

Safety Department

Annual Report

Year 1947

11. ACCIDENTS
AND
PERSONAL
INJURY

TABLE I

FATAL ACCIDENT RECORD
THE CLEVELAND-CLIFFS IRON CO. AND CLIFFS POWER & LIGHT CO.
 1898 - 1947, 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
	3,666	14	3.79
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
	7,729	41	5.30
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
	13,028	66	5.06
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
	13,332	35	2.70
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
	18,348	43	2.36

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TABLE I (Cont'd.)

<u>YEAR</u>	<u>NO. MEN EMPLOYED</u>	<u>NUMBER FATALITIES</u>	<u>FATALITY RATE</u>
1921	2309	6	2.60
1922	2301	1	.43
1923	2728	6	2.20
1924	2472	5	2.02
1925	2472	2	.81
	12,282	20	1.61
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
1911 - 1947	96,525	215	2.23

Based On Per Thousand
Employees

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TABLE II

Classification of Causes of Fatal Accidents
From December 1, 1898 to December 31, 1947

A.	Fall of ground.....	109	
	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>	175
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>1</u>	54
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.....	1	
	Miscellaneous Causes.....	<u>1</u>	35
E.	<u>Miscellaneous Causes:</u>		
	Falling in Raise, Stope, or Pocket.....	9	
	Electric Shock.....	11	
	Falling from Ladder, Stage, Trestle, etc.	8	
	By Moving Machinery.....	7	
	Mine Fires.....	3	
	Stockpile Slide.....	3	
	Miscellaneous Causes.....	<u>3</u>	44
	TOTAL.....		336

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INJURYb. Non-Fatal Injuries

The year of 1947 was not a successful year in the prevention of injury. Our frequency and severity rates are much above any of the past ten years. Comparing our rates for the industry as a whole, using the National Safety Council statistics for 1946, which are the latest available, our frequency for 1947 is 45.04 compared to 39.13 for mining other than coal mining. Our severity is 6.12 compared with 6.58. Exclusive of fatal injuries our rates would compare with a year ago.

Falls of ground caused most of the injuries underground (30), more than any other cause and of course more employees are faced with this hazard. I believe we have made real progress in the prevention of this type of accident.

Falling or moving materials or bounding objects accounted for twenty injuries and considerable lost time. This type of accident has come in for much discussion and attempts at prevention on the part of all supervisors and must be one of our objectives during the coming years.

Falls of persons, including slipping and falling caused seventeen injuries. This type of accident has been caused mainly because of carelessness on the part of the injured. It is impossible to direct the movements of all men at all times so this type of injury must be expected. One of these stumbling and falling accidents, which happened on a clear path, came near being fatal because the man fell on his dinner-bucket. In other cases there were broken bones.

The handling of tools, machinery and material, and underground haulage, each caused twelve injuries and again caused some of our most serious injuries. These five causes of injury accounted for 91 of 120 injuries underground and will require close supervision in the future.

On surface at underground mines there were fourteen compensable injuries. Five were caused by falling material, most of which was carelessness. The handling of tools and equipment caused three injuries, none serious. Slipping and falling caused two injuries, none serious. Bumping against objects, struck by timber, haulage, miscellaneous and machinery in motion caused one injury each. One, moving machinery, caused a permanent disability.

The open-pit mines have done a very good job of accident prevention with a frequency of 24.14 and a severity of 0.647 compared to the Lake Superior Iron Ore Mines average for 1946 of 13.25 frequency and 3.18 severity. Of the twelve compensable injuries there were three each caused by slipping & falling, falling material and power trucks. One injury was caused by tools and two were miscellaneous or unclassified.

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In miscellaneous operations there were three compensable injuries. They were caused by persons falling, operating machines and falling material.

During the year many new men have been employed and most of these men have come directly from the armed services. The average number of men employed during 1946 was 2,791 and for 1947 the number was 3,942. This increased the burden on all supervisors including old and new. Many of these men had a belligerent attitude towards work, safety and supervisors. They also showed more than the normal recklessness when handling machinery and had very little regard for the safety of others or themselves. All supervisors in charge of these new, young men have had to use tact in their supervision to avoid trouble. It is my belief, that during 1948 we shall have much better cooperation from the men than during 1947 and I feel sure our injury rates will be more favorable.

The following tables on accident statistics are very interesting and show trends from year to year. Since 1942 we have used the American Standards Association and U.S. Bureau of Mines methods of compiling accident statistics so our rates may be compared to any in the United States.

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TABLE IV
CLASSIFICATION OF COMPENSABLE ACCIDENTS

	Athens	Maas	Negaunee	Cliffs Shaft	Lloyd	Spies	Mather "A"	Mather "B"	Camb.-Jack.	Canisteeo	Holman Cliffs	Hill-Trumbull	Atkins	Hawkins	Sargent	Agnew	Sthse. & Shops	Miscellaneous	TOTALS
I. <u>Trade Risk, Incidental And Non-Preventable</u>	5	5	3	7	3	1	6	1	2		1	1	1					1	37
II. <u>Negligence of Company:</u>																			
3. <u>Violation of Rules</u>				1															1
4. <u>Improper Act Or Selection of Method of Doing Work - (By Foreman)</u>		1									1								2
5. <u>Failure to Instruct Men as to Method, Hazards, etc.</u>									1										1
6. <u>Failure to Provide Safety Devices</u>							1												1
7. <u>Failure to Provide Tools, Appliances or Places To Work</u>	3		2				1				1				2				9
III. <u>Negligence of Workmen:</u>																			
A. <u>Injured Workmen</u>																			
1. <u>Failure to Use Safety Devices Provided</u>																			-
2. <u>Failure to Use Proper Appliances or Tools Provided</u>																			-
3. <u>Violation of Rules</u>	2	1	1				1		1								1		7
4. <u>Improper Act or Improper Method of Doing Work</u>	11	9	3	8	5		11		7		1		1	2		2			60
B. <u>Other Workman</u>																			
3. <u>Violation of Rules</u>		1					1											1	3
4. <u>Improper Act or Improper Method of Doing Work</u>		1	1						1					1					4

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TABLE IV (Continued from previous page)

CLASSIFICATION OF COMPENSABLE ACCIDENTS

	Athens	Maas	Negaunee	Cliffs Shaft	Lloyd	Spies	Mather "A"	Mather "B"	Camb.-Jack.	Canisteo	Holman Cliffs	Hill-Trumbull	Atkins	Hawkins	Sargent	Agnew	Sthse. & Shops	Miscellaneous	TOTALS	
III-A-3 - III-A-4	1																			1
III-A-4 - III-B-3	1																			1
III-A-4 - III-B-4	3	4	1	1	1	1	5		3							1				20
III-A-3 - III-B-3		1	1																	2
III-A-3 - III-B-4		1																		1
III-A-3 - III-B-3 - II-5/				1																1
III-A-4 - II-7				1																1
III-B-3 - II-5						1														1
III-A-2 - III-A-4										1										1
III-A-3 - II-6							1													1
III-B-3 - III-B-4											1									1
TOTALS	26	24	12	19	9	3	27	1	15	1	5	1	2	3	2	3	2	1		156

TOTALS
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INJURYb. 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
TOTAL	45	11,433,250	72,106,241
17 Year - Average	2.647	254,072	1,602,361

* Man-Shifts Worked During Year Without Fatality

** Amount of Ore Mined " " " "

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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>Fatal</u>	<u>TOTAL</u>
Athens	64	36	26		126
Maas	79	32	22	2	135
Negaunee	47	22	12		81
Cliffs Shaft	74	18	16	3	111
Lloyd	34	15	9		58
Tilden	-	-	-		-
Spies-Virgil	29	6	3		38
Mather "A"	144	39	26	1	210
Princeton	3	-	-		3
Cambria-Jackson	26	21	14	1	62
Canisteo	88	4	1		93
Holman Cliffs	71	9	5		85
Hill-Trumbull	65	2	1		68
Sthse. & Shops	13	3	2		18
C.P.& L. Co.	8	-	-		8
Laboratory	-	-	-		-
Ishpeming Hospital	1	-	1		2
Engineering Dept.	-	-	-		-
Atkins	21	7	2		30
Mather "B"	5	2	1		8
Sargent	60	3	2		65
Agnew	56	3	3		62
Hawkins	47	8	3		58
Miscellaneous	2	-	-		2
	—	—	—	—	—
TOTALS	937	230	149	7	1,323

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TABLE VII

CAUSES OF COMPENSABLE INJURIESUNDERGROUND

<u>Cause</u>	<u>Ag-</u> <u>new</u>	<u>Ath</u> <u>ens</u>	<u>Camb-</u> <u>ria</u>	<u>Cliffs</u> <u>Shaft</u>	<u>Lloyd</u>	<u>Maas</u>	<u>Mather</u> <u>"A"</u>	<u>Mather</u> <u>"B"</u>	<u>Neg.</u>	<u>Spies</u>	<u>Total</u>
Falls of ground	2	8		3	1	7	2		6	1	30
Using or handling tools, machinery or material	1	3	1		1	1	4		1		12
From flying particles		1		1	1	1	1			1	6
Falling or moving materials or bounding objects		5	2	2	1	5	5				20
Falls of persons, Slipping or Stumbling		3	2	3	2	3	3		1		17
Loading at chutes			3	2	1				1		7
Bumping against objects			1				1	1	1		4
Chunks rolling down pile		2	1		1	2	1				7
Wire ropes			2				2				4
Haulage		2		1	1	2	5		1		12
Miscellaneous				1							1
TOTALS	3	24	12	13	9	21	24	1	11	2	120

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TABLE VII (Cont'd.)

SURFACE

<u>Cause</u>	<u>Ag- new</u>	<u>Ath ens</u>	<u>Camb -ria</u>	<u>C.S.</u>	<u>Lloyd</u>	<u>Maas</u>	<u>Math- er"A"</u>	<u>Math- er"B"</u>	<u>Neg.</u>	<u>Spies</u>	<u>Sar- gent</u>	<u>Total</u>
Using or handling tools, materials or machinery		1				1				1		3
Falls of persons, slipping or stumbling				1			1					2
Struck by timber haulage train		1										1
Bumping against objects				1								1
Caught by moving sheave wheel				1								1
Struck by falling material			2						1		2	5
Miscellaneous							1					1
TOTALS	0	2	2	3	0	1	2	0	1	1	2	14

OPEN PIT MINESHill

<u>Cause</u>	<u>Tilden</u>	<u>Hawkins</u>	<u>Trumbull</u>	<u>Canisteeo</u>	<u>Atkins</u>	<u>Holman</u>	<u>Cliffs</u>	<u>Total</u>
Using or handling tools, materials or machinery				1				1
Falls of persons, slipping or stumbling		1					2	3
Falling or moving material		1			1		1	3
Trucks					1		2	3
Miscellaneous		1	1					2
TOTALS	0	3	1	1	2		5	12

OTHER OPERATIONS

<u>Cause</u>	<u>Ishpeming Hospital</u>	<u>General Storehouse and Shops</u>	<u>Total</u>
Falls of persons, slipping	1		1
Using machinery		1	1
Falling material		1	1
TOTALS	1	2	3

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TABLE VIII

FREQUENCY RATESALL COMPENSABLE INJURIES

<u>Year</u>	<u>Total Man Days Worked</u>	<u>Number of Compensable Injuries</u>		<u>Frequency * 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	45.04

