C. Olson, Engineer, was employed to help out in surface surveys together with several helpers. Lawrence K. Viall left the Department on June 30th and Anselm Mantyla was employed in his place.

The following table shows the personnel of the Department, their position at the end of the year and the period of employment:

<u>Name</u>	<u>Position</u>	<u>Entered</u>	<u>Left</u>	<u>1948 Employment</u>
Carl Brewer	Recorder			12 Months
Robert M. DeGabriele	Engineer			12 "
John M. Haivala	"			12 "
Grant T. Hollett	"			12 "
T. Adolph Kauppila	"			12 "
Maxwell H. Madsen	"			12 "
H. Walter Rembold	"	Mar. 3, 1948		10 "
W. Harlow Stannard	Draftsman			12 "
Lawrence K. Viall	"		June 30th	6 "
George B. Manzoline	"			12 "
Anselm Mantyla	"	July 19th		5½ "
Donald W. Carlson	Stenographer			12 "
Clifford H. Amel	Surveyor			12 "
Edgar G. Curtis	"			12 "
P. Daniel Isaacson	"			12 "
C. Arthur Koski	"			12 "
F. Alfred Koski	"			12 "
Ernest A. Oja	"			12 "
Ralph K. Oja	"			12 "
John R. Sleeman	"			12 "
Kenneth C. Olson	"	July 6th	Sept. 22nd	2½ "
Robert E. Anderson	Helper	July 1st		6 "
Clarence P. Ayotte	"	April 12th		8½ "
Herbert S. Kelly	"	May 28th		7 "
Louis R. Miller	"	Mar. 1st	Jan. 31st	11 "
Alfred B. Nault	"			12 "
Raymond E. Oja	"			12 "

<u>Name</u>	<u>Position</u>	<u>Entered</u>	<u>Left</u>	<u>1948 Employment</u>
Russell J. Paull	Helper			12 Months
Raymond S. Windsand	"			12 "
Martin D. Tasson	"	Aug. 2nd		5 "
Werner E. Talus	"	July 22nd	Sept. 10th	1½ "
Joseph H. Copeland	"	July 2nd	Aug. 31st	2 "
Donald J. Beauchamp	Draftsman	July 1st	Sept. 22nd	2½ "
Wayne D. Ahl	Surveyor	Aug. 2nd	Aug. 20th	3 weeks
Robert R. Wallace	"	Aug. 2nd	Aug. 20th	3 "

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

<u>Name</u>	<u>Date Entered</u>	<u>Length of Service</u>
Carl Brewer	August, 1906	30 years, 3 months
Robert M. DeGabriele	December, 1945	3 " 1 "
John M. Haivala	March, 1943	5 " 10 "
Grant T. Hollett	August, 1940	8 " 4½ "
T. Adolph Kauppila	March, 1944	4 " 10 "
Maxwell H. Madsen	September, 1943	5 " 4 "
H. Walter Rembold	March, 1948	" " 10 "
W. Harlow Stannard	November, 1940	8 " 2 "
George B. Manzoline	December, 1947	1 " ½ "
Anselm Mantyla	July, 1948	" " 5½ "
Donald W. Carlson	August, 1936	9 " 1 "
Clifford H. Amel	May, 1944	4 " 7½ "
Edgar G. Curtis	February, 1944	4 " 11 "
P. Daniel Isaacson	November, 1940	3 " 4½ "
C. Arthur Koski	June, 1941	4 " 1 "
F. Alfred Koski	January, 1936	8 " 9 "
Ernest A. Oja	March, 1943	5 " 10 "
Ralph K. Oja	February, 1947	1 " 10½ "
John R. Sleeman	February, 1947	1 " 10½ "
Robert E. Anderson	July, 1948	" " 6 "
Clarence P. Ayotte	April, 1948	" " 8½ "
Herbert S. Kelly	May, 1948	" " 7 "
Louis R. Miller	August, 1945	3 " 3½ "
Alfred B. Nault	September, 1946	2 " 3½ "
Raymond E. Oja	October, 1946	2 " 3 "
Russell J. Paull	March, 1947	1 " 9 "
Raymond S. Windsand	December, 1947	1 " ½ "
Martin D. Tasson	August, 1948	" " 5 "

In the above table, the "length of service" covers only that period the men were employed in the Engineering Department. Some of them have been in other Departments at one time or another. Time spent in the Armed Services is not included in this table.

The following table shows the number of days worked, sick or absent during the year, of all those who were in the Department.

<u>Name</u>	<u>Days Worked</u>	<u>Days Sick</u>	<u>Days Absent</u>
Carl Brewer	270½	5½	-
Robert M. DeGabriele	260½	2	16
John M. Haivala	266½	2	13½
Grant T. Hollett	267	-	14½
T. Adolph Kauppila	260	2	17½
Maxwell H. Madsen	268	1	9
H. Walter Rembold	224	-	8½
W. Harlow Stannard	263	-	13
Anselm Mantyla	120½	-	4
George B. Manzoline	270	1	5
Donald W. Carlson	269	2	7½
Edgar G. Curtis	263	4½	11½
C. Arthur Koski	270	1	10
F. Alfred Koski	268	-	11
Ernest A. Oja	264	-	12½
P. Daniel Isaacson	269	1	10½
Clifford H. Amel	266½	-	10½
Robert E. Anderson	129	-	6½
Clarence P. Ayotte	202½	-	-
Herbert S. Kelly	154½	½	5½
Louis R. Miller	230	9½	14½
Alfred B. Nault	266	-	12
Ralph K. Oja	270	-	11
Raymond E. Oja	259½	11	5½
Russell J. Paull	262½	-	15½
John R. Sleeman	269½	-	8½
Raymond S. Windsand	273½	1	4
Martin D. Tasson	110	-	4½
Donald J. Beauchamp	57½	1	-
Joseph H. Copeland	42	-	-
Kenneth C. Olson	56½	-	-
Werner E. Talus	36	-	-
Wayne D. Ahl	16	-	-
Robert R. Wallace	16	-	-
Lawrence K. Viall	132	-	8½

The following table shows the distribution of time spent underground, in the field, and in the office:

<u>Name</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>
Carl Brewer	-	39	231½	270½
Robert M. DeGabriele	161	14½	85	260½
John M. Haivala	104	15½	147	266½
Grant T. Hollett	86	32	149	267
T. Adolph Kauppila	131	34	95	260
Maxwell H. Madsen	75	45	148	268
H. Walter Rembold	78	58	88	224
W. Harlow Stannard	-	-	263	263
Anselm Mantyla	-	-	120½	120½
George B. Manzoline	-	-	270	270
Donald W. Carlson	-	-	269	269
Edgar G. Curtis	117	32	114	263
C. Arthur Koski	136	17	117	270

<u>Name</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>
F. Alfred Koski	24	229	15	268
Ernest A. Oja	-	175	89	264
P. Daniel Isaacson	141	23 $\frac{1}{2}$	104 $\frac{1}{2}$	269
Clifford H. Amel	1	178	87 $\frac{1}{2}$	266 $\frac{1}{2}$
Robert E. Anderson	53	31	45	129
Clarence P. Ayotte	119	31	52 $\frac{1}{2}$	202 $\frac{1}{2}$
Herbert S. Kelly	68	7 $\frac{1}{2}$	79	154 $\frac{1}{2}$
Louis R. Miller	-	59	171	230
Alfred B. Nault	128	19	119	266
Ralph K. Oja	112	20	138	270
Raymond E. Oja	47	139 $\frac{1}{2}$	73	259 $\frac{1}{2}$
Russell J. Paull	111	26	125 $\frac{1}{2}$	262 $\frac{1}{2}$
John R. Sleeman	108	49 $\frac{1}{2}$	112	269 $\frac{1}{2}$
Raymond S. Windsand	160 $\frac{1}{2}$	21	92	273 $\frac{1}{2}$
Martin D. Tasson	-	90	20	110
Donald J. Beauchamp	-	-	57 $\frac{1}{2}$	57 $\frac{1}{2}$
Joseph H. Copeland	-	40	2	42
Kenneth C. Olson	-	50	6 $\frac{1}{2}$	56 $\frac{1}{2}$
Werner E. Talus	-	35	1	36
Wayne D. Ahl	-	14	2	16
Robert R. Wallace	-	14	2	16
Lawrence K. Viall	-	-	132	132
TOTALS	1,960 $\frac{1}{2}$	1,539	3,623	7,122 $\frac{1}{2}$
%	27.5	21.6	50.9	100.0

The survey crews were kept constantly busy giving lines for the sub-level and block caving systems of mining. Both these methods require constant attention and the survey crews take their orders directly from the engineer, superintendent or mining captain as the case may be so that the underground development progresses according to plan.

During the early part of the summer two field crews were kept busy running survey lines at 800' intervals across Section 12, 47-27, where the Geological Department was doing geophysical work. Later in the year these survey crews were sent to the Humboldt area for the preliminary surveys in that district. Late in the year surveys were run at the Webster, Portland and Ohio Mines in the South Michigan District.