* Based On 1-Million Man-Hours Of Labor

TABLE VIII-A

SEVERITY RATESALL COMPENSABLE INJURIES

<u>Year</u>	<u>Non-Fatal</u>		<u>Fatal</u>		<u>Days Lost</u>	
	<u>Days Lost</u>	<u>Rate</u>	<u>Days Lost</u>	<u>Days Lost</u>	<u>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	10,503	1.226	42,000	52,503	6.127	

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

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TABLE IX

COMPARISON OF COMPENSABLE ACCIDENTS, INCLUDING FATALITIES
BY MINES

<u>Mine Or Plant</u>	<u>Frequency</u>		<u>Severity</u>	
	<u>1946</u>	<u>1947</u>	<u>1946</u>	<u>1947</u>
Athens	18.248	77.87	1.186	1.527
Cliffs Shaft	21.386	35.79	1.452	21.156
Canisteeo	7.069	13.62	0.244	2.071
C.P.& L. Co.	0.000	0.00	0.000	0.000
Sthse. & Shops	7.143	14.75	0.621	0.138
Hill-Trumbull	10.395	7.06	4.029	0.042
Holman Cliffs	19.273	26.50	4.097	0.339
Lloyd	29.788	74.05	1.352	1.228
Maas	17.618	62.73	1.373	14.336
Miscellaneous	0.000	7.81	0.000	0.250
Negaunee	22.179	59.23	0.847	1.107
Spies-Virgil	11.331	33.97	0.346	0.785
Tilden	0.000	0.00	0.000	0.000
Mather "A"	26.856	68.14	1.228	7.392
Cambria-Jackson	25.503	68.99	1.677	12.832
General Roll	0.000	0.00	0.000	0.000
Atkins		66.71		0.801
Agnew		31.82		0.515
Mather "B"		35.29		0.282
Sargent		37.36		1.554
Hawkins		40.45		0.244
	<hr/>	<hr/>	<hr/>	<hr/>
ALL PROPERTIES	16.899	45.04	1.337	6.127

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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 Days Lost Comp. Injuries</u>	<u>Frequency Rate</u>	<u>Severity Rate</u>
Athens	508,100	796,234 $\frac{3}{4}$	26	1,138	32.65	1.429
Negaunee	490,638	574,138 $\frac{1}{2}$	12	581	20.90	1.012
Maas	722,401	892,580	22	12,733	24.65	14.265
Cambria-Jackson	554,105	521,782	14	6,641	26.83	12.727
Mather "A"	702,143	968,519	26	7,065	26.84	7.295
Mather "B"		84,992 $\frac{1}{2}$	1	15	11.77	0.176
Lloyd	253,976	324,162	9	357	27.76	1.101
Cliffs Shaft	546,796	1,033,830	16	21,815	15.48	21.101
Spies-Virgil	160,442	264,927	3	197	11.32	0.744
Agnew	198,519	157,137	3	72	19.09	0.458
Sargent	147,411	133,811	2	204	14.95	1.525
Tilden	168,669	34,805	0	0	0.00	0.000
Atkins	432,705	134,898	2	92	14.83	0.682
Hill-Trumbull	785,604	424,603	1	12	2.36	0.028
Holman Cliffs	768,192	528,337	5	161	9.46	0.305
Canisteco	854,638	367,022	1	750	2.72	2.043
Hawkins	620,416	250,245	3	44	11.99	0.176
Sthse. & Shops		339,028 $\frac{1}{4}$	2	37	5.90	0.109
C.P. & L. Co.		141,039	0	0	0.00	0.000
Miscellaneous		127,900 $\frac{1}{4}$	1	32	7.82	0.250
General Roll		469,761 est.	0	0	0.00	0.000
TOTALS	7,914,755	8,569,754 $\frac{3}{4}$	149	51,946	17.39	6.062

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TABLE XI

ACCIDENT STATISTICS FOR 1947

Mine Or Plant	Tons Of Ore Mined	Hours Of Labor	No. Of Fatalities	No. Of Comp. Injuries	No. Of Non-Comp. 1-7 Days	Days Lost, Fatalities	Comp. Days Lost	Tot. Lost-Time Inj. including Fatalities	Non-Comp. Inj. Days Lost 1-7 Days	No. Slight Inj. No Lost Time	Tot. Days Lost All Injuries	Frequency	Severity	Position Rating	Position Rating, All Properties
Athens	508100	796234 $\frac{1}{2}$	26	36		1138	62	78	64	1216	77.87	1.527	6	15	
Negaunee	490638	574138 $\frac{3}{4}$	12	22		581	34	61	47	642	59.23	1.107	4	13	
Maas	722401	892580	2	22	32	12,000	733	56	64	79	12797	62.73	14.336	10	20
Cambria	554105	521782	1	14	21	6,000	641	36	55	26	6696	68.99	12.832	9	19
Mather "A"	702143	968519	1	26	39	6,000	1065	66	94	144	7159	68.14	7.392	8	18
Mather "B"		84992 $\frac{1}{2}$	1	2		15	3	9	5	24	35.29	0.282	1	8	
Lloyd	253976	324162 $\frac{1}{2}$	9	15		357	24	41	34	398	74.05	1.228	5	14	
Cliffs Shaft	546796	1033830 $\frac{1}{2}$	3	16	18	18,000	3815	37	54	74	21869	35.79	21.156	11	21
Spies-Virgil	160442	264927 $\frac{1}{2}$	3	6		197	9	11	29	208	33.97	0.785	3	11	
Agnew	198519	157137 $\frac{3}{4}$	3	3		72	6	9	56	81	31.82	0.515	2	10	
Sargent	147411	133811 $\frac{1}{2}$	2	3		204	5	4	60	208	37.36	1.554	7	16	
TOTALS	4284531	5752116 $\frac{1}{4}$	7	134	197	42,000	8818	338	480	618	51298	58.74	8.918		
Tilden	168669	34805	0	0				0			0.00	0.000	1	3	
Atkins	432705	134898	2	7		92	9	16	21	108	66.71	0.801	5	12	
Hill-Trumbull	785604	424603	1	2		12	3	6	65	18	7.06	0.042	2	4	
Holman Cliffs	768192	528337	5	9		161	14	18	71	179	26.50	0.339	4	9	
Canisteo	854638	367022	1	4		750	5	10	88	760	13.62	2.071	6	17	
Hawkins	620416	250245	3	8		44	11	17	47	61	40.45	0.244	3	6	
TOTALS	3630224	1739910	12	30		1059	42	67	292	1126	24.14	0.647			
Sthse. & Shops		339028 $\frac{1}{4}$	2	3		37	5	10	13	47	14.75	0.138	3	5	
C.P. & L. Co.		141039	0	0		0	0		8	0	0.00	0.000	2	2	
Miscellaneous		127900 $\frac{1}{4}$	1	0		32	1		6	32	7.81	0.250	4	7	
General Roll		469761 est.	0	0		0	0				0.00	0.000	1	1	
TOTALS		1077728 $\frac{1}{2}$	3	3		69	6	10	27	79	5.57	0.073			
GRAND TOTALS	7914755	8569754 $\frac{3}{4}$	7	149	230	42,000	9946	386	557	937	52503	45.04	6.127		

Underground

Open Pit

Indep. Unit

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TABLE XII

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

	<u>Frequency</u>	<u>Severity</u>
1946 National Rating, All Mining, Other Than Coal	39.13	6.58
1946 " " , Underground Metal Mining	35.04	7.54
1946 " " , Open-Cut Metal Mining	22.90	1.99
1946 Lake Superior District, All Mines	23.21	3.33
1947 Cleveland-Cliffs Iron Co., Compensable Accidents	17.39	6.062
1947 " " " " , All Accidents	45.04	6.127
1947 " " " " , Open-Cut Mining	24.14	0.647
1947 " " " " , Top Slicing	57.46	7.810
1947 " " " " , Stopping	43.13	13.848
1947 " " " " , Sub-Level Caving	74.35	6.003
1947 " " " " , Low-Height Block Caving	68.14	7.392
1947 " " " " , General Shops	14.75	0.138
1947 " " " " , General Roll	00.00	0.000
1947 " " " " , Miscellaneous	7.81	0.250
1947 Cliffs Power & Light Company	00.00	0.000

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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.....	47	FIRST HALF OF DAY SHIFT
12:00 Noon to 4:00 P.M.	41	SECOND HALF OF DAY SHIFT
4:00 P.M. to 8:00 P.M.	23	FIRST HALF OF AFTERNOON SHIFT
8:00 P.M. to 12:00 M.N.	21	SECOND HALF OF AFTERNOON SHIFT
12:00 M.N. to 4:00 A.M.	2	FIRST HALF OF NIGHT SHIFT
4:00 A.M. to 8:00 A.M.	10	SECOND HALF OF NIGHT SHIFT
NO TIME STATED.....	12	

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TABLE XIV
PERCENTAGES OF COMPENSABLE INJURIES OF THE VARIOUS AGE GROUPS
ALL PROPERTIES - MESABA RANGE
1947

<u>Age Groups</u>	<u>No. of Compensable Injuries</u>	<u>Percentage of Employees</u>	<u>Percentage of Injuries</u>	<u>Frequency Rating</u>	<u>Severity Rating</u>	<u>Days Lost</u>
18 to 25 Years	6	17.8%	35.3%	6	8	840
26 to 30 "	1	10.4%	5.9%	4	4	26
31 to 35 "	1	15.4%	5.9%	2	6	60
36 to 40 "	1	12.0%	5.9%	3	3	24
41 to 45 "	-	9.1%	-	1	1	0
46 to 50 "	-	8.3%	-	1	1	0
51 to 55 "	4	9.4%	23.5%	8	7	260
56 to 60 "	1	9.9%	5.9%	5	2	16
61 to 65 "	3	7.7%	17.6%	7	5	109
	<u>17</u>	<u>100.0%</u>	<u>100.0%</u>			<u>1335</u>

b. Non-Fatal Accidents (Continued)

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TABLE XV

PERCENTAGES OF COMPENSABLE INJURIES INCLUDING FATALITIES OF THE VARIOUS AGE GROUPS
UNDERGROUND PROPERTIES - MARQUETTE AND MENOMINEE RANGES
1947

<u>Age Groups</u>	<u>No. of Compensable Injuries And Fatalities</u>	<u>Percentage of Employees</u>	<u>Percentage of Injuries</u>	<u>Frequency Rating</u>	<u>Severity Rating</u>	<u>Days Lost</u>
18 to 25 Years	13	11.7%	9.5%	4	1	258
26 to 30 "	16	11.6%	11.8%	5	2	799
31 to 35 "	31	15.7%	22.8%	9	4	12713
36 to 40 "	16	14.8%	11.8%	2	5	6807
41 to 45 "	13	11.8%	9.6%	3	8	6624
46 to 50 "	13	9.3%	9.6%	6	7	6406
51 to 55 "	5	8.8%	3.6%	1	9	6114
56 to 60 "	15	8.3%	11.0%	8	6	6812
61 to 70 "	14	8.0%	10.3%	7	3	4009
	<u>136</u>	<u>100.0%</u>	<u>100.0%</u>			<u>50552</u>

b. Non-Fatal Accidents (Continued)

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b. Non-Fatal Accidents (Continued)

TABLE XVI

SHOWING OCCUPATION OF INJURED WORKERS
(COMPENSABLE INJURIES)

<u>UNDERGROUND</u>		<u>OPEN PIT</u>		<u>SURFACE</u>	
Miners.....	78	Machine Operator.....	1	Surface Foreman.....	1
Trammers.....	1	Laborer.....	1	Laborer.....	3
Timbermen.....	9	Mechanics' Helper.....	1	Hoisting Engineer...	1
Scraper Operators.....	6	Drill Helper.....	1	Machinists' Helper..	1
Motor Brakemen.....	10	Drill Operator & Blaster..	2	Timber Frammer.....	1
Chutemen.....	4	Truck Driver.....	3	Pipeman.....	1
Loader Operator.....	1	Pit Foreman.....	1	Carpenter.....	1
Shift Boss.....	2	Repairman.....	1	Machinist.....	1
Timber Hoister.....	7	Shovel Oiler.....	1	Garageman.....	1
Miners' Helper.....	6	Blasters' Helper.....	1	Shovel Fireman.....	1
Chain Gang.....	1	Car Sampler.....	1		
Stemmer.....	2				
Skip-Tender.....	2				
Track Cleaner.....	1				
	—		—		—
TOTALS	130		14		12

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INJURYc. Safety Inspection

Under our present set-up of safety inspection every supervisor is a safety inspector. Members of the Safety Department make all inspections in company with the supervisors with the idea of checking any hazards which have been overlooked and to try to foresee any new hazards and offer suggestions and recommendations. In most cases, we have good cooperation, but at times the thought of production seems to overshadow safety and we find many violations of safety rules. It is generally known that good production comes with safety and vice-versa. The table on safety inspections shows the number of violations reported but does not show the true totals as no reports are made out when the supervisor, in company with a member of the Safety Department, makes the correction after he has noticed the violation of rules; but, if he does not see the violation a report is usually made and his attention is called to the fact. More cooperation on the part of the supervisors is needed along this line of endeavor. There were a total of 125 violations reported at all Michigan properties during the year compared to 93 for 1946 and 164 safety suggestions compared to 68 a year ago. Total of violations, suggestions, recommendations and fire hazards on written reports numbered 342. Many others were made verbally. The members of the Safety Department inspected all different parts of all operating properties except the full-length of the hoisting shafts and the #2 Negaunee air shaft. To inspect hoisting shafts from surface to the bottom would cause too much delay in hoisting ore and are inspected twice a week by the shaft crews. Our inspections of shafts has been confined to the cage-roads between operating levels.

Idle Properties

All idle property was inspected by me during the spring and again during the fall of the year. Damage to fencing was not as considerable as during 1946. Mr. Julian Payen and his crew made all necessary repairs.

Fire Patrol Inspections

These inspections are made after the last shift preceeding an idle period and once every 24 hours until the mine resumes normal operation. The purpose is to check for any incipient fires which may have started after the regular shift left their work-places, see that all power switches are open and to report any unusual condition in the mine. The inspections are usually made by the shift bosses. During the year there were no fires reported by these patrols. Surface inspections are made by the policemen and watchmen.

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INJURYc. Safety Inspection (Continued)TABLE XVII
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>
Cliffs Shaft	10	30	1	1	42
Princeton	-	-	-	-	-
Spies-Virgil	2	3	-	-	5
Maas	27	29	3	3	62
Negaunee	4	15	-	1	20
Athens	58	31	4	1	94
Cambria-Jackson	13	18	2	-	33
Lloyd	1	10	2	1	14
Mather "A"	6	20	4	2	32
Mather "B"	1	2	-	1	4
Shops & Sthse.	-	3	-	-	3
Diamond Drills	-	1	-	-	1
Ishpeming Hospital	3	2	1	5	11
Mather Inn	-	-	-	20	20
Tilden	-	-	-	1	1
TOTALS	125	164	17	36	342

TABLE XVIII
1946

<u>Mine or Plant</u>	<u>Violations Of Standards</u>	<u>Safety Suggestions</u>	<u>Recommendations</u>	<u>Fire Hazard</u>	<u>Total</u>
Cliffs Shaft	10	15	9	2	36
Princeton	4	1	-	-	5
Spies-Virgil	-	4	-	-	4
Maas	18	12	5	-	35
Negaunee	1	5	3	-	9
Athens	23	13	1	-	37
Cambria-Jackson	22	2	7	-	31
Lloyd	3	3	2	1	9
Mather "A"	10	9	4	-	23
Shops & Sthse.	2	2	4	-	8
Diamond Drills	-	-	1	-	1
Ishpeming Hospital	-	2	3	2	7
TOTALS	93	68	39	5	205

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c. Safety Inspection (Continued)

Blasting Procedure Inspections

Our method of having shift bosses make out blasting procedure reports of each mining contract at least six times each year can be classed as an educational feature. The miners are closely checked for any mistakes they make and corrections made. During the year, Mr. Rogers and myself have watched miners charge and blast rounds at all the properties and it has only been in electrical blasting where a few mistakes were made in our presence. These mistakes were mainly in connecting wires and hanging wire where there was a possibility of stray currents. The Safety Department assisted with the first blast in the block-cave area at the Athens Mine where both prima-cord and electrical blasting were used and at the Republic Experiment where blasting was done with prima-cord.

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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	69	17
Cambria-Jackson	0	0
Cliffs Shaft	386	25
Lloyd	9	2
Maas	239	46
Mather "A"	225	6
Negaunee	177	50
Spies-Virgil	25	2
	<hr/>	<hr/>
TOTALS	1130	148

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11. ACCIDENTS
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INJURYc. Safety Inspection (Continued)Rules And Regulations

A total of 430 rule books were distributed during the year to new and old employees. 336 were for underground workers, 74 for surface workers at the mines and 20 for employees of the Cliffs Power & Light Company which has a separate rule book for employees.

The Mesaba Range underground mines will use a revision of the Michigan Mines rule books. Because of the difference in their operations they cannot use all our rules and regulations.

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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	3	32	35
Cambria-Jackson	5	22	27
Cliffs Shaft	0	56	56
C.P.& L. Co.	20	0	20
Lloyd	4	0	4
Mather "A" Shaft	6	167	173
Mather "B" Shaft	14	1	15
Maas	4	18	22
Negaunee	0	14	14
Princeton	1	0	1
Gen. Shops & Sthse.	26	0	26
Spies-Virgil	5	26	31
Tilden	3	0	3
Miscellaneous	3	0	3
	—	—	—
TOTALS	94	336	430

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INJURYc. Safety Inspection (Continued)Inspection Reports By Plant And Mine Foremen

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

Hoisting Ropes (daily)
Skip & 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)

These inspection reports are sent to the mine superintendent and the Safety Department which checks them.

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>Camb. Cliffs</u>			<u>Mather</u>				<u>Spies-</u>		<u>Tilden</u>	<u>TOTAL</u>	
	<u>Athens</u>	<u>Jack</u>	<u>Shaft</u>	<u>Lloyd</u>	<u>Maas</u>	<u>"A"</u>	<u>"B"</u>	<u>Negaunee</u>	<u>Princeton</u>			<u>Virgil</u>
Hoisting Ropes Skip and -	252	304	295	298	269	295		298		266		2,277
Cage Roads	101	115	82	90	74	52		53		38		605
Ladder Roads	51	11	78	19	48	54		66		38		365
Safety Catches	13	7	18	12	12	13		13		15		103
Slack Ropes	11	7	11	9		9		13		16		76
Hoist Inspection	24	12	24	24	24	24	2	25		24		183
Fire - Extinguishers	2	1	1	1	1	2		2		2	1	13
Fire - Equipment	3	1		1	2	1		4				12
Fire - Prevention	17	11	27	7	19	5	4	25	3	12	14	144
TOTALS	474	469	536	461	449	455	6	499	3	411	15	3,778

	<u>Ag-</u>	<u>At-</u>	<u>Can-</u>	<u>Gen.</u>	<u>Hawkins</u>	<u>Hibbing</u>	<u>Hill-</u>	<u>Holman</u>	<u>Ishpeming</u>	<u>Neg.</u>	<u>Rented</u>	<u>Sar-</u>	<u>Sthse.</u>	<u>TOTAL</u>
	<u>new</u>	<u>kings</u>	<u>isteeo</u>	<u>Office</u>	<u>Mine</u>	<u>Office</u>	<u>Bull</u>	<u>Cliffs</u>	<u>Hospital</u>	<u>Disp.</u>	<u>Bldgs.</u>	<u>gent</u>	<u>Shops</u>	
Fire - Extinguishers		1	1	2		1	1	1	1		1		1	10
Fire - Prevention	2	3	8		26	2	16	14	1	1		6		79
TOTALS	2	4	9	2	26	3	17	15	2	1	1	6	1	89

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TABLE XXII

NUMBER OF FIRE EXTINGUISHERS INSPECTED

<u>Mine or Plant</u>	<u>2½ Gal. Soda Acid</u>	<u>2½ Gal. Non- Freezing</u>	<u>2½ Gal. Foam</u>	<u>1 Gal. 1-1½ Quart Carbon-Tetra- Chloride</u>	<u>15-30 Dry Powder Type</u>	<u>150 Dry Powder Type</u>	<u>2-3 Gal. Car-Tet. Chloride</u>	<u>Tot.</u>
Athens	10			34	8		4	56
Atkins				2	2	1	1	6
Cambria-Jackson	12			16	4		1	33
Canisteeo	6		1	14	18			39
C.P.& L. Co.								0
Cliffs Shaft	10		3	33	3		2	51
General Office	13			14				27
Hibbing Office	3						1	4
Hill-Trumbull				12	37		1	50
Holman Cliffs				16	26			42
Ishpeming Hospital	9			13				22
Lloyd	8	1	1	26	2		4	42
Maas	7			28	5		5	45
Mather "A"	8			62	36			106
Negaunee	12			31	12		10	65
Rented Buildings				13				13
Spies-Virgil	6			56	22		8	92
Sthse. & Shops	13	7		28			1	49
Tilden	1			37	3		5	46
	—	—	—	—	—	—	—	—
TOTALS	118	8	5	435	178	1	43	788

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.

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This action was taken in 110 cases during the year compared to 35 during 1946. This is due probably because supervisors understand union labor agreements a little better now than they did a year ago and know their rights as supervisors. I do not believe the increase came because of more violations of company rules, regulations or policies.

I am firmly convinced that taking action as has been done during the year will improve conditions in our mines.

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TABLE XXIII

CAUSES AND NUMBER OF DISCIPLINARY ACTION

<u>Cause</u>	<u>Cambria</u>	<u>Athens</u>	<u>Maas</u>	<u>Neg.</u>	<u>Mather Cliffs</u>			<u>Sthse.</u>	<u>Total</u>	
					<u>" A "</u>	<u>Shaft</u>	<u>Lloyd Spies</u>			
Losing Time	14	8	3	2	4	3	6	1	41	
Reporting to work in an intoxicated condition	1	1	3		3	1		1	10	
Insubordination		1			8	3	1		13	
Violation of "No Smoking" Rule	1	1				2	1	1	6	
Violation of Safety Rules	1			1	14		1		17	
Leaving work without permission		1			5				6	
Loafing on job					12	2			14	
Violation of mining standards					2				2	
Destruction of Company property					1				1	
TOTALS	17	12	6	3	49	11	3	7	2	110

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11. ACCIDENTS
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INJURYc. Safety Inspection (Continued)Central Safety Committee

The committee met once each month during the year, usually during the first week of the month. Accidents were classified and discussions covered all apparent hazards. A brief list of the subjects follows:

Disciplinary Action

Standardize lay-offs at all mines. A lay-off to result if there is a violation of rules but not for common unsafe practice, in which case a warning should be given first and lay-off on second offense.