The Mining Engineers spent most of their time at the mines working with the Mine Superintendent and Mining Captains and only came to the office for the posting of maps and to get information needed. They also supervised closely the work of the survey crews.

The following summary of the work done by the men in the Department shows the mines to which they were assigned. The more special jobs are reviewed under the headings "MINES" and "MISCELLANEOUS".

CARL BREWER, Recorder, supervised the work of the Department, but was engaged most of the year in connection with the preparation of various forms of leases and in connection with the acquisition of lands, both by option to purchase or lease. He compiled the Tax Commission reports, stockpile estimates, etc. He assisted Mr. Jackson in completing the purchases of lands in the Republic District and obtaining options and purchases in the Humboldt and Michigamme Districts. He reviewed the delinquent tax lists for the different counties for the Mining Department and the Cliffs-Power & Light Company and prepared the 1948 tax list of their properties. He had frequent consultations with the Legal Department relative to Abstracts, land titles, preparation of documents, etc.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
General Engineering	-	39	231½	270½	100.0
%	0.0	14.4	85.6		100.0

ROBERT M. DEGAERIELE, Mining Engineer, did the engineering work at the Athens Mine throughout the year and at the Cambria-Jackson until August 15th. His supervision of the block-caving above the 8th Level, Athens, early in the year and that in the Corbit Lease in the latter part of the year, required practically all of his time.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine	128½	11½	66½	206½	79.3
Cambria-Jackson Mine	31½	3	18½	53	20.3
Mather Mine "A" Shaft	1			1	.4
TOTAL	161	14½	85	260½	
%	61.8	5.6	32.6		100.0

JOHN M. HAIVALA, Mining Engineer, was in charge of the engineering work at the Lloyd and Spies-Virgil Mines throughout the year. He supervised the sinking of the winze at the Lloyd Mine to the 9th Level, and the installation of the pocket. At the Spies Mine, he conducted drilling experiments.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Lloyd Mine	53	9	71½	133½	50.1
Spies-Virgil Mine	51	6½	75½	133	49.9
TOTAL	104	15½	147	266½	
%	39.0	5.8	55.2		100.0

GRANT T. HOLLETT, Mining Engineer, was kept busy at the Mather Mine "A" Shaft throughout the year. He assisted in the planning for the new trestle and in the development of the 6½ Level and sinking the winze and shaft to the 7th Level.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Mather Mine "A" Shaft	85	32	149	266	99.6
Lloyd Mine	1			1	.4
TOTAL	86	32	149	267	
%	32.2	12.0	55.8		100.0

T. ADOLPH KAUPPILA, Mining Engineer, had charge of the engineering work at the Maas and Tilden Mines throughout the year, and the Negaunee Mine until August 15th. He was assisted during the latter part of the year at the Maas Mine by Mr. Rembold. Mr. Kauppila left the Department at the end of the year to become an Operating Engineer.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Cambria-Jackson Mine	1			1	.4
Maas Mine	102½	17	72½	192	73.8
Negaunee Mine	26½	½	13½	40½	15.6
Spies-Virgil Mine	1	-	1	2	.8
Tilden Mine	-	13½	4½	18	6.9
General Engineering	-	3	3½	6½	2.5
TOTAL	131	34	95	260	
%	50.4	13.1	36.5		100.0

MAXWELL H. MADSEN, Mining Engineer, did the engineering work at the Cliffs-Shaft Mine throughout the year. He did some triangulation work in Sections 3, 4 and 9, 47-27 during the summer.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Cliffs-Shaft Mine	73	2½	119	194½	72.6
Republic Mine	-	6	½	6½	2.4
Spies-Virgil Mine	1		4½	5½	2.0
Research Lab		16		16	6.0
General Engineering	1	20½	24	45½	17.0
TOTAL	75	45	148	268	
%	28.0	16.8	55.2		100.0

H. WALTER REMBOLD, Mining Engineer, entered the Department on March 15th and assisted Mr. Kauppila in the Negaunee District. On August 15th he took over the engineering work at the Cambria-Jackson and Negaunee Mines.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine	2	-	$\frac{1}{2}$	$2\frac{1}{2}$	1.1
Cambria-Jackson Mine	$24\frac{1}{2}$	3	$27\frac{1}{2}$	55	24.5
Cliffs-Shaft Mine	$\frac{1}{2}$	$5\frac{1}{2}$	5	11	4.9
Lloyd Mine	1	-	-	1	.4
Maas Mine	22	$29\frac{1}{2}$	$21\frac{1}{2}$	73	32.6
Mather Mine "A" Shaft	4	$4\frac{1}{2}$	$2\frac{1}{2}$	11	4.9
Negaunee Mine	22	1	$24\frac{1}{2}$	$47\frac{1}{2}$	21.3
Spies Mine	2	-	-	2	.9
Tilden Mine	-	3	2	5	2.2
Humboldt District	-	3	$\frac{1}{2}$	$3\frac{1}{2}$	1.6
Republic District	-	7	4	11	4.9
Research Lab	-	$1\frac{1}{2}$	-	$1\frac{1}{2}$	.7
TOTALS	78	58	88	224	
%	34.8	25.9	39.3		100.0

W. HARLOW STANNARD, Draftsman, spent a good deal of his time in the early part of the year in connection with the drill records for the Geological Department, drawings for the Mechanical Department and various miscellaneous maps and drawings. On August 1st he was put in charge of all of the draftsmen and office supplies, equipment and surveying instruments. The latter part of the year was spent on special work in connection with the mine maps and the preparation for the Annual Report.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine			$9\frac{1}{2}$	$9\frac{1}{2}$	3.6
Cambria-Jackson Mine			$3\frac{1}{2}$	$3\frac{1}{2}$	1.3
Cliffs-Shaft Mine			$1\frac{1}{2}$	$1\frac{1}{2}$	.6
Lloyd Mine			$3\frac{1}{2}$	$3\frac{1}{2}$	1.3
Mather Mine "A" Shaft			26	26	9.9
Mather Mine "B" Shaft			$36\frac{1}{2}$	$36\frac{1}{2}$	13.9
Morris Mine			$12\frac{1}{2}$	$12\frac{1}{2}$	4.8
Spies Mine			$\frac{1}{2}$	$\frac{1}{2}$	.2
General Engineering			$120\frac{1}{2}$	$120\frac{1}{2}$	45.8
Geological Department			$25\frac{1}{2}$	$25\frac{1}{2}$	9.7
Mechanical Department			$7\frac{1}{2}$	$7\frac{1}{2}$	2.9
Republic District			$8\frac{1}{2}$	$8\frac{1}{2}$	3.2
Humboldt District			5	5	1.9
Section 12, 47-27			$2\frac{1}{2}$	$2\frac{1}{2}$	.9
TOTALS			263	263	100.0

LAWRENCE K. VIALI, Draftsman, during the six months he was in the Department, was occupied in making new mine maps for the different properties and posting the diamond drill records for the Geological Department. He left the Department on June 30th.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine			24	24	18.2
Cambria-Jackson Mine			7 $\frac{1}{2}$	7 $\frac{1}{2}$	5.7
Lloyd Mine			23 $\frac{1}{2}$	23 $\frac{1}{2}$	17.8
Maas Mine			3	3	2.2
Mather Mine "A" Shaft			22	22	16.7
General Engineering			25 $\frac{1}{2}$	25 $\frac{1}{2}$	19.3
General Storehouse			2 $\frac{1}{2}$	2 $\frac{1}{2}$	1.9
Morris Mine			1	1	.8
Spies Mine			6	6	4.5
Geological Department			13	13	9.9
Negaunee Mine			4	4	3.0
TOTALS			132	132	100.0%

GEORGE B. MANZOLINE, Draftsman, continued his work on the Cliffs Power & Light Company ownership maps until August 15th. The rest of the year was spent in making new surface maps and other special maps such as new Annual Report tracings, surface maps, etc.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Cliffs Power & Light Co.			182 $\frac{1}{2}$	182 $\frac{1}{2}$	67.6
General Engineering			69	69	25.6
Mather Mine "A" Shaft			6 $\frac{1}{2}$	6 $\frac{1}{2}$	2.4
Mather Mine "B" Shaft			7	7	2.6
Athens Mine			4	4	1.4
Cambria-Jackson Mine			1	1	.4
TOTALS			270	270	100.0%

DONALD J. BEAUCHAMP, Draftsman, was employed between July 1st and September 22nd. Practically all of his time was spent in making new working maps for the various mines. The following table shows the distribution of his time:

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine			12	12	20.9
Mather Mine "A" Shaft			27 $\frac{1}{2}$	27 $\frac{1}{2}$	47.8
Cliffs-Shaft Mine			5	5	8.7
Lloyd Mine			3 $\frac{1}{2}$	3 $\frac{1}{2}$	6.1
Maas Mine			2	2	3.5
Republic District			1	1	1.7
Cambria-Jackson Mine			$\frac{1}{2}$	$\frac{1}{2}$	.9
Spies Mine			3 $\frac{1}{2}$	3 $\frac{1}{2}$	6.1
General Engineering			2 $\frac{1}{2}$	2 $\frac{1}{2}$	4.3
TOTALS			57 $\frac{1}{2}$	57 $\frac{1}{2}$	100.0

ANSELM MANTYLA, Draftsman, entered the Department on July 19th. He took over the posting of the drill records for the Geological Department and most of his time was spent in connection with making new maps for the mines, both working maps and annual report tracings.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine			21½	21½	17.8
Cambria-Jackson Mine			6½	6½	5.4
Lloyd Mine			7	7	5.8
Cliffs-Shaft Mine			1	1	.8
Mather Mine "A" Shaft			24½	24½	20.3
Spies Mine			13	13	10.8
Geological Department			19½	19½	16.2
General Engineering			10½	10½	8.7
Republic District			17	17	14.2
TOTALS			120½	120½	100.0

EDGAR G. CURTIS, Surveyor, did much of the surveying at the Maas, Negaunee and Athens Mine during the first half of the year and did all of it at the Cambria-Jackson and Athens Mine for the last half of the year.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine	65	22	57	144	54.7
Cambria-Jackson Mine	16½	4½	20½	41½	15.8
Maas Mine	25½	4½	32	62	23.6
Negaunee Mine	9	1	4½	14½	5.5
Spies Mine	1			1	.4
TOTALS	117	32	114	263	
%	44.5	12.2	43.3		100.0

C. ARTHUR KOSKI, Surveyor, did the surveying at the Cliffs-Shaft, Lloyd and Spies-Virgil Mines throughout the year and at the Cambria-Jackson during the first half. He also assisted at some of the other mines in special surveys. The following table shows the distribution of his time for the year:

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine		1		1	.4
Cambria-Jackson Mine	14	3½	9½	27	10.0
Cliffs-Shaft Mine	44	1	38	83	30.7
Lloyd Mine	27	3½	19½	50	18.5
Maas Mine	1			1	.4
Mather Mine "A" Shaft	1	½	1½	3	1.1
Mather Mine "B" Shaft	½		1½	2	.8
Spies Mine	48½	½	20½	69½	25.7
Tilden Mine		1½	½	2	.8
General Engineering		5½	26	31½	11.6
TOTAL	136	17	117	270	
%	50.4	6.3	43.3		100.0

F. ALFRED KOSKI, Surveyor, was at the Mather Mine "B" Shaft all of the year. During the summer he gave lines and grades and supervised all construction work. In the shaft he supervised the installation of bearer sets, gave lines, etc. as required during sinking operations.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Mather Mine "B" Shaft	24	227	15	266	99.3
Research Laboratory	-	2		2	.7
TOTALS	24	229	15	268	
%	9.0	85.4	5.6		100.0

P. DANIEL ISAACSON, Surveyor, made the surveys at the Mather Mine "A" Shaft throughout the year, working with Ralph K. Oja as the alternate surveyor.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Mather Mine "A" Shaft	140	23	104½	267½	99.4
Mather Mine "B" Shaft	½			½	.2
Cliffs-Shaft Mine				½	.2
Tilden Mine		½		½	.2
TOTAL	141	23½	104½	269	
%	52.4	8.8	38.8		100.0

ERNEST A. OJA, Surveyor, was in the field most of the year. Early in the year he ran surveys on to Milwaukee Lake in the Republic District for sounding, and brushed one-half mile of line at the Spies-Virgil Mine for the Geological Department. He made surveys of the Cliffs-Shaft and Mather "A" stockpiles just prior to the shipping season in order to obtain factors for stockpile estimates. He went to Escanaba and Green Bay to make estimates of coal at the Company's docks. During May, June and part of July he ran survey lines in Section 12, 47-27 and during the last half of July, August and September, was making the preliminary surveys in the Humboldt District. The balance of the year he spent in the Humboldt and Michigamme Districts running surveys, locating drill holes, etc. The following table shows the distribution of his time for the year:

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Cliffs-Shaft Mine		5	3	9	3.0
Maas Mine			1	1	.4
Mather Mine "A" Shaft		6½	6	12½	4.7
Mather Mine "B" Shaft		4	1½	5½	2.1
Spies Mine		12	3	15	5.7
General Engineering		12½	28	40½	15.3
Humboldt District		58	14	72	27.3
Michigamme District		14	5	19	7.2
Republic		17	19	36	13.6

Ernest Oja (Continued)

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Section 4, 47-27		4	$\frac{1}{2}$	$4\frac{1}{2}$	1.7
Section 11, 47-27		-	$3\frac{1}{2}$	$3\frac{1}{2}$	1.3
Section 12, 47-27		42	$4\frac{1}{2}$	$46\frac{1}{2}$	17.7
TOTAL	-	175	89	264	
%	-	66.3	33.7		100.0

CLIFFORD H. AMEL, Surveyor, during the early part of the year was engaged in photographing and printing for the Annual Report. He was made a surveyor during the early part of the summer and had charge of brushing lines for the Spies and Section 12 surveys. He assisted in the stockpile and coal pile estimates. Later in the summer, he ran additional surveys in the Humboldt and Michigamme Districts.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine			$6\frac{1}{2}$	$6\frac{1}{2}$	2.4
Cliffs-Shaft Mine		6	5	11	4.1
Maas Mine			2	2	0.8
Mather Mine "A" Shaft		8	$2\frac{1}{2}$	$10\frac{1}{2}$	3.9
Mather Mine "B" Shaft			2	2	0.8
Negaunee Mine			3	3	1.1
General Engineering		16	$42\frac{1}{2}$	$58\frac{1}{2}$	22.0
E. & A. CC-175		16	$4\frac{1}{2}$	$20\frac{1}{2}$	7.7
Humboldt District		28	2	30	11.3
Michigamme District		14	-	14	5.3
Republic District		16	7	23	8.6
Section 12, 47-27		74	3	77	28.9
Spies Mine	1	-	$\frac{1}{2}$	$1\frac{1}{2}$	.6
Morris Mine			7	7	2.5
TOTAL	1	178	$87\frac{1}{2}$	$266\frac{1}{2}$	
%	.4	66.8	32.8		100.0

RALPH K. OJA, Surveyor, worked with Mr. Isaacson at the Mather Mine "A" Shaft throughout the year. He was made a surveyor early in the year.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Cliffs-Shaft Mine	1			1	.4
Lloyd Mine	1		$\frac{1}{2}$	$1\frac{1}{2}$	.6
Mather Mine "A" Shaft	109	20	$137\frac{1}{2}$	$266\frac{1}{2}$	98.6
Spies Mine	1			1	.4
TOTAL	112	20	138	270	
%	41.5	7.4	51.1		100.0

JOHN R. SLEEMAN was a helper in the Negaunee District until June when he was made a surveyor and took over the survey work at the Maas and Negaunee Mines.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine	39½	4	21	64½	23.9
Cambria-Jackson Mine	1½		½	2	.7
Cliffs-Shaft Mine			1	1	.4
Maas Mine	54½	24½	63	142	52.7
Mather Mine "A" Shaft	1		1	2	.7
Negaunee Mine	11½	1	12½	25	9.4
Tilden Mine		18	8½	26½	9.8
General Engineering		2	4½	6½	2.4
TOTAL	108	49½	112	269½	
%	40.1	18.4	41.5		100.0

ROBERT E. ANDERSON entered the Department July 1st as a Helper in the Negaunee District, working with Messrs. Sleeman and Curtis on the underground surveys.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine	11	7	5½	23½	18.2
Cambria-Jackson Mine	6		3½	9½	7.4
Cliffs-Shaft Mine			2	2	1.6
Maas Mine	31	8	22½	61½	47.7
Negaunee Mine	5		4	9	7.0
Spies Mine			1	1	.8
Tilden Mine		16	2½	18½	14.2
General Engineering			4	4	3.1
TOTAL	53	31	45	129	
%	41.1	24.0	34.9		100.0

CLARENCE P. AYOTTE, entered the Department as Helper on April 12th and worked on the survey crew at the Mather Mine "A" Shaft for the rest of the year.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Lloyd Mine	1			1	.5
Mather Mine "A" Shaft	116½	7	49½	173	85.4
Spies Mine	1½	1½		3	1.5
General Engineering		½	½	1	.5
Section 4, 47-27		1		1	.5
Section 12, 47-27		21	2½	23½	11.6
TOTAL	119	31	52½	202½	
%	58.8	15.3	25.9		100.0

HERBERT S. KELLY entered the Department as Helper on May 28th. He assisted in the surveys at the Cliffs-Shaft, Cambria-Jackson, Lloyd and Spies Mines. The following table shows the distribution of his time for the year:

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine	2		$\frac{1}{2}$	$2\frac{1}{2}$	1.6
Cambria-Jackson Mine	5	1	$3\frac{1}{2}$	$9\frac{1}{2}$	6.1
Cliffs-Shaft Mine	$8\frac{1}{2}$		7	$15\frac{1}{2}$	10.0
Lloyd Mine	11	$1\frac{1}{2}$	7	$19\frac{1}{2}$	12.6
Maas Mine	$1\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$2\frac{1}{2}$	1.6
Mather Mine "A" Shaft	11		4	15	9.7
Mather Mine "B" Shaft		$\frac{1}{2}$	1	$1\frac{1}{2}$	1.0
Negaunee Mine	1	$\frac{1}{2}$		$1\frac{1}{2}$	1.0
Spies Mine	28		$9\frac{1}{2}$	$37\frac{1}{2}$	24.3
Tilden Mine		$3\frac{1}{2}$	$\frac{1}{2}$	4	2.6
General Engineering			$45\frac{1}{2}$	$45\frac{1}{2}$	29.5
TOTALS	68	$7\frac{1}{2}$	79	$154\frac{1}{2}$	
%	44.0	4.9	51.1		100.0

ALFRED B. NAULT, Helper, assisted in the surveys at the Cliffs-Shaft, Lloyd and Spies-Virgil Mine throughout the year and at the Cambria-Jackson and other mines as the occasion required.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine		1		1	.4
Cambria-Jackson Mine	14	3	$5\frac{1}{2}$	$22\frac{1}{2}$	8.5
Cliffs-Shaft Mine	$40\frac{1}{2}$	1	$41\frac{1}{2}$	83	31.2
Lloyd Mine	$25\frac{1}{2}$	$3\frac{1}{2}$	12	41	15.4
Maas Mine	1			1	.4
Mather Mine "A" Shaft			$3\frac{1}{2}$	$3\frac{1}{2}$	1.3
Mather Mine "B" Shaft		$1\frac{1}{2}$		$1\frac{1}{2}$	.6
Spies Mine	42	3	$23\frac{1}{2}$	$68\frac{1}{2}$	25.8
Tilden Mine		3		3	1.1
General Engineering	5	3	33	41	15.3
TOTALS	128	19	119	266	
%	48.1	7.2	44.7		100.0

RAYMOND E. OJA, Helper, assisted in the underground surveys at the various mines until April when he asked to be relieved of underground work because of his skiing injury last year. He spent the rest of the year helping on the various field crews in the Section 12, 47-27, Humboldt, Republic and Michigamme Districts.

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

Ray Oja

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine	18½	½	7	26	10.1
Cambria-Jackson Mine	2½			2½	1.0
Cliffs-Shaft Mine	1½	½		2	.7
Lloyd Mine	2½			2½	1.0
Maas Mine	13	4½	2	19½	7.5
Mather Mine "A" Shaft	2	3	1	6	2.3
Mather Mine "B" Shaft		3	1	4	1.5
Negaunee Mine	5	1		6	2.3
Spies Mine	2	2	1	5	1.9
General Engineering		21	54	75	28.9
E. & A. CC-175		9½		9½	3.7
Humboldt District		44	5	49	18.9
Michigamme District		15½		15½	6.0
Republic District		6		6	2.3
Section 12, 47-27		29	2	31	11.9
TOTALS	47	139½	73	259½	
%	18.1	53.8	28.1		100.0

RUSSELL J. PAULL, Helper, assisted at the Mather "A" Mine surveys until April when he was transferred to the Negaunee District and has worked principally with Mr. Curtis at the Athens and Cambria-Jackson Mines.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine	36	16	27	79	30.1
Cambria-Jackson Mine	14	1	11	26	9.9
Cliffs-Shaft Mine	2		2½	4½	1.7
Lloyd Mine	4		2	6	2.3
Mather Mine "A" Shaft	6½	1	15	22½	8.6
Maas Mine	33	2	18½	53½	20.3
Spies Mine	9	2	2½	13	5.1
General Engineering		3	40½	43½	16.6
Negaunee Mine	6½		4	10½	4.0
Tilden Mine		1		1	.4
Morris Mine			2½	2½	1.0
TOTALS	111	26	125½	262½	
%	42.3	9.9	47.8		100.0

RAYMOND S. WINDSAND, Helper, has assisted in the surveys at the Mather Mine "A" Shaft throughout the year.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine	1			1	.4
Cambria-Jackson Mine	$\frac{1}{2}$			$\frac{1}{2}$	.2
Cliffs-Shaft Mine	3			3	1.1
Mather Mine "A" Shaft	151	13	46 $\frac{1}{2}$	210 $\frac{1}{2}$	77.0
Spies Mine	3		1	4	1.5
General Engineering	2	7	44 $\frac{1}{2}$	53 $\frac{1}{2}$	19.4
Republic District		1		1	.4
TOTALS	160 $\frac{1}{2}$	21	92	273 $\frac{1}{2}$	
%	58.7	7.7	33.6		100.0

MARTIN D. TASSON, Entered the Department August 2nd as Chauffeur because of the necessity of transporting field crews to different localities. He also looked after the cars and assisted in field surveys during the latter part of the year at Humboldt and Michigamme.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
E. & A. CC-175		4 $\frac{1}{2}$		4 $\frac{1}{2}$	4.1
General Engineering		32	19	51	46.4
Humboldt District		36	1	37	33.6
Michigamme District		14 $\frac{1}{2}$		14 $\frac{1}{2}$	13.2
Republic District		2		2	1.8
Section 12, 47-27		1		1	.9
TOTALS		90	20	110	
%		81.8	18.2		100.0

LOUIS R. MILLER, Helper, assisted in the field surveys during the early part of the year in the Republic, Spies and Section 12 areas. After July 1st, he was in charge of the blueprint room and was in the office most of the time from then on, making blueprints and helping in other office work.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine		5	3 $\frac{1}{2}$	8 $\frac{1}{2}$	3.7
Cambria-Jackson			$\frac{1}{2}$	$\frac{1}{2}$	.2
Cliffs-Shaft		5	5 $\frac{1}{2}$	10 $\frac{1}{2}$	4.6
Lloyd Mine		1		1	.4
Maas Mine		1	4	5	2.2
Mather Mine "A" Shaft		2	7 $\frac{1}{2}$	9 $\frac{1}{2}$	4.1
Negaunee Mine			1	1	.4
General Engineering		1	132 $\frac{1}{2}$	133 $\frac{1}{2}$	58.0
Humboldt District		2		2	.8
Republic District		5 $\frac{1}{2}$	8 $\frac{1}{2}$	14	6.1
Section 4, 47-27		1		1	.4

Louis R. Miller (Continued)

<u>Property</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Section 12, 47-27	35½	3½	39	17.01
Spies Mine	1	3½	4½	2.1
TOTALS	59	171	230	
%	25.7	74.3		100.0

JOSEPH H. COPELAND was employed as a Helper on the surface surveys between July 2nd and August 31st when he returned to college.

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

<u>Property</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Humboldt District	24	1	25	59.5
Republic District	7		7	16.7
Section 12, 47-27	9	1	10	23.8
TOTALS	40	2	42	
%	95.2	4.8		100.0

WERNER E. TALUS was also employed as a Helper in the surface surveys between July 22nd and September 10th when he returned to college.

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

<u>Property</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Maas Mine	1		1	2.8
Humboldt District	15	1	16	44.5
Republic District	7		7	19.4
Section 12, 47-27	12		12	33.3
TOTALS	35	1	36	
%	97.2	2.8		100.0

MESSRS. WAYNE D. AHL and ROBERT R. WALLACE were employed for three weeks in August running levels in Section 3 and 4, 47-27 for the Geological Department in connection with their geophysical surveys. They also ran levels on the N-S 11400 W. line which extended 2½ miles South from Teal Lake to the South line of Section 11, 47-27.

DONALD W. CARLSON did the stenographic work for both the Engineering and Geological Departments for the entire year. He requisitioned supplies, did the filing, recorded documents and took care of the general office work for both departments.

KENNETH C. OLSON, Surveyor, was employed from July 6th to September 22nd to run surveys in the Humboldt District for geophysical work by the Geological Department.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Humboldt District	-	44	6½	50½	89.4
Republic District	-	1		1	1.7
Spies Mine	-	5		5	8.9
TOTALS	-	50	6½	56½	
%	-	88.5	11.5		100.0

E. DISTRIBUTION OF TIME

There was an unusually large amount of field work during 1948. Furthermore, the underground surveys required a great deal more attention than previously.