Protective Footwear During Cold Weather

Approval of a fibre-cap for footwear for surface employees because the steel-toe cap causes freezing of the toes. Encourage use of overshoes over protective leather footwear.

Photographic Safety Posters

If possible have photographs taken on the job (underground in particular) and have poster units made of them. This because of a lack of underground posters by National Safety Council and other organizations. We receive only twelve posters a year covering underground work from the National Safety Council, but others do cover some of the work.

First Aid Training

Decided that Safety Department arrange for training at an early date. Bosses to sign up men on a voluntary basis.

Blasting Reports

Safety Department to remind superintendents of any lag in shift bosses reports on blasting practice.

Blasting Wire

Blasting wire received from manufacturer which was defective and could be recognized with the naked eye. Warning to all operators to be on the alert for poor blasting wire.

Reporting Slight Accidents

Decided that employees should be encouraged to report any slight accident by end of shift on which it occurs. Legally, a man claiming injury has three months from date of injury in which to give his employer notice of such injury and six months from date of injury in which to file claim.

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INJURYc. Safety Inspection (Continued)Central Safety Committee (Cont'd.)Stretchers At Mines

Each mine is equipped with at least two stretchers - one Navy Stokes (basket-type) and one army stretcher. Suggested that all mines be equipped with at least two basket-type stretchers and one army stretcher in case of injury to more than one man up on the sub-levels. Most mines have one basket, one toboggan and one army stretcher.

Metal Skids For Utility Hoists

Utility hoists should be equipped with metal skids the same as a scraper hoist so they will drag on the ground better and provide a better place to sprag them in place.

Fire Patrols

Superintendents reminded that these patrols must be kept up as usual. Biggest danger of fire is between shifts at the end of the week or during idle periods.

Raise Grizzlies

Recommended that raise grizzly for ore compartment be made of three "H" beams instead of rails. Rails break easily, especially if old. Mather Mine uses "H" beams with cross pieces of angle iron welded to them. Planks are wedged beneath the top flange of the two outside "H" beams for secure footing around grizzly.

Angle Iron Stage Supports

Angle-iron is used at most mines as a support for stages, but are not used 100%. Method of spiking angle irons to timber legs should be improved.

Violation of Safety Rules By Supervisors

This came in for much discussion. Supervisors sometimes become lax and fail to see violations and sometimes violate themselves; sometimes knowingly and other times because they do not know all rules. Supervisors have a greater obligation in setting an example than other employees.

Dust Analysis

Superintendents reminded that dust counts are rising due to laxness on the part of supervisors and miners. Dusty places which can be recognized with the eyes are reported immediately, as are poor installations. A preliminary report is sent to mines as soon as dust analysis has been made, which usually is from one to two days. Final report is sent to mines when laboratory has made silica analysis. Standard method of eliminating dust successfully was discussed thoroughly.

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INJURYc. Safety Inspection (Continued)Central Safety Committee (Cont'd.)Use Of Shin-Guards & Metatarsal Guards

Reports on use of shin guards while barring mill raises not favorable, especially when ore is damp or wet. In dry ore they are good, but damp ore prevents easy movement of joint between shin-guard and metatarsal guard. Will be used in some places. Mather "B" Shaft miners sinking shaft use the metatarsal guard.

Blasting Mis-Fires

Trouble with mis-fires prevailed for some time at nearly all mines. DuPont officials investigated as requested and finally found the trouble was at the factory and a report was submitted. This was one of the most serious conditions we had in the mines during the year, but luckily it did not cause injury.

Water Hydrants And Fire Hose

In order to standardize on water hydrant and fire hose threads an investigation of those used at all mines and in the Cities of Negaunee and Ishpeming was made by the Safety Department and this information was turned over to all superintendents and heads of departments.

Mine Rescue Training

Arrangements were made to train at least 10 mine rescue men from each smaller mine and not less than 15 from the larger mines. September was set as the best month for this work and the U.S. Bureau of Mines would participate in the training. The new Chemox Oxygen Generating Apparatus was described to committee members. Mine rescue procedure was explained to superintendents so they in turn could advise foremen what to do in case of fire underground.

San-Equip Waterless Toilets

The Safety Department gave a summary of experiences of other companies as to the use of this toilet underground. It has been successful at a number of mines. The Cambria-Jackson Mine placed orders for three and will try them out.

Moving Of Scraper Hoists

It was decided not to move scraper hoists under their own power until more satisfactory methods could be worked out. It was suggested that special crews be employed for this work. The special crews have been used at some mines for years and has been satisfactory.

Miscellaneous

Regular inspection of safety hats at all mines as soon as warehouse has large enough supply for replacements.
Standardize telephone code at all mines.
Guards for storage trenches at all mines.

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INJURYc. Safety Inspection (Continued)Lake Superior Mines Safety Council

The council met nine times during the year including the annual meeting. Following are the dates, place of meeting and The Cleveland-Cliffs Iron Company representatives at each meeting:

January 23, 1947 - Ely, Minnesota Attendance - 55	G. R. Whittington
February 27, 1947 - Hibbing, Minnesota Attendance - 75	Joel Olson G. R. Whittington
March 27, 1947 - Coleraine, Minnesota Attendance - 82	E. L. Bemis W. A. Pakkala Arthur Schalin A. J. Stromquist W. W. Waite G. R. Whittington Joseph Chrape John Foucalt
April 17, 1947 - Ironwood, Michigan Attendance - 106	George Curnow A. E. Hill F. W. Johnson Leander Johnson D. A. Millman John Peel R. G. Schaal F. J. Staples A. J. Stromquist T. Wilfred Tippett Louis Tousignant J. S. Westwater
May 22, 1947 - Duluth, Minnesota Attendance - 23	A. J. Stromquist G. R. Whittington
June 19-20, 1947 - Duluth, Minnesota Annual Meeting Total Attendance - 620	R. M. Belliveau Matt Bjerne H. C. Bolthouse

(Continued)

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INJURYc. Safety Inspection (Continued)Lake Superior Mines Safety Council (Cont'd.)June 19-20, 1947 - Duluth, Minnesota
(Cont'd. From Previous Page)

Arnold Hill
Tom Hill
Grant Hollett
Stanley Kelly
D. A. Millman
Dan Orlovich
Matt Renowden
T. Soder
W. A. Sterling
P. P. Swanson
William Treloar
G. R. Whittington

Carl Brewer
J. J. Foucalt
F. J. Haller
Ole Hoff
Adolph Kauppila
H. J. Leach
William Nicholas
W. A. Pakkala
Arthur Schalin
Adolph Stark
A. J. Stromquist
John Tregoning
W. W. Waite
J. A. Wivell
J. K. Young

September 11, 1947 - Duluth, Minnesota
Attendance - 25

Arthur Schalin
A. J. Stromquist

November 6, 1947 - Ely, Minnesota
Attendance - 64

G. R. Whittington

December 11, 1947 - Ishpeming, Michigan
Attendance - 98

Peter Bessolo, Jr.
Guerrino Bezzi
Raymond Borlaw
F. G. Culbert
Wm. Goldsworthy
Thomas W. Hill
Henry Kuisti
J. Maino
Ray Matthews
H. O. Moulton
W. C. Oliver
H. F. Rogers
Wm. J. Skewis
H. W. Sundberg

Theo. Andreson
Wm. Bianchi
Kelly Campbell
George Curnow
Tom Guy
Allen Hjelt
H. Langlois
W. J. Mallett
Earl Mattila
Arthur Nault
Matt Renowden
Gust Saari
C. J. Stakel
Curtis Sundeen

Sigfred Anderson
William Anderson
W. R. Atkins
Ray Boase
John Clanirille
Clinton Doney
Maurice Hager
Stanley Kelly
Albert J. Larsen
Onnie Marjama
August Mattson
John D. Nigra
Glen Roberts
T. A. Sandstrom
A. J. Stromquist
S. W. Sundeen
Marvin Swanson

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INJURYc. Safety Inspection (Continued)Lake Superior Mines Safety Council (Cont'd.)

Total attendance for all meetings was 1,148. Arrangements for the Ishpeming, Michigan meeting were made by H. F. Rogers, T. W. Hill and myself of the C.C.I. Co., Mr. A. J. Guscatt, North Range Mining Company and Emil Kronquist, Jones & Laughlin Company. I presented an illustrated lecture on "Safety Devices and Methods Used in Lake Superior Ore Mines".

During the past year Mr. G. R. Whittington, Safety Supervisor on the Mesaba Range, served as chairman of the Prize Awards Committee of the Lake Superior Mines Safety Council. I have been serving as a member of the executive committee; Chairman- Exhibits Committee and Vice-President of the council.

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INJURYc. Safety Inspection (Continued)National Safety Council

We continue to hold membership in the council and receive good service from the council. The annual safety meeting of the council was held October 5th to 11th. Our company was represented by C. R. Sundeen, John Bjorne, Harry F. Rogers, W. R. Atkins, J. K. Young, E. H. Bemis, G. R. Whittington and myself.

I presented an illustrated lecture on "Safety Devices and Methods in Lake Superior District Ore Mines". The mining section had a well-prepared program and good attendance. Members of our organization attended other sectional meetings besides the mining section and also the morning lectures held for all personnel.

Safety Banner Flag Awards

The Banner Flags for 1947 were awarded as follows:

Underground Operation

Mather Mine, "B" Shaft with a severity rating of 0.282. There were 3 lost-time injuries causing a total of 24 days lost or an average of 8 days per injury. Only one of these injuries was compensable.

Open Pit Operation

The Tilden open-pit mine won the banner flag for this type of operation. There were no injuries so the severity rating was 0.00.

The Hill-Trumbull Mine with three lost-time accidents causing 18 days lost-time had the fine severity rating of 0.042.

Independent Unit

The Cliffs Power & Light Company again won the banner flag for independent units with a clear slate and a severity rating of 0.00. The Cliffs Power & Light Company has operated a total of 52 months without a compensable injury.

Cleveland-Cliffs "Orbit"

Volume I. Number 1 of the "Orbit" went to press February, 1947 and six numbers were published during the year. This family journal has made quite a hit with employees and others. Contributions from the various properties have been very limited, but I believe in time when people better understand what is needed for the "Orbit" to make it better, we shall receive better cooperation.

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INJURYc. Safety Inspection (Continued)Foreman's Safety Bonus

A total of \$5,793.39 was paid to foremen as a safety bonus during the year. Penalties amounted to \$129.37. These bonuses are highly prized by most of the foremen and are a real incentive for safe work practice. I am not sure that our system of awarding the bonuses is entirely correct, but it is effective. I am inclined to believe that some foremen who have but few men working for them have the most hazardous jobs but get the smallest bonus. The foremen I have in mind are the shaft or timber foremen. They should, I believe, be given more consideration.

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INJURYc. Safety Inspection (Continued)

TABLE XXIV

SAFETY BONUSES PAID TO FOREMEN

<u>Mine Or Plant</u>	<u>Amount</u>	<u>Men Participating</u>	<u>Amount Of Penalties Imposed</u>
Athens	\$ 912.91	12	\$ 39.00
Cliffs Shaft	1,041.35	15	15.46
Lloyd	345.07	7	16.16
Maas	971.41	11	37.34
Mather "A"	860.36	14	--
Negaunee	700.97	10	9.23
Spies-Virgil	240.26	5	12.18
Cambria-Jackson	618.11	10	--
C.P.& L. Co.	102.95	2	--
	<hr/>	<hr/>	<hr/>
TOTALS	\$ 5,793.39	86	\$129.37

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TABLE XXV

OCCUPATIONS OF MEN PARTICIPATING IN BONUS

<u>Title</u>	<u>Athens</u>	<u>C.S.</u>	<u>Camb. Jack.</u>	<u>Lloyd</u>	<u>Maas</u>	<u>Mather "A"</u>	<u>Negaunee</u>	<u>Spies</u>	<u>C.P.&L. Co.</u>	<u>TOTAL</u>
Shift Boss	9	11	7	5	8	9	6	2		57
Machinery Foreman	1	1	1	1	1	1	1	1		8
Surface Foreman	1	1	1	1	1	2	2	1		10
Timber Foreman	1	1	1		1		1	1		6
Scraper Foreman		1								1
Ass't. Mech. Foreman						1				1
Electrician Foreman						1				1
Line Foreman									2	2
TOTALS	12	15	10	7	11	14	10	5	2	86

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INJURYd. Ventilation

General mine ventilation during the year has been kept up very well. Mr. Tom Hill and myself have kept a constant check of the ventilation in all the mines and when necessary have made recommendations for changes. Good cooperation has been had from all mine superintendents on general mine ventilation. Quite a number of changes have been made during the year which will be listed under individual mines.

A brief summary of the ventilation at each mine follows:

Athens Mine

A total of 79,950 C.F.M. is supplied to the mine, of which 66,300 C.F.M. is re-circulated and 13,650 C.F.M. is fresh air as of July 22, 1947. Since that date, doors in the skip-pit have decreased the volume of re-used air so that only about 45% is re-circulated. This re-circulation of air is because of failure to keep air doors and shaft timber stations closed. Distribution of air through the mine through operating contracts has been good in most instances. Only a few auxillary fans for development to headings have been used. An average of about six auxillary fans have been used to ventilate mining contracts. Vent-tubing on these auxillary fans has not been properly maintained as well as it should be. Ventilation raises between the 7th and 4th levels have been opened up during the latter part of the year and should lower the pressure in the mine. Ventilation of development headings has not been kept up to our standards because of failure to keep vent-tubing close to the breast.

Cambria-Jackson Mine

The ventilation system in the Cambria-Jackson Mine has been very good. The main mine fan, with blades in #4 position, has supplied 28,100 C.F.M. This air is well distributed to all mining contracts. The brattice around the fan has been concreted and made fire-proof. A booster fan is in operation at the west end of the 6th level to furnish air to two contracts. Some of this air is re-circulated through the old stopes above the 6th level. The volume would be about 4,500 C.F.M. All air-lock doors have been kept in first-class condition and leakage to the shaft on the 6th level is not more than necessary to ventilate the shaft plat.

Cliffs Shaft Mine

There has been no change in the ventilation at the Cliffs Shaft Mine during the year. A total of 52,000 C.F.M. are exhausted from "A" and "B" Shafts. 24,111 C.F.M. exhausts from "A" Shaft and 27,960 exhausts from "B" Shaft. This reading corresponds with the intake on 6th level at the incline. A new mine fan has not yet

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INJURYd. Ventilation (Continued)Cliffs Shaft Mine (Cont'd.)

been installed. All preparations for the installation of the fan were completed during the summer but the fan and motor have not as yet been taken underground to be installed. A number of openings have been made into the top of stopes to increase ventilation to certain parts of the mine. But first-class ventilation cannot be expected until the new fan is installed.

Lloyd Mine

A B. F. Sturtevant #60 Mine Fan, located on the 4th level, Section 6 Shaft, is exhausting 10,270 C.F.M. when reversed and the exhaust air goes up Lloyd Shaft. No recommendations were made for a larger fan because it was expected the life of the mine would be short and probably will be short. A booster fan will be used to ventilate the new workings below the 8th level. Distribution of air to mining contracts has been good. All air-doors have been kept in first-class condition. The main mine fan is reversed frequently so that at times the exhaust air is going up the Lloyd Shaft and after blasting is exhausted up Section 6. The fan is also reversed to keep ice out of the Lloyd Shaft. When the main mine fan is exhausting up Section 6 Shaft it handles 18,250 C.F.M.

Maas Mine

The air supply for the Maas Mine, amounting to 47,483 C.F.M. comes from the Negaunee Mine. The fan is located on surface at No. 2 Negaunee Shaft. About 20,000 C.F.M. comes direct to the Maas 400 Drift on the 4th level. All the rest of the air passes through working contracts in the Negaunee Mine and exhausts from the 14th level, Negaunee Mine to the Maas Mine. Distribution of air to the mining contracts has been good in most cases, but many auxillary fans must be used in order to ventilate separate mining contracts. 5300 Cross-Cut in Maas Mine is ventilated by a #40 Sturtevant Fan which is used as a booster and small auxillary fans ventilate approximately four contracts above the 5300 Cross-Cut. This cross-cut is the poorest ventilated in the Maas Mine because there are no connections to any other cross-cuts in the mine, it being isolated from the rest of the mine. All connections between the Maas and Negaunee Mines have water-misting curtains installed to allay dust or powder smoke. At the present time a new air connection is being made from 6th level, Maas to the 14th level, Negaunee which will greatly improve ventilation in the Maas Mine. Exhaust air which is now going to the Maas Shaft on the 6th level will exhaust to the Maas Shaft on the 5th level.

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INJURYd. Ventilation (Continued)Mather "A" Mine

The main mine fan for the Mather Mine is located on the 3rd level. This American Blower, size 5½, furnished 33,500 C.F.M. This air is split inside on the 3rd level, with 16,700 C.F. going to the 2nd level to ventilate contracts above that level and the other split goes to the 5th and 6th levels with a total of 18,600 C.F. This fan is now too small for the Mather Mine and a new fan was ordered during the year and will be in use early in 1948. The new fan will be able to furnish from 40,000 C.F.M. up to approximately 120,000 C.F.M. Air has been well distributed throughout the entire mine. The fresh air for the Mather Mine is taken down through the cage road and exhausted through the skip compartment. Nearly all development headings have been ventilated by use of #45 Sturtevant Fans with Coppus Fans of 3,500 C.F.M. capacity sweeping the breast of the heading. During the coming year considerable work will have to be done to control air when the new fan is in use, as the present air-doors are the free-swinging type and will leak considerable air because they cannot be closed properly. Air-lock doors must be installed in order to prevent leaks to the shaft. All air doors at the present time are either air-operated or are opened by the motors or cars when passing through. Because of the great amount of development work it has been next to impossible to keep the circulation of air through the mine 100%.

Negaunee Mine

Fresh air for the Negaunee Mine is furnished by a Jeffrey-Aerodyne, 8-H, 72, propeller-type fan located on surface at Negaunee Number Two Shaft. With the blade position in #4, 83,776 C.F.M. of air was furnished on the 9th level. Total output of the fan at 4.7 inches W.G. totalled 110,000 C.F.M. Loss of air is mainly around the fan station and through old workings near old #1 Shaft. On the 13th level 20,000 C.F. of fresh air goes to the Maas 400 Drift. The rest of the air ventilates all contracts between the 13th and 14th levels. Two booster fans assist in this ventilation; one located on the 13th level, blowing into the main mining sub and one located in the 1420 Cross-cut on the 14th level to draw air from mining contracts above. Ventilation drifts to the mining contracts have been kept in excellent condition. Total amount of air going up Negaunee hoisting shaft is 23,182 C.F.M.

Spies-Virgil Mine

The Spies-Virgil Mine is ventilated by a Jeffrey-Aerodyne, 8-H, #42 fan; the blade position being No. 1 operating against .7 inches W.G. It is supplemented by a Sturtevant #45 fan to ventilate the 6th level. The main mine fan is located on surface over the air shaft connected with the new mining area. The air current is reversed from

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time to time during the winter months to prevent ice forming in the Spies Shaft. At the present time a heating unit is being installed at the Spies Shaft to pre-heat the air so that all air may be taken down the Spies Shaft without any freezing and allow all smoke from blasting to be drawn from working places up the air shaft and be exhausted to the outside. Ventilation of the few contracts operating has been excellent. Ventilation of the development heading on the 6th level at the present time is very good. The main mine fan at the Spies-Virgil will be large enough to handle any ventilation needed in the Spies Mine for a long time in the future.

Dust Elimination and Analysis

A total of 417 dust samples were taken during the year of 1947. Of these, 180 were taken in rock work and 237 in ore. The trend has been upwards compared to 1946. All dust samples were taken under normal operating conditions and were taken regardless of whether equipment was in full operating condition. All men working in rock were furnished with respirators and were required to use them at all times during this work. Shift bosses or captains decided when respirators must be used in ore. The recommended maximum limit in ore is 10,000,000 dust particles per cubic foot and in rock 5,000,000 particles per cubic foot.

The average light field count of all samples taken at the various mines range from 2.23 at the Mather "B" Shaft to 11.65 at the Spies-Virgil for underground operations. The average dust counts in raise mining is still high at most mines. Three mines, the Lloyd, Cliffs Shaft and Maas kept all dust counts in raising operations much below the maximum limit. Other mines were consistently high. The average dust counts in all drifting operations range from 5.91 to 8.80, which is a very good average.

Average dust counts in ore were below the recommended maximum limits at the Athens, Maas, Negaunee and Spies-Virgil Mines. Cliffs Shaft, Lloyd and Mather "A" were just a few points above the recommended maximum limits.

The average dust counts in rock in the underground mines was slightly above the recommended maximum limit in all mines with the exception of Mather "B" Shaft.

The main reason for dust counts being high in most mines was failure to use standard recommended methods or failure to maintain standard methods in use. In some instances, the water pressure was

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INJURYd. Ventilation (Continued)Dust Elimination and Analysis (Cont'd.)

too low at the drill machine and in other cases water-blasts were not used properly. In a number of cases where ventilation fan and tubing were sufficient to handle the job, poor methods caused a lack of air at the working face. Water curtains or misting curtains used to allay dust in air-ways were generally well-kept and maintained.

During the coming year instructions will be given to all supervising personnel as to the maintenance of ventilating equipment and the allaying of dust.

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INJURYd. 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

Mine or Plant	<u>1947</u>		<u>TOTAL</u>	<u>TOTAL</u>
	<u>In Ore</u>	<u>In Rock</u>	<u>1947</u>	<u>1933 - 1947</u>
Athens	25	28	53	589
Cambria-Jackson	40	15	55	150
Cliffs Shaft	57	40	97	1531
Lloyd	34	6	40	547
Maas	17	20	37	560
Mather "A"	20	44	64	433
* Mather "B"	-	2	2	2
Negaunee	37	1	38	746
** Princeton	-	-	-	85
Spies-Virgil	1	24	25	102
Tilden	6	-	6	42
Miscellaneous	-	-	-	111
TOTALS	<u>237</u>	<u>180</u>	<u>417</u>	<u>4898</u>

* Started Operation, April, 1947.