The following table shows the distribution of time for the year, divided between underground, field and office, for the different properties and jobs, and the percentage of time spent on each property:

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine	303½	68	266	637½	8.9
Cambria-Jackson Mine	131	19	119½	269½	3.8
Cliffs-Shaft Mine	174½	26½	237	438	6.1
Lloyd Mine	127	17½	151	295½	4.1
Maas Mine	285	92½	244½	622	8.7
Mather Mine "A" Shaft	628	130½	638	1,396½	19.6
Mather Mine "B" Shaft	25	236	65½	326½	4.6
Negaunee Mine	86½	5	71	162½	2.3
Spies-Virgil Mine	192	33½	170	395½	5.5
Tilden Mine		60	18½	78½	1.1
General Engineering	8	166	961½	1,135½	15.9
Geological Department			58	58	.8
Republic District		75½	65½	141	2.0
Michigamme District		58½	5	63	.9
Humboldt District		254	36	290	4.1
Cliffs Power & Light Co.			182½	182½	2.6
Research Laboratory		19½		19½	.3
Morris Mine			23	23	.3
Mechanical Department			7½	7½	.1
Section 12, 47-27		223½	19	242½	3.4
Stenography			269	269	3.8
Section 4, 47-27		14	2½	16½	.2
Section 11, 47-27			3½	3½	.1
E. & A. CC-175		30	4½	34½	.5
Section 5, 47-27		10	2	12	.2
Storehouse			2½	2½	.1
TOTALS	1,960½	1,539	3,623	7,122½	
%	27.5	21.6	50.8		100.0

F. COSTS

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

	<u>1946</u>	<u>1947</u>	<u>1948</u>
Salaries	\$ 40,802.33	\$ 57,754.59	\$ 79,449.63
Auto Expense	2,373.78	3,333.94	3,335.67
Furniture & Fixtures	261.51	361.11	34.47
Heat, Light & Power	789.69	1,026.51	721.25
Insurance	124.32	145.48	149.69
Postage	33.70	27.82	53.90
Repairs	112.88	80.00	41.90
Stationery & Printing	153.65	234.72	809.88
Supplies	3,450.24	5,053.10	7,152.02
Taxes	46.69	46.55	51.65
Traveling & Entertainment	159.64	508.32	1,020.09
Telephone & Telegraph	96.08	101.34	132.89
Papers & Periodicals	21.43	16.33	2.50
Unemployment Insurance Tax	529.87	849.90	887.37
General - Unclassified	491.79	653.78	1,059.60
Old Age Benefit Tax	407.63	587.93	682.66
Depreciation	104.07	104.08	95.37
Group Annuity Premiums	-	201.18	-
Equipment	788.58	1,358.17	-
	<hr/>	<hr/>	<hr/>
TOTALS	\$50,748.18	\$72,444.85	\$95,680.54

H. AUTOMOBILES

The Company-owned Ford and Chevrolet station-wagons were operated throughout the year. The Ford Tudor sedan furnished by Four Wheels, Inc., was replaced by a similar Ford on November 19th.

The following table shows the mileage covered in 1948, the total mileage to the end of the year, and the date the cars were received in the Engineering Department:

<u>Car</u>	<u>Miles</u>		<u>Date Received</u>
	<u>1948</u>	<u>Total</u>	
Ford Sedan	12,246	34,517	August 17, 1946
Ford Sedan	1,849	2,296	November 19, 1948
Ford Station-Wagon	6,129	51,618	January 24, 1941
Chevrolet Station-Wagon	10,694	58,114	July 29, 1943

I. MINES

The following summary covers the special work done at the various properties during the year:

GENERAL

The mines operated on a six day schedule throughout the year. With the enlarged survey crew personnel, the Department was able to keep up with the demands for surveys at all the properties. The development of main levels at the Mather "A", Lloyd and Spies Mines required frequent lines and grades. Diamond drill holes were located so as to give proper alignment and then were resurveyed after drilling commenced. There was comparatively little surface work in connection with the mines. There were inspections of the caved areas at each property in the spring after the snow disappeared and the extensions of settlement were surveyed late in the fall.

ATHENS MINE

Estimates were prepared for excavation and grading at the East end of the stocking ground to provide better access to the stockpile area. During the year additional cracks developed affecting the foundations of houses on Boyer Avenue and Ann Street besides showing up in the mine buildings and tunnel near the shaft. The settlement of the dry building required constant attention for maintaining steam and water service. During the summer, a series of iron pins were placed, which were surveyed both for location and elevation so that vertical as well as lateral subsidence could be noted over a period of time. Pins were also set to determine whether or not the shaft house was being affected. There was very little change noted by late fall. During the year frequent plans were made for a new surface lay-out, both partial and complete, but by the end of the year nothing definite had been decided.

Underground, the development of the block-caving system in the Corbit Lease was planned and supervised, which required frequent surveys both for alignment and grade for the scraper and grizzly subs and all of the raises involved in the block-caving system. Mr. DeGabriele, as Mining Engineer, watched the progress of withdrawal very carefully after the actual mining commenced. Frequent studies for development of the new ore Deposit North of the main dike were made.

CAMBRIA-JACKSON MINE

Check surveys were run on the 7th Level to the connection from the 3rd Level, Mather "A" Shaft, and after the connection was holed, the surveys between the two properties tied in by a difference of 1.21' in the Northing and Southing and 0.31' in the Easting and Westing, with 0°07' for course and 1.39' for elevation. Considering the difficulties in plumbing the Hartford No. 2 Shaft where a distance of only 5' between wires could be obtained, we consider this tie-in satisfactory. Plans were prepared for the development of the 8th Level, making a comparison between a vertical winze with skip, or incline for belt conveyor.

CLIFFS-SHAFT MINE

During the year, Mr. Madsen, working with the Geological Department, prepared an estimate of tonnage tied up in pillars and floors which estimate amounted to 3,900,000 tons. Besides the regular quarterly surveys, monthly advances of drift development and raises were made for the Superintendent.

LLOYD MINE

The sinking of the winze to the 9th Level was resumed early in the year. The progress of the winze and development of the 9th Level was supervised and lines given as required. The development of the stopes above the 9th Level also were planned and surveys were made as needed from time to time.

MAAS MINE

The construction of the concrete base for the new steel stocking trestle West of the shaft was planned and supervised to make ready for the construction of the steel work. Underground, a new skip pit cleaning raise was planned and surveys run as needed during its development. Mr. Kauppila worked with the Geological Department in making a study of the ore body with special attention to the limits above and below the 6th Level which was used in making a careful study of a proposed 7th Level development. By the end of the year, it was decided to deepen the winze from which the 6th Level had been developed and plans prepared for installation of equipment preparatory to sinking.

MATHER MINE "A" SHAFT

Early in the year, the East timber yard was graded by contract and frequent lines and grades were needed during the progress of this work. Afterwards, lines were given for the installation of timber tracks, construction of retaining walls, etc. During the summer a careful study was made of the steel trestles with a view towards a 3rd stocking trestle and a widening of the permanent trestle and having a better alignment for the top tram tracks. Plans for the installation of the 6½ Level for handling of rock and later for the development of the 7th Level were prepared. By the end of the year the 6½ Level was completed and the winze to the skip pit level below the 7th were completed. This skip pit had also been driven under the shaft ready for raising to the present shaft bottom. The development of the 5th and 6th Levels throughout the year required frequent lines and grades and several check surveys were run on the 6th Level from the shaft to the breast of the drift toward "B" Shaft. Elevations were carefully checked from the collar to the 6th Level and to an established bench mark, and the proposed rail elevation at "B" Shaft was carefully considered so that the necessary cut-out and shaft set arrangement could be made at the proper elevation.

MATHER MINE "B" SHAFT

Early in the year sections were made across the proposed stocking area and estimates prepared for grading. This work was supervised as it progressed under contract. Lines and grades were given for forms and the construction of the tunnel adjacent to the shaft was supervised during the summer. In the shaft, frequent plumbings were made to check the bearer and shaft sets.

NEGAUNEE MINE

There was very little survey work required at the Negaunee Mine during the year but some lines were given on the 14th Level.

SPIES-VIRGIL MINE

The shaft was again plumbed from the 4th to 6th Level to check the 6th level surveys and lines and grades given as the drifting progressed toward the East Deposit. Surveys were run into the subs above the 4th Level as required.

TILDEN MINE

There was very little work done at the Tilden Mine except to estimate possible stripping, locate drill holes and supervise the blasts at the different benches as they were made.