** Closed Down.

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d. Ventilation

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TABLE XXVII

VARIOUS OCCUPATIONS WHERE DUST SAMPLES WERE COLLECTED

<u>Occupation</u>	<u>Athens</u>	<u>Cliffs Shaft</u>	<u>Camb. Jack.</u>	<u>Lloyd</u>	<u>Maas</u>	<u>Math er-A</u>	<u>Math er-B</u>	<u>Neg.</u>	<u>Spies-Virgil</u>	<u>Tilden</u>	<u>Totals</u>
Drilling	16	56	22	16	16	27	--	13	11	--	177
Scraping	17	21	25	17	7	11		13	4	--	115
Using Loader To Fill Cars	8	8	--	--	--	13	--	1	6	--	36
Elasting	2	--	--	--	--	3	--	3	2	--	10
Timbering	4	--	6	4	8	7	--	4	--	--	33
Hand-Shoveling	--	--	--	2	--	--	2	--	--	--	4
Barring Back	--	4	--	--	--	--	--	--	1	--	5
Blowing Cars	--	--	--	--	--	--	--	1	--	--	1
Loading Cars At Chute	1	--	--	--	--	--	--	1	--	--	2
Gen. Mine Air	2	4	1	1	3	--	--	2	1	--	14
Charging Holes	1	1	1	--	1	2	--	--	--	--	6
Rigging Machine	--	--	--	--	--	--	--	--	--	--	--
Breaking Chunks	2	--	--	--	--	--	--	--	--	--	2
Driving Spiling Poles	--	--	--	--	2	1	--	--	--	--	3
Rolling & Dividing Ore Samples	--	1	--	--	--	--	--	--	--	--	1
Crushing Ore Sample	--	1	--	--	--	--	--	--	--	--	1
Pulverizing Ore Sample	--	1	--	--	--	--	--	--	--	--	1
Crushing Ore	--	--	--	--	--	--	--	--	--	4	4
Loading at Pocket	--	--	--	--	--	--	--	--	--	2	2
TOTALS	53	97	55	40	37	64	2	38	25	6	417

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d. 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
Cliffs Shaft	17.94	14.56	8.29	8.98	15.53	9.86	10.36	7.77
* Cambria								
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		

(Continued)

* Not in operation during this period.

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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>
Athens	7.28	25.80	4.90	8.33	6.64	4.17	7.39
Cliffs Shaft	8.18	7.55	5.99	6.23	8.18	6.34	8.64
Cambria			12.10	6.21	17.05	11.99	9.30
Lloyd	8.05	6.95	5.01	14.45	6.49	9.38	11.17
Maas	17.29	8.46	12.48	8.78	8.17	9.29	6.08
Mather "A"	2.42	5.58	6.64	7.57	8.39	7.72	10.88
Mather "B"							2.23
Negaunee	14.02	17.02	4.65	11.81	11.92	6.67	7.05
* Princeton			10.59	6.32	8.48		
Spies-Virgil	6.97			5.59	14.22	3.59	11.65
Tilden	49.60				24.18	66.92	33.65
* Gardner Mackinaw							
Miscellaneous		3.00					

* No longer in operation.

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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	16.21	6.07	7.39
Cliffs Shaft	6.74	8.80	8.64
Cambria-Jackson	36.04	5.91	9.30
Lloyd	2.98	6.74	11.17
Maas	3.02	6.34	6.08
Mather "A"	27.49	6.86	10.88
Mather "B"			2.23
Negaunee		8.80	7.05
Spies-Virgil		7.98	11.65

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d. 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	8.09	7.20	7.39
Cliffs Shaft	10.98	5.88	8.64
Cambria-Jackson	9.99	7.07	9.30
Lloyd	11.33	10.34	11.17
Maas	6.67	5.87	6.08
Mather "A"	10.34	11.25	10.88
Mather "B"		2.23	2.23
Negaunee	7.05		7.05
Spies-Virgil	4.30	11.97	11.65
Tilden	33.65		33.65

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INJURYe. Mine Rescue Training

During the month of September the Safety Department with the assistance of the U.S. Bureau of Mines Engineer trained a total of 121 men in mine rescue methods. 116 of these men received additional training and 5 men were new and received the initial training. The additional trained men received 16 hours of training and the initial trained men received 24 hours of training.

Each mine has from 8 men at the Lloyd Mine to 33 men trained at the Mather "A" Shaft. Also available are engineers from the engineering department.

Some of the men given training will be unable to actually use self-contained oxygen breathing apparatus during mine fires because of physical disability, but these men are key-men, such as bosses whom we intend to use only at fresh-air bases. These men will assist in directing the work because of their knowledge of the mine and repair and recharge apparatus in case of emergency.

We have the advantage of having a great number of men who have already fought underground mine fires and therefore feel confident we would be able to handle any situation that should arise.

Training of mine-rescue men this year consisted of use of the 2-hour McCaa self-contained breathing apparatus, the new Chemox self-generating Oxygen breathing apparatus, the all-service gas mask, self-rescuers, inhalators and artificial respiration. Part of the wearing of this equipment was in a room filled with smoke.

Names of all these men are posted at all mine offices along with their address and phone number.

All mine superintendents and heads of departments have been given instructions as to procedure in case of fire in their mines.

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

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TABLE XXXII

MEN TRAINED IN MINE RESCUE
DURING SEPTEMBER, 1947

<u>Mine</u>	<u>Initial Training</u>	<u>Additional Training</u>	<u>TOTALS</u>
Athens		16	16
Cambria-Jackson		20	20
Cliffs Shaft		13	13
Engineering Dept.		3	3
Lloyd		8	8
Maas		14	14
Mather "A"	5	28	33
Negaunee		14	14
	-	-	-
TOTALS	5	116	121

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INJURYe. Mine Safety and Mine Rescue CoursesReports on Accident Statistics

We have followed the usual routine by sending our accident statistics to the following:

Marquette County Mine Inspector, Ishpeming, Michigan
 Iron County Mine Inspector, Iron River, Michigan
 Itasca County Mine Inspector, Kewatin, Minnesota
 U.S. Bureau of Mines, Statistical Division, College Park, Maryland
 Lake Superior Mines Safety Council, Duluth, Minnesota

Mine Rescue Station

We have made the usual routine inspection of all mine rescue equipment and made all necessary repairs and adjustments at that time. All equipment has been kept in first-class condition in case of emergency.

In February we received two new Chemox self-generating oxygen breathing apparatus. In April we received four more, giving us a total of six Chemox apparatus. These Chemox apparatus were given their first tests under actual conditions in May month when fire broke out in the Athens Mine.

Oxygen cylinders for the McCaa oxygen-breathing apparatus have been sent out for hydro-static tests. Five new oxygen bottles for McCaa apparatus were bought to replace bottles which were leaking. An air-dryer also was added to the high-pressure oxygen pump to take moisture out of the compressed oxygen so as to eliminate rusting within the oxygen cylinders.

On completion of mine rescue training in September, 500 - 4 lb. jars of Cardoxide were bought and are stored away for emergency use.

Our equipment at the station and at various mines now amounts to 15 McCaa 2-hr. Oxygen Breathing Apparatus, 10 all-service gas masks, 6 Chemox self-generating Oxygen Breathing Apparatus, 12 self-rescuers, and three H & H inhalators; one kept at the mine rescue station, one at the Central Office and one at the Spies Mine. We have one portable motorized high-pressure Oxygen Pump and one Drager hand-operated high-pressure Oxygen Pump which is kept as a reserve in case of emergency. We have 5 flame-safety lamps, 5 carbon-monoxide detectors and one carbon-monoxide indicator. Spare parts are kept for all this equipment.

Athens Mine Fire

On April 21st smoke was detected in the old gob in No. 5 contract in the slice from 810 raise 40' above the 8th level. Temporary brattices were built in the slice but the smoke moved out to 966 raise through unsettled gob so the area was sealed by covering 810, 801 and 966 raises. Immediately after the temporary sealing, permanent seals were installed over the top of 810 and 966 raises and a concrete seal was placed near the top of 801 raise. One and a half-inch pipe line had been placed through the seals from the fire area into 810 raise. Water running from the 810 raise was hot enough to burn the fingers on completion of these stoppings and brattices. On May 15th, 28,000

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INJURYe. Mine Safety and Mine Rescue Courses (Cont'd.)Athens Mine Fire (Cont'd.)

cubic feet of carbon-dioxide was injected into the sealed area. There was an immediate change in the water which came out of 810 raise, turning quite cool or normal and all odor had left the water. Tests for carbon-monoxide were made at the seals and all parts of the mine on the exhaust-air side of the fire area. A continually-operating carbon-monoxide indicator with alarm attachments was installed in the exhaust air on the 4th level to give warning should carbon-monoxide be released. The carbon-monoxide indicator would ring a bell and turn on warning lights in case the carbon-monoxide content should reach .02%.

It was expected when heavy blasting was started in the block-cave area, adjacent to the fire area, that some of our seals would be broken and carbon-monoxide would leak out of the sealed fire area. But, at no time was any carbon-monoxide found at any point in the mine since the carbon-dioxide was injected.

It would be impossible to know if this fire had really gone out for at the present time there is no access to the fire area for all seals are badly crushed and pipe-lines through which air samples were to be taken have been closed off. Favorable is the fact that there is no odor of fire at any point and all water coming from the fire area has cooled. When the block-cave area, which is under the old fire, was first opened up and until ore was drawn from the block, for sometime there was heat present. After the block of ore started to move there was a change when the water started to come through some of the draw fingers. From that time on the block-cave area has been cool.

Spies-Virgil Mine

Two trips were made to the Spies-Virgil Mine in an attempt to locate a cave from the Virgil Mine fire-area which we believed had caved through to the 1st level. Because the entire area has been sealed off for a number of years a fan was installed in the bulkhead, 3rd level, Spies Mine and air was driven through the old Spies stopes and air-ways to the 1st level and Virgil Shaft. This was the only access to this area. On the first trip we were able to reach the bottom of the air raise which leads from the 1st to the 3rd level. Because the air was deficient of oxygen and the ladder was in poor condition, the fan was left operating for six days when we were able to repair the ladder-way and reach the 1st level. Because of the long distances to travel it was impossible to use the oxygen-breathing apparatus because of its limitations.

On January 30 in company with three men we reached the area close to the Virgil Shaft and located smoke coming from the fire area which indicated the location of the cave.

This position was spotted on the maps. Because of the intense heat it was impossible to reach the very edge of the cave, but we were able to travel to within 70 or 80' of this smoke.

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TABLE XXXIII

FIRST AID SUPPLIES DISTRIBUTED

<u>Material</u>	<u>Number Distributed</u>
Merthiolate Pads.....	37,425
Ounces of Merthiolate.....	213
1" Roller Bandage.....	465
2" " "	349
3" " "	222
Rolls of Adhesive Tape.....	49
Picric Gauze.....	206
Plain Gauze.....	544
Leather Finger Cots.....	99
Merthiolate Applicators.....	1,838
Ounces Aromatic Spirits of Ammonia.....	13
Tubes of Ungentine.....	25
Ounces of Absorbent Cotton.....	12
Triangular Bandages.....	36
Pairs of Scissors.....	3
	<hr/>
TOTALS.....	41,499

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INJURYf. MiscellaneousIncipient FiresUnderground

Two small fires were started in the Cliffs Shaft Mine and extinguished by the foreman. I believe both of these fires were started by cigarettes. One of these fires was in an old rubbish pile in the stope and water had to be poured on it for approximately twelve hours. There was no loss of time because of either fire.