J. MISCELLANEOUSORE ESTIMATES

During the year the ore outlines at the various properties were checked with the Geological Department so that information could be correlated both for estimate purposes and for use of the Mine Superintendent. The ore estimates prepared for the Michigan State Tax Commission and also for the Mine Superintendents for 1948 are shown below and compared with those of the previous year:

	<u>As of 12/31/47</u>	<u>As of 12/31/48</u>
Athens Mine	2,703,097 tons	2,610,597 tons
Cambria-Jackson Mine	2,228,622	1,732,110
Cliffs-Shaft Mine	1,816,756	1,798,890
Lloyd Mine	341,211	533,848
Maas Mine	5,942,378	5,616,883
Mather Mine "A" Shaft	11,228,515	12,153,767
Negaunee Mine	413,260	198,170
Spies - East Deposit	<u>722,396</u>	<u>665,595</u>
TOTALS	25,396,235 tons	25,309,860 tons

STOCKPILES

In March, after shipping season started and before any shipping was done from the stockpiles, the ore in stock at the Cliffs-Shaft and Mather "A" Mine was surveyed to obtain the cubical contents. It was anticipated that the piles would be entirely cleaned up and that we could obtain a factor for the ore at these properties. At the Cliffs-Shaft Mine, the size of opening in the screen at the crusher had been reduced several times since our last factor was obtained thus changing the proportion between fines and lump. At the Mather "A" Mine, no factor had been obtained and we had previously used that of the Maas Mine, namely 13.75 cubic feet per ton. The factors obtained by these surveys are as follows:

Cliffs-Shaft Lump	15.22 cu. ft. per ton.
Cliffs-Shaft Crushed	14.06 " " " "
Mather	13.75 " " " "

The estimates of ore in stock were made as of November 1st, 1948 and the following table shows the ore in stock on November 1, 1948 as compared with that of November 1, 1947:

	<u>November 1, 1947</u>	<u>November 1, 1948</u>
Athens mine	5,336 tons	0 tons
Cambria-Jackson Mine	2,808	0
Cliffs-Shaft Mine	0	24,374
Lloyd Mine	98,323	49,324
Maas Mine	32,432	4,214
Mather Mine "A" Shaft	3,948	3,733
Negaunee Mine	63,335	0
Princeton Mine	14,165	0
Spies-Virgil Mine	7,873	11,522
TOTALS	<u>228,220 tons</u>	<u>93,167 tons</u>

SHAFT GAUGING

The runners in the various operating shafts were gauged on the dates shown on the table below:

Athens - - - -	September 26
Cambria-Jackson -	" 19
Cliffs-Shaft A & B -	November 5.
Lloyd Mine	- October 17.
Maas	- October 31.
Mather "A"	- October 10.
Negaunee	- September 23.
Spies	- October 24.

TRIANGULATION SURVEYS

During September and October, Mr. Madsen re-ran some of the quadrilaterals West of Ishpeming so as to extend the triangulation system into Sections 4 and 9, 47-27. We were unable to do as much as we hoped but were able to establish one good quadrilateral in that area.

SURFACE TRAVERSE SURVEYS

The Geological Department extended their geophysical surveys onto Section 12, 47-27 and to assist this work, we ran eight miles of survey coordinate lines in that Section, establishing concreted iron pins in favorable locations on all the lines. The coordinate lines run were the following:

S. 5600	S. 8000
S. 6400	S. 9600
S. 7200	S. 10400

These lines were all connected by traverse on the East side of the section and the survey was tied in with the triangulation station #110 in Section 7, 47-26. All these surveys checked very closely and were adjusted for correction. The entire survey, therefore, is now tied in with the triangulation system. This work kept two crews busy under Messrs. E. Oja and C. Amel until the middle of July, after which time Amel's crew completed the work.

The old markers at the Northeast corner and the Southwest corner of the NW $\frac{1}{4}$ of NW $\frac{1}{4}$ of Section 7, 47-26 were replaced by standard markers set in concrete. This work was done in conjunction with the engineers of the Jones & Laughlin Ore Company, representing the owners of adjacent lands.

REPUBLIC DISTRICT

During February soundings were taken on Milwaukee Lake located in Section 8, 46-29, where an average of 10' of water and 20' of mud were found. This information was desired in anticipation of the use of the lake for tailings disposal. Several weeks were spent in contouring parts of the SE $\frac{1}{4}$ of NE $\frac{1}{4}$ of Section 7 and the SW $\frac{1}{4}$ of NW $\frac{1}{4}$ of Section 8, 46-29 as a probable site for a beneficiation plant.

The purchasing of all the lands under options in Sections 8 and 17, 46-29, was completed the latter part of the year. Mr. Brewer attended to the completion of the abstracts and title opinions for these lands but this work was not completed by the end of the year.

HUMBOLDT DISTRICT

During the spring, preliminary studies were made as to what lands might be needed for tailings disposal purposes for development of the Washington Iron Company lands. During April, Mr. Brewer assisted Mr. G. R. Jackson in securing options to purchase the land. In some cases direct purchases had to be made and by the end of the year, most of the land had been either purchased or optioned. The following table shows the descriptions of lands either optioned or purchased and the name of the party from whom they were obtained:

<u>Name</u>	<u>Lands Optioned or Purchased</u>	<u>Title Acquired</u>
Victor C. Laitala	W $\frac{1}{2}$ of SE $\frac{1}{4}$, Section 10, 47-29	Option
Taisto Tuomi	SE $\frac{1}{4}$ of SE $\frac{1}{4}$, " 10, "	Purchased
Arthur Rosten	SW $\frac{1}{4}$ of SW $\frac{1}{4}$, S $\frac{1}{2}$ of SE $\frac{1}{4}$ of Section 11, 47-29	Option
Ivar Mackey	NW $\frac{1}{4}$ of SW $\frac{1}{4}$, " 11, "	Purchased
Niilo Parkkonen	SW $\frac{1}{4}$ of SW $\frac{1}{4}$, " 12, "	Purchased
Arthur Rosten	SE $\frac{1}{4}$ of SW $\frac{1}{4}$, " 12, "	Purchased
Lillie Ogea	E $\frac{1}{2}$ of NE $\frac{1}{4}$, " 14, "	Option
Mabel S. Skewis	NE $\frac{1}{4}$ of NE $\frac{1}{4}$, " 15, "	Option
Mary J. Snell	SE $\frac{1}{4}$ of NE $\frac{1}{4}$, " 15, "	Option
Alfred C. Richards	NW $\frac{1}{4}$ of NE $\frac{1}{4}$ and NE $\frac{1}{4}$ of NW $\frac{1}{4}$, Section 15, 47-29	Option

There were several other parcels desired but we have not yet come to terms with the owners. In July, surveys were started commencing at the Northeast corner of Section 1, 47-29 and were run down onto Sections 11 and 12, comprising the property of the Washington Iron Company. On July 18th a polaris observation was made upon which the courses of our surveys are based. A check of 0°01' in course was made with previous surveys of other companies. During the late summer and fall two East and West lines were run, namely: the S. 5600 line from 3752 W. to 9000 W. and the S. 6400 line from 5600 W. to 9728 W. Both the East and West ends of these lines were tied in by traverse surveys near the highway, US-41. Additional surveys were run to tie in property corners and the area adjacent to the highway was mapped. Most of the surveys involved a considerable amount of chopping as the terrain is quite heavily wooded with second growth. Concreted iron pins were set on all the survey lines and levels run to them.

AERIAL SURVEYS

Contour maps of the Humboldt and Republic Districts were required in order that proper study could be made as to what lands would be needed for plant site, surface equipment, tailings disposal, etc. It was realized that surface surveys would take too long to give the information desired. It was therefore decided to have contour maps made from aerial photographs of both these districts. A contract was given to the Aero Service Corporation of Philadelphia for these maps and definite descriptions were given them, of which 10' contours were desired. There were 2,740 acres in the Humboldt District and 2,490.3 acres in the Republic District. The Aero Service Corporation took their photographs during October and they had a survey crew in the field for horizontal and vertical control during the latter part of November and early December. Prior to the air photography, our field crews marked many of the property corners and survey stations by either strips of cheesecloth or lime in order that they could be identified on the maps. The finished contour maps had not been received by the end of the year but were expected in January. These maps will be of great value in preliminary studies for development of both areas.

LEVELING

During three weeks in August, Messrs. Wallace and Ahl ran about five miles of levels for the Geological Department in connection with their geophysical surveys. A mile and a half of these surveys were in Section 5, 47-27 and the balance on a North-South line across Sections 35, 48-27 and Sections 2 and 11, 47-27 on the 11400 W. coordinate line.

COAL ESTIMATES

During April a survey crew measured the coal in stock on the docks in Green Bay and Escanaba for the Coal Department.