Surface

January 11 - Cliffs Shaft Mine. Small oil fire outside of the engine house caused by an explosion of the compressed-air receiver.

June 29 - Grass fire in the yard of the Engineering Building. Fire started by a group of small children.

August 10-11 - Grass fire west of Cliffs Shaft Mine which was caused by railroad locomotive. Fire extinguished by Ishpeming Fire Department.

April - Mather "A" Shaft. Small fire in the boiler house and in March another one at the same location, both extinguished by policeman.

Foremans' Meetings

The monthly meetings were held at all mines with the superintendent acting as chairman. The Safety Department members took part in many of these meetings. Operating and safety problems were discussed and accidents which had happened at the mines were also discussed and means of eliminating hazards were suggested. At the Negaunee Mine meetings were held of various groups of employees so that by the end of the year all the employees of the mine had attended at least one meeting. This type of meeting, I believe, is the most effective in accident prevention.

Plans have been made to conduct meetings with supervisors for all mines and all but the superintendents and captains will attend. The Safety Department will be in charge of all these meetings.

First Aid Training

During the week of April 7 - 11, M. L. Williams, Mining Engineer, U.S. Bureau of Mines, Safety Division, Duluth, Minnesota, conducted a first-aid class with a total of 38 employees attending. Thirty-four of these men completed the training and were recommended for certificates.

(Cont'd.)

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INJURYf. Miscellaneous (Continued)First Aid Training (Cont'd.)

Following is the list of attendance by mines and departments:

Athens - 1
Cambria - 1
C.P.& L. Co. - 4
Cliffs Shaft - 12
Engr. Dept. - 1
Lloyd - 5
Maas - 2
Mather "A" - 0
Negaunee - 4
Sthse. & Shops - 2
Safety Dept. - 2
Tilden - 0

Bug Elimination

Two Hydro-Mistorizors were bought and a man trained in the use of same to eliminate roaches and other insects in all change-houses and buildings. This has been a successful method of eliminating roaches from the buildings.

Exchange Accident Data

Twenty-six company members of the Lake Superior Mines Safety Council contributed exchange accident data during the year.

Mather Inn Safety Inspection

Mr. Rogers and myself made a complete inspection of the Mather Inn and recommendations were sent to the management.

Exhibits

Exhibits of safety devices and photographs of safety devices and methods were placed on display at the annual meeting of the Lake Superior Mines Safety Council in Duluth, Minnesota

Meeting with Mesaba Range Underground Mine Supervisors

Meetings were held with Mesaba Range underground-mine supervisors on safety rules and safety inspection for underground mines. These rules and inspections are to be used at the Sargent and Agnew Mines.

Eye-Glass Inspection

A survey of all safety eye-glasses and goggles was made at the Mather "A" Mine.

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INJURYf. Miscellaneous (Continued)Cleveland-Cliffs Club Meeting

Meeting held in February with 139 supervisors present.

The speakers were:

C. J. Stakel, Manager
H. C. Bolthouse, Superintendent, Mesaba
F. Cash, Supervising Engineer, U.S. Bureau of Mines
J. D. Preston, Gen. Mgr., C.P. & L. Co.
W. Connibear, Retired Safety Director - C.C.I. Co.
A. J. Stromquist, Chairman
Walter Gries, Welfare Department, entertained with stories.

ANNUAL REPORT OF THE MINING ENGINEERING DEPARTMENT FOR THE YEAR ENDING
DECEMBER 31ST, 1947

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 for itself, or as operating agent, for other companies, in 1947. The underground maps show, in red, the location of mining operations during the year, and the open pit cross-sections show, in color, the unmined formation at the end of the year, as well as the portions of the pit removed during 1947.

The following table shows the mines included in the different books, the company for which the book was prepared and their affiliated companies. The Cleveland-Cliffs Iron Company books were bound, 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 Canisteo Cliffs-Shaft Hawkins Lloyd Maas Sargent Spies-Virgil Tilden	Athens Atkins Hill-Trumbull Holman-Cliffs Mather A Shaft Mather B Shaft Negaunee.
The Mesaba-Cliffs Mining Company Partners: Hanna Iron Ore Co. Inland Steel Co. Jones & Laughlin Steel Corp. Pittsburg Steel Co. Republic Steel Co. Wheeling Steel Co.		Hill-Trumbull Holman-Cliffs
The Athens Iron Mining Company, Partner: Pickands Mather. & Co.		Athens
The Negaunee Mine Company Partner: Bethlehem Steel Co.		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, Hill-Trumbull, Holman-Cliffs and Sargent.
E. L. Bemis, Superintendent,	Agnew, Sargent.
A. T. Soder, Superintendent,	Atkins.
W. A. Pakkala, Superintendent,	Canisteo
H. J. Leach, Superintendent,	Hill-Trumbull.
J. J. Foucault, Superintendent,	Holman-Cliffs.
C. R. Sundeen, Superintendent,	Athens.
J. Trosvig, Superintendent,	Cambria-Jackson.
S. W. Sundeen, Superintendent,	Cliffs-Shaft.
O. Marjama, Superintendent,	Lloyd, Spies-Virgil.
H. O. Moulton, Superintendent,	Maas, Tilden.
F. J. Haller, Superintendent,	Mather A and B Shaft.
W. R. Atkins, Superintendent,	Negaunee.

B. MAP REPORTS

Two sets of prints of working maps were made each month of each of the soft ore Michigan mines, showing, in red, the work done on the various levels and sub-levels during that month. Similar sets of the Cliffs-Shaft Mine were made four times during the year. These sets were for the Manager and Mine Superintendents. Each Mining Captain, Under-Captain and Shift Boss received, monthly, copies of these maps, folded to take underground.

Other map reports were made during the year for fee-owners, their representatives and others, 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 month's work. One of these sets was forwarded to Pickands Mather & Company. Two sets of maps were sent to the Detroit Trust Company, Detroit, Michigan, as Trustee for the Maria Corbit Estate, showing, in red, the work done on Harvey Lot 13. One of these sets showed the work done from January 1st to July 1st and the other for that done from July 1st through December 31st.

CLIFFS-SHAFT MINE

One set of prints of the geological maps of the Bancroft and Section 10 Leases, scale 1" = 50', were prepared for the Duluth office of the Oliver Iron Mining Company, after each of the four surveys during the year. These maps showed, in color, the work done since the last survey, except the set sent at the end of the year which showed all the work done during the year as well as the areas used in making up the estimate of ore reserves as of December 31, 1947. Two copies of the calculations of these ore reserve estimates accompanied this last set of maps. Early in the year we were instructed to discontinue furnishing copies of these maps to the Ishpeming office of the Oliver Iron Mining Company.

MAAS MINE

Mr. Russell C. Miller, fee-owner representative of the Maas interests, resigned as of March 1, 1947. He had been receiving a set of monthly mine maps, scale 1" = 50', at the end of each month, showing, in red, the work done in the mine during that month. These sets were discontinued after February as no successor has been appointed. Our relations with Mr. Miller were very friendly and cordial, and he had been very cooperative during the seven years he was so associated with us. As there was no work done on the Roman Catholic Cemetery Lease during January, no maps were sent to Mr. R. S. Archibald of Negaunee. This Cemetery lease was surrendered as of January 31st, 1947.

NEGAUNEE MINE

The monthly set of working mine maps sent Mr. R. C. Miller, Negaunee, were discontinued as of March 1, 1947, because of his resignation as fee-owner representative.

At the end of the year a set of whiteprints of the North-South cross-sections of the Negaunee Mine lease were sent to Dr. Donald M. Fraser, Chief Geologist of the Bethlehem Steel Company, Bethlehem, Pennsylvania, showing the changes due to mining during the year.

MICHIGAN STATE TAX COMMISSION

Estimates of ore reserves as of December 31, 1947 of the Athens, Cambria-Jackson, Cliffs-Shaft, Lloyd, Maas, Mather A Shaft, Negaunee and Spies-Virgil Mines were prepared for the Michigan State Tax Commission. Accompanying these estimates were Annual Report maps of each of the above mines showing the areas used in making these estimates. Maps of each level and sub-level were included, where any work was done during the year, whether there were ore areas used for estimating or not. The estimate of the East Deposit, Spies-Virgil Mine was made from sections, the others being made from plan maps.

C. REMARKS ON MISCELLANEOUS DOCUMENTS AND ABSTRACTS

All documents affecting the Company lands and rights pass through the Engineering Department for recording and approval. Each one is entered on the department records and is initialed by Mr. Brewer. When necessary, they are referred to Mr. Derby when the mineral value is concerned. Special reports were made in special cases where necessary and maps prepared to accompany documents as required. Mr. Brewer conferred with the Legal Department relative to the preparation of other documents desired by the Mining Department.

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	4	82
Miscellaneous Documents	35	1631
Easements	13	440
Rights of Way	0	224
Surface Leases	109	6105
Sales	354	3971
Tax Histories	0	704

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

MINING LEASES

Lease No. 14-A

The Roman Catholic Cemetery Lease, Maas Mine, was cancelled as of January 31, 1947.

Lease No. 78, Atkins Mine

Early in the year copies of the various documents covering the operations of the Atkins Mine were received. These documents included the lease of one-half interest in the N $\frac{1}{2}$ of S $\frac{1}{2}$ of Section 12, 59-19, Minnesota, the operating agreements, etc.

Lease No. 79, Wanless Mine

The Wanless Mine is located on the E $\frac{1}{2}$ of SE $\frac{1}{4}$ of Section 16, 56-19, Minnesota. This property belongs to the State of Minnesota, and was leased to the North Range Mining Company for a term of 50 years after September 7, 1946, the date of the lease. Under date of March 28, 1947, this property was assigned to The Cleveland-Cliffs Iron Company by the North Range Mining Company.

Lease No. 80, Agnew Mine

The Agnew Mine is located on the NE $\frac{1}{4}$ of NE $\frac{1}{4}$ of Section 11, 57-11, Minnesota. The International Harvester Company assigned the lease on this property and other rights to The Cleveland-Cliffs Iron Company under date of March 1, 1947, which expires December 15, 1951.

Lease No. 81, Hawkins Mine

The Hawkins Mine comprises the following lands: SE $\frac{1}{4}$ of NE $\frac{1}{4}$, and NE $\frac{1}{4}$ of SE $\frac{1}{4}$ of Section 31, 57-22 and the SW $\frac{1}{4}$ of NW $\frac{1}{4}$ and NW $\frac{1}{4}$ of SW $\frac{1}{4}$ of Section 32, 57-22, Minnesota. The International Harvester Company assigned the lease of this property and other auxiliary lands and rights to The Cleveland-Cliffs Iron Company under date of March 1, 1947, which expires December 15, 1963.

Lease No. 82, Sargent Mine

The Sargent Mine is located on the following lands: SE $\frac{1}{4}$ of Section 23, 57-22 and the W $\frac{1}{2}$ of NE $\frac{1}{4}$ of Section 26, 57-22, Minnesota. The International Harvester Company assigned the lease of this property and other auxiliary lands to The Cleveland-Cliffs Iron Company under date of March 1, 1947, which expires December 15, 1967.

MISCELLANEOUS DOCUMENTS

All documents affecting land titles or rights affecting operating mines or mineral lands are included in this classification. There were seventeen documents covering Michigan lands and eighteen covering the properties in Minnesota.