GROUND WATER LEVELS

During the year monthly readings of the ground water levels were taken at the Maas, Negaunee, Athens and Mather "A" Mines. The following table shows a comparison of these readings:

Test Hole No.	<u>MAAS MINE</u> Elevation of Water		Difference 1948	Original Elevation	Total Difference
	Jan. 1, 1948	January 1, 1949			
1W	1261.1	1255.2	-5.9	1317.0	-61.8
2W	1252.0	1250.0	-2.0	1318.8	-68.8
5W	1251.5	1252.0	+0.5	1366.6	-114.6
9W	1271.4	1269.9	-1.5	1281.8	-11.9
13W	1304.2	1304.4	+0.2	1340.0	-35.6
14W	1286.4	1282.7	-3.7	1323.8	-41.1
15W	1309.2	1307.8	-1.4	1326.3	-18.5
16W	1279.6	1279.4	-0.2	1324.8	-45.4
18W	1257.4	1253.2	-4.2	1319.4	-66.2
20W	1263.1	1261.6	-1.5	1319.0	-57.4
21W	1247.8	1243.1	-4.7	1229.1	+14.0

NEGAUNEE MINE

Test Hole No.	Elevation of Water		Difference 1948	Original Elevation	Total Difference
	Jan. 1, 1948	Jan. 1, 1949			
6A	1180.7	1182.7	+2.0	1197.0	-14.3
7	1187.8	1188.7 (Oct. 1)(1)	+0.9	1195.1	-6.4

ATHENS MINE

104W	1296.3	1296.6	+0.3	1299.5	-2.9
105W	1299.0	1298.5	-0.5	1301.5	-3.0
106W	1297.1	1295.6	-1.5	1302.4	-6.8

MATHER "A" MINE

22	1388.0 (May 1)(2)	1385.0	-3.0	1387.8	-2.8
26	1406.8 (May 1)	1404.6	-2.2	1406.8	-2.2
32*	1407.9	1401.8	-6.1	1409.4	-7.6
38A	1390.1	1386.1	-4.0	1391.3	-5.2
40	1396.0 (July 1)	1383.3	-12.7	1394.8	-11.5
54*	1389.2	1381.1	-8.1	1390.2	-9.1
55*	1390.1	1383.9	-6.2	1390.5	-6.6
56*	1399.4	1390.0	-9.4	1401.0	-11.0
57*	1430.1	1416.3	-13.8	1420.1	-3.8
60*	1393.3 (May 1)	1385.6	-7.7	1393.3	-7.7
61*	1407.3 (May 1)	1389.0	-18.3	1407.3	-18.3
62*	1384.3 (May 1)	1380.4	-3.9	1384.3	-3.9

*These holes have slotted pipes.

(1) This hole was lost due to gravel washing operations in the vicinity.

(2) Dates shown are when first reading was taken in 1948.

At the end of the year it was decided that readings at the Maas, Negaunee and Athens Mines be discontinued because of the uncertainty as to their accuracy. There is a solid pipe in all of these holes so that the only access water can have is from the bottom. Therefore, if the bottom becomes plugged by silt, etc., the reading of any water elevation in the pipe may not coincide with any ground water levels on the outside. A study of the fluctuation in the individual pipes leads us to believe that most of the pipes are more or less stopped up.

The Layne-Northwest Company completed their well at the Mather "A" Shaft early in the year and the pump which was installed during March produced 330 G.P.M. This gradually reduced during the year until at the end it was pumping 110 G.P.M. This pumping apparently had very little effect on the ground water as shown in the various test holes except in Holes 56 and 61 which are about 400 and 300 feet away from the well. The water in Hole #40 is below ledge surface, and is therefore not reliable.

There were frequent conferences with Mr. Wilbur T. Stuart of the Water Division of the U. S. Geological Survey regarding his study of the ground water situation in this locality. Mr. Stuart was also asked to recommend where we could probably obtain an adequate water supply for any developments in the Humboldt District. His study has been of great value in making preliminary plans for water supply in this District.

Mr. Stuart also assisted the Department in a study of an adequate water supply for the proposed Cliffs Power & Light Company steam plant in Ishpeming.

OWNERSHIPS

Early in the year authorization was given to obtain accurate ownership information on the Marquette Range and elsewhere as it seemed advisable in connection with reconnaissance surveys. These ownerships have been placed on maps similar to those being prepared for the Cliffs Power & Light Company, scale 1" = 500', so that they supplement those maps. Most of the information as to ownerships gathered during the year were in Ranges 28, 29 and 30, Marquette County and Range 31 in Baraga County. In the early part of the year, many of the Cliffs Power & Light Company maps were completed but work on these had to be discontinued temporarily because of other work.

MINING OPTIONS AND LEASES

Iron County

The preparation of mining options and leases for Land Offers 2391 and 2417, covering the NW $\frac{1}{4}$ of Section 26 and the NE $\frac{1}{4}$ of Section 27, 43-35, respectively, have been continued throughout the year. The general form of option and lease was prepared and submitted to the fee-owners for preliminary approval. This, however, could not be done until September as it took the Legal Department a long time to make full title reports. The situation was further complicated by the State ownership of platted lots and metes and bounds descriptions. The Michigan Department of Conservation in whose name the land stood, offered their lands in the above descriptions for mining least at public auction on April 16, 1948. This Company was the successful bidder for the State lands. Afterwards it became necessary to determine the proportion of State ownership in the different forties of each Land Offer and an agreement had to be made between the State and the fee-owners as to the proper proportions. This had not been entirely completed by the end of the year. It is expected that all of these documents will be ready for submission to the fee-owners early in 1949.

Baraga County

Early in the year the Mining Department became interested in the Michigamme District and investigations were made as to the title and possibilities of beneficiation. The area naturally divides itself into the two districts; the North Michigamme District comprising the old Michigamme and Spurr Mines and the South Michigamme District comprising the Webster, Portland, Steward and Ohio Mines. In the North Michigamme District, options to purchase were obtained on several parcels of land in Section 24, 48-31, two of which options were consummated. These options were as follows:

Donald A. Olson, covering the NE $\frac{1}{4}$ of SE $\frac{1}{4}$ of Section 24, 48-31, Surface only

Arnabelle Evensen and Evalyn Sommers, covering a two-thirds interest in the N $\frac{1}{2}$ of SW $\frac{1}{4}$ of Section 24, 48-31.

George Bressler and wife, covering the NW $\frac{1}{4}$ of NW $\frac{1}{4}$ of Section 24, 48-31.

The first two of these options were taken up and the lands purchased, while the third option was allowed to elapse. These lands were later conveyed to the Inland Steel Company.

A study was made as to the value of Mr. W. G. Mather's lands in Section 19, 48-31 comprising the old Michigamme Mine.

In the South Michigamme District, negotiations to purchase the SE $\frac{1}{4}$ and the SE $\frac{1}{4}$ of SW $\frac{1}{4}$ of Section 22, 48-31 were made with the owner, the Huron Mineral Land Company and although the terms had been agreed upon, the deal was not completed at the end of the year.

Application for lease had been made in November to the fee-owners of the N $\frac{1}{2}$ of NW $\frac{1}{4}$ of Section 26, 48-31, comprising the Portland Mine and the terms and form of lease were agreed upon. The lease was being prepared at the end of the year.

Application was made late in the year to the Department of Conservation for the leasing of the S $\frac{1}{2}$ of SW $\frac{1}{4}$ of Section 23, 48-31, comprising the Steward Mine. This application had been approved but no action had been taken by the Conservation Department by the end of the year.

CASCADE DISTRICT

The Cascade Corporation, under Land Offer No. 2458, offered the NW $\frac{1}{4}$ and the SE $\frac{1}{4}$ of Section 19, 47-26 and the NE $\frac{1}{4}$ and W $\frac{1}{2}$ of Section 29, 47-26 to the Company for mining purposes. The form of lease submitted was not satisfactory to us and by the end of the year negotiations were under way for acceptable terms.

FORMS OF MINING OPTION AND LEASE

The preparation of the form of option and lease for the Iron County properties showed the necessity of having a more or less standard form of document which could be presented to fee-owners at the time of application for lease. The Mining Lease prepared by the Michigan Department of Conservation for the mining of iron ore under which the first public auction of Michigan State lands was held on April 16th, was considered an excellent document. It was decided that, if possible, future Company leases would be based on this form. The preparation of standard blank forms of option for lease and operating agreements occupied a good portion of Mr. Brewer's time during the year. Toward the latter part of the year he commenced preparation of standard forms based on the State lease.

MINE WATER DISCHARGE

Negotiations were completed with the Barasa heirs for the Athens Mine water discharge across the S $\frac{1}{2}$ of SE $\frac{1}{4}$ of Section 32, 48-26. Negotiations were completed for the purchase of the SW $\frac{1}{4}$ of SE $\frac{1}{4}$ of Section 33, 48-26 from Alice V. Malone and the undivided half of the N $\frac{1}{2}$ of SE $\frac{1}{4}$ and the SE $\frac{1}{4}$ of SE $\frac{1}{4}$ of Section 33, 48-26 from Elizabeth K. Keating. Unsuccessful negotiations were made with the Maloney heirs for the purchase of the SW $\frac{1}{4}$ of SW $\frac{1}{4}$ of Section 33, 48-26. All of these lands were needed to take care of the Athens and Maas-Negaunee Mine water discharges.

The Spies mine water has flowed across the Allen Addition to Iron River for many years, and buildings have been constructed over the ditch, making it difficult to maintain proper flowage. Investigation showed that this ditch could be re-routed to by-pass the Allen Addition entirely. This diversion of partly open ditch and part pipe, was planned and the installation was supervised by Mr. Olson.

HOLIDAYS

The following holidays were granted during the year:

January 1st New Year's Day.
May 31st Memorial Day.
July 5th Independence Day.
September 6th Labor Day.
November 25th Thanksgiving Day.
December 24th ($\frac{1}{2}$) Christmas Eve.
December 25th ($\frac{1}{2}$) Christmas Day.
December 31st ($\frac{1}{2}$) New Year's Eve.

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MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1948

AGNEW MINE:

This mine operated the twelve months with only a few changes made on mechanical equipment. Due to increased number and larger size of double drum slushers underground, it was necessary to install a second 100 K.W. synchronous converter set in engine house. On account of stripping at the South Agnew Mine in July, a 40 ft. section was removed from upper end of Layne Bowler deep well pump to bring motor equipment back to ground level.

In engine house, the compressor discharge was equipped with thermal cut out and thermometer as protection from excessive heat. In August, the intercooler and aftercooler were cleaned, reducing the compressor discharge temperature from 330° to 275°.

During April, a 1½ yd. rented diesel shovel was used to load out ore stock pile which was cheaper than to use the old 4 yd. steam shovel. This steam shovel and a 70 ton locomotive were cut up and shipped for scrap in September.

ATHENS MINE:

On surface, a 100 G.P.M. 120 ft. head deep well pump from Maas Mine was installed in Lucky Star Shaft during July to lower surface water in the hopes that the volume of underground mine water would decrease. It was found this pumping caused the shaft timbers to subside when water support was removed and the pump had to be taken out to save it. Later it was found that the increased water was coming from Partridge Creek on the south boundary of pit. Some trouble was experienced on permanent top tram trestle when the knee bracing on one column buckled, squashing the top tram car when it fell 40 ft. The Hard Ore steel crew reinforced the braces in August and a new car was installed. The 80-B electric shovel for stock pile loading was overhauled and the boom shortened five feet. In the engine house, the Ingersoll-Rand compressor intercooler and jackets were cleaned in June and steel piping for cooling water changed to copper piping.

Underground a conveyor belt system was installed on 4th level for test on block caving system. After shuttle feeder speed was reduced and a broken shaft replaced on drive sprocket, the equipment gave satisfaction. In the shaft, 300 ft. of 6" air line rusted out and was replaced. In pump house, the plungers on Prescott pumps were changed. It was necessary to remove the double deck cage for repairs in September and replace it with a single deck. The double deck was overhauled and put back into operation during December.

As the two galvanized hoisting ropes worn out on skip hoist showed an increase of 100,000 tons over the non-galvanized type, it has been decided to standardize on this type rope for the future for all mines in the old Negaunee District.

ATKINS MINE:

On receipt of new 54-B electric shovel No. 64, the No. 49 shovel from Canisteo Mine was repaired and shipped to the Cliffs Shaft Mine at Ishpeming for stock pile loading. In the shops, a 5 ton overhead crane was installed.

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1948

ATKINS MINE: (Continued)

When mining started April 28th, all repairs to crushing, screening and belt conveyor equipment were completed. No trouble was experienced until September 15th when a bad slide occurred at bottom of pit that damaged the No. 64 shovel. A $1\frac{1}{2}$ yd. machine was rented from E. Young and used until our shovel could be repaired. Due to a bent frame of electric generator, it was necessary to ship it to Minneapolis for repairs and replace it with one from Shovel No. 67 that had finished loading stock pile at Maas Mine in November. No. 64 machine was repaired and put back in operation December 13th. In the meantime, it was decided to discontinue use of crushing, screening and conveyor equipment, so the 15 ton Browning motor crane from Holman Mine dismantled it during November and December. In December, the crusher was shipped to the Hawkins Mine for repairs. Also in December, the Browning motor crane had an accident that bent the boom but damaged nothing else. This was repaired with only a short delay.

In August, a new 27-T gas driven churn drill was received and has been kept busy in the pit. During the same month, a 500 G.P.M. 225 ft. head Ingersoll-Rand motor pump was received and used to replace similar pit pump that was sent to the Hawkins Mine for repairs. In May, a $\frac{1}{2}$ yd. electric shovel was transferred here from the Hawkins to load out stock pile.

CAMBRIA-JACKSON MINE:

On surface, a new Truscon building was erected west of the shops to house mine supplies too large for warehouse. An I beam trolley was installed to carry heavy equipment from shops to storage yard next to this Truscon building. In the timber yard, the old $\frac{3}{8}$ yd. hydro crane, Model H-3, was traded in on a new one that has many improvements. Eight truck loads of structural steel and timber from old Princeton No. 2 Mine were used here in shaft house repairs and underground. In engine house, the 500 HP motor on hoist had to be rewound and a temporary 400 HP motor replaced it. To make a quick change, an overhead I beam trolley was installed from old I beams salvaged from scrapped steam shovel. The steel drum shell on hoist showed some wear but this was reduced by more frequent lubrication of hoisting ropes. The pinion shaft pedestal bearing holding down bolts on this hoist proved too light and were increased from 1" to $1\frac{1}{4}$ " diameter.

Underground the $7\frac{1}{2}$ " x 12" Gould Triplex pump on 7th level was converted to a $6\frac{1}{2}$ " x 12" unit and the pump house enclosed to keep out dust and smoke. A short section of 10" discharge column cracked and leak was repaired by welding. On 4th level, a 50 ft. section of 4" pipe was replaced due to corrosion and pipe hangers were added to discharge column where new steel sets were placed in shaft. To eliminate skip spillage and overloading, the false sides were removed as well as side boards at top. In October, the bonnet and cage back were bent due to falling chunks and had to be repaired. In the fall, the sumps were cleaned on 6th and 7th level and should last all winter. On 4th level, the main gear loosened on one Prescott pump. This was corrected by shrinking the hub bolts tighter.

CANISTEO MINE:

Repairs to Washing Plant equipment continued during January, February, and March. The $7\frac{1}{2}$ HP motors on Akins classifiers proved too light for full production and were replaced with 15 HP motors. In the shop, repairs were

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1948

CANISTEO MINE: (Continued)

completed to Shovel No. 47 and it was returned to Hill Trumbull Mine. Repairs to No. 48 Shovel were completed in April and it started operating in stock pile.

In May, eleven bottom dump 20 ton Euclid trucks equipped with General Motors diesel engines were received and started stripping operations June 3rd. Improved speed, balance and dumping time proved these units better than end dump trucks for this job. A Hardinge classifier was installed in washing plant on a recirculation system to improve the product.

The two 7000 G.P.M. 250 ft. head Allis Chalmers centrifugal pumps equipped with 600 HP motors were too large for any future pumping jobs in our pits so they were sold to the Oliver Iron Mining Co. in July and moved to Gilbert Mine to unwater that area. In August, the 12" tailings discharge line failed and was replaced with a 16" line. This cut the liquid speed down to less than 6 ft. per second and trouble of blockage was expected but none developed. E. Young completed stripping west of pit ready for the 7W dragline to start work. A switch track was cut in on south side of pit and several car loads of 7W dragline arrived in September. In November, the dragline was completed and moved to northwest corner of pit to start winter stripping by trucks loaded through a steel hopper moved on runners.

Before washing plant completed the season October 24th, two bad slides occurred in tailings pond banks and 600 ft. of 16" pipe were laid to divert the water from the breach until the banks could be built up again in December. In the pit, a 6" Gould centrifugal pump supplying water to washing plant lost its water and was ruined from overheating. Its capacity was 1500 G.P.M. against 325 ft. head. It was replaced by a duplicate pump secured from factory and caused no delays. During the summer and fall, No. 2 conveyor was installed from pit to dump ground east of Bovey ready to start stripping next spring. After testing, the belt was tied down to prevent any wind damage during the winter.

During December, some surface changes were necessary around washing plant. A caterpillar and two terra-cobras completed the new fresh water reservoir and the 16-B shovel cut a drainage ditch through the mill area. At the shops, No. 48 shovel is being overhauled and the 8 ft. pan conveyor rebuilt.

CLIFFS SHAFT MINE:

Underground, the 7" x 18" Worthington power pump in 15th level pump house gave some trouble as the cast iron cross head shoes scored cross head guide on opposite side from motor. This was corrected by hand smoothing the guide and replacing the cast iron with bronze shoes. In November, a piston rod broke on the same side and was replaced with one on hand. The sump for this pump house was cleaned in June and dam installed to keep dirt from pump suction. It was necessary to replace shaft in centrifugal pump that supplies a flooded suction for Worthington pole pump. The two old Prescott pumps on the 15th level were overhauled and a new pot installed on No. 1. At the bottom of No. 3 shaft, a 50 H.P. Jeffrey Aerodyne fan was installed in July to pull fresh air into mine.