EASEMENTS

These are transmission line rights of way for the Cliffs Power & Light Company. Four easements were for the new line to the Jones & Laughlin research laboratory in Negaunee, two covered the relocation of the tower line at Mather B shaft, and two were rights of way for the new line from Humboldt to the Champion Mine. The other five were for service lines, such as railway crossings, etc.

RIGHTS OF WAY

These are railroad rights of way.

SURFACE LEASES

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

SALES

These are for transfer of title, including Bills of Sale for Company houses sold direct, or under contract on mineral lands, sale of lands off the mineral formation, platted lots in Gwinn, Munising, etc.

TAX HISTORIES

There were no tax histories received during 1947.

ABSTRACTS OF TITLE

The Engineering department has not done any work on Abstracts for many years, when the title of Company lands was being investigated. It has not been able to keep up with the work during the last twenty years, with the constantly changing title records, so that the abstract files are from up to date. All abstracts of title that are received are sent to the Legal Department for title opinions. It would require a full time employee over a year to bring our abstracts of title records up to date. The Cleveland office has taken over most of this work.

D. THE FORCE

The Engineering Department, in the last few years, has been called upon more and more for engineering work at the mines. The mining engineers have needed more time for planning, consulting and supervising than ordinary surveying and mapping. As a result the position of Surveyor was established and the ranks filled by former helpers as they became experienced. At the end of the year, the force consisted of five mining engineers, five surveyors, eight helpers and three draftsmen. Several of the helpers are nearly enough experienced to become surveyors, and will be advanced as the openings occur. One additional mining engineer is needed. Mr. P. Daniel Isaacson has been advanced to Surveyor during the year and three new helpers have been added, namely: John R. Sleeman, Russell J. Paull and Raymond S. Windsand.

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>1947 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 "
W. Harlow Stannard	Draftsman			12 "
Lawrence K. Viall	"			12 "
George B. Manzoline	"	Dec. 23rd		12 $\frac{1}{2}$ "
Donald W. Carlson	Stenographer			12 "
Edgar G. Curtis	Surveyor			12 "
C. Arthur Koski	"			12 "
F. Alfred Koski	"			12 "
P. Daniel Isaacson	"			12 "
Ernest A. Oja	"			12 "
Clifford H. Amel	Helper			12 "
Louis R. Miller	"			12 "
Alfred B. Nault	"			12 "
Ralph K. Oja	"	Feb. 11th		10 $\frac{1}{2}$ "
Raymond E. Oja	"			12 "
Russell J. Paull	"	Mar. 25th		9 "
John R. Sleeman	"	February 12th		10 $\frac{1}{2}$ "
James R. Magnuson	"	May 26th	July 31st	2 "
James Jenkins	"	July 14th	Aug. 31st	1 $\frac{1}{2}$ "
John E. Hayden	"	Jan. 6th	Mar. 29th	3 "
Raymond S. Windsand	"	Dec. 16th		1 $\frac{1}{2}$ "

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	39 years, 3 months
Robert M. DeGabriele	December, 1945	2 " 1 "
John M. Haivala	March, 1943	4 " 10 "
Grant T. Hollett	August, 1940	7 " 4 $\frac{1}{2}$ "
T. Adolph Kauppila	March 1944	3 " 10 "
Maxwell H. Madsen	September, 1943	4 " 4 "
W. Harlow Stannard	November, 1940	7 " 2 "
Lawrence K. Viall	April, 1945	2 " 8 "
George B. Manzoline	December, 1947	1 $\frac{1}{2}$ "
Donald W. Carlson	August, 1936	8 " 1 "
Edgar G. Curtis	February, 1944	3 " 11 "
C. Arthur Koski	June, 1941	3 " 1 "
F. Alfred Koski	January, 1936	7 " 9 "
Ernest A. Oja	March, 1943	4 " 10 "
P. Daniel Isaacson	November, 1940	2 " 4 $\frac{1}{2}$ "
Clifford Amel	May, 1944	3 " 7 $\frac{1}{2}$ "
Louis R. Miller	August, 1945	2 " 4 $\frac{1}{2}$ "
Alfred B. Nault	September, 1946	1 " 3 $\frac{1}{2}$ "
Ralph K. Oja	February, 1947	10 $\frac{1}{2}$ "
Raymond E. Oja	October, 1946	1 " 3 "
Russell J. Paull	March, 1947	9 "
John R. Sleeman	February, 1947	10 $\frac{1}{2}$ "
Raymond S. Windsand	December, 1947	1 $\frac{1}{2}$ "

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	255 $\frac{1}{2}$	14	2 $\frac{1}{2}$
Robert M. DeGabriele	263	4	11
John M. Haivala	270	-	5
Grant T. Hollett	269 $\frac{1}{2}$	-	7
T. Adolph Kauppila	268	-	7
Maxwell H. Madsen	261 $\frac{1}{2}$	1	10 $\frac{1}{2}$
W. Harlow Stannard	252 $\frac{1}{2}$	7 $\frac{1}{2}$	12
Lawrence K. Viall	254 $\frac{1}{2}$	7 $\frac{1}{2}$	10
George B. Manzoline	5	-	$\frac{1}{2}$
Donald W. Carlson	256 $\frac{1}{2}$	2	13 $\frac{1}{2}$
Edgar G. Curtis	258 $\frac{1}{2}$	3 $\frac{1}{2}$	14 $\frac{1}{2}$
C. Arthur Koski	269	-	10 $\frac{1}{2}$
F. Alfred Koski	259	2	11
Ernest Oja	261	-	11
P. Daniel Isaacson	266 $\frac{1}{2}$	$\frac{1}{2}$	8
Clifford Amel	265 $\frac{1}{2}$	-	8
Louis R. Miller	234 $\frac{1}{2}$	28	13 $\frac{1}{2}$
Alfred B. Nault	264	3 $\frac{1}{2}$	6 $\frac{1}{2}$
Ralph K. Oja	237 $\frac{1}{2}$	-	4
Raymond E. Oja	155 $\frac{1}{2}$	-	1
Russell J. Paull	203	-	5 $\frac{1}{2}$
John R. Sleeman	235	1	6 $\frac{1}{2}$
James R. Magnuson	47 $\frac{1}{2}$	-	-
Raymond S. Windsand	10	-	-
James Jenkin	25	10	-
John E. Hayden	65 $\frac{1}{2}$	-	-

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	1	56	198 $\frac{1}{2}$	255 $\frac{1}{2}$
Robert M. DeGabriele	129	7	127	263
John M. Haivala	126	6	138	270
Grant T. Hollett	124	30	115 $\frac{1}{2}$	269 $\frac{1}{2}$
T. Adolph Kauppila	144	23	101	268
Maxwell H. Madsen	67	32	162 $\frac{1}{2}$	261 $\frac{1}{2}$
W. Harlow Stannard	-	15	237 $\frac{1}{2}$	252 $\frac{1}{2}$
Lawrence K. Viall	-	-	254 $\frac{1}{2}$	254 $\frac{1}{2}$
George B. Manzoline	-	-	5	5
Donald W. Carlson	-	-	256 $\frac{1}{2}$	256 $\frac{1}{2}$
Edgar G. Curtis	126	11	121 $\frac{1}{2}$	258 $\frac{1}{2}$
C. Arthur Koski	104 $\frac{1}{2}$	36	128 $\frac{1}{2}$	269
F. Alfred Koski	57	157	45	259

<u>Name</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>
Ernest A. Oja	-	159	102	261
P. Daniel Isaacson	170	13 $\frac{1}{2}$	83	266 $\frac{1}{2}$
Clifford H. Amel	2	153	110 $\frac{1}{2}$	265 $\frac{1}{2}$
Louis R. Miller	107	10	117 $\frac{1}{2}$	234 $\frac{1}{2}$
Alfred B. Nault	104 $\frac{1}{2}$	36	123 $\frac{1}{2}$	264
Ralph K. Oja	143	22	72 $\frac{1}{2}$	237 $\frac{1}{2}$
Raymond E. Oja	15	104	36 $\frac{1}{2}$	155 $\frac{1}{2}$
Russell J. Paull	115	23	65	203
John R. Sleeman	115	16	104	235
James R. Magnuson	-	47	$\frac{1}{2}$	47 $\frac{1}{2}$
Raymond S. Windsand	6	-	4	10
James Jenkin	-	25	-	25
John E. Hayden	27 $\frac{1}{2}$	$\frac{1}{2}$	37 $\frac{1}{2}$	65 $\frac{1}{2}$
TOTAL	1,683 $\frac{1}{2}$	982	2,747 $\frac{1}{2}$	5,413
%	31.1	18.1	50.8	100.0%

During 1947 there was considerably more underground construction and development work than in previous years. The increased use of the sub-level caving system of mining and the inauguration of the block caving system at the Athens Mine were the conspicuous examples of the changes in mining methods that require attention by the Engineering Department. The preliminary engineering needed for the driving of the transfer and grizzly sub-levels in the block caving system, with their special methods of timbering and the accurate spacing of raises, requires almost daily attention while this work is underway. There was very little triangulation surveying during the year and only such work was done as was needed in anticipation of requirements for planning and exploring.

The mining engineers supervised and planned the work done by the surveying crews at their properties and were responsible for this work. They frequently conferred with the Superintendents and Mining Captains for supervising all construction and development at their properties. Most of their time was spent at the mines and they only came to the office to do the necessary work on the maps and to prepare the monthly map reports.

The following summary of the work done by the men in the Department shows the mines at which they worked. The special jobs that occurred during the year are reviewed under the heading "Mines".

CARL BREWER, Recorder, supervised the general work of the Department and coordinated the allotment of helpers to the mines and field work. He made all the plans for surveys done during the year that were not directly connected with the operation of the mines. A large part of his time was spent in handling the various documents that passed through the Department, making such reports thereon as were necessary and determining many questions as to title, Company rights, etc. He compiled the Annual Report books, Tax Commission reports, stockpile estimates, etc. He spent some time at Republic studying the region around the Republic Mine and assisted Mr. Jackson in securing options for land purchases in that District. He reviewed the delinquent tax lists for the different counties for the Mining Department and also those of the Cliffs Power & Light Co. and prepared the 1947 tax list of their properties.

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	1	56	198½	255½	100.0
%	0.4	21.9	77.7		100.0

ROBERT M. DEGABRIELE, Mining Engineer, did the engineering work at the Athens and Cambria-Jackson Mines throughout the year. At the Athens Mine he planned the skip pit arrangement below the 10th Level and had a great deal to do in assisting in laying out the plans for block-caving. He made several inspections of the Hartford No. 2 shaft, Cambria-Jackson Mine, in connection with the proposed replacement of timbering below the 6th 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>
Athens Mine	69½	4	67	140½	53.4
Cambria-Jackson Mine	59½	3	60	122½	46.6
TOTAL	129	7	127	263	
%	49.0	2.7	48.3		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 experimental radial drilling at the Spies-Virgil property and made special reports on this work. He supervised the installation of the underground hoisting and pocket arrangement at the top of the winze on the 8th Level in the Lloyd Mine.

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	50½	3	52	105½	39.1
Spies-Virgil Mine	70½	3	82½	156	57.7
Negaunee Mine	3	-	2	5	1.9
General Engineering	2	-	1½	3½	1.3
TOTAL	126	6	138	270	
%	46.7	2.2	51.1		100.0

GRANT T. HOLLETT, Mining Engineer, was in charge of the engineering work at the Mather Mine A Shaft during the year. He assisted in the design and installation of the ventilating and heating system at the shaft collar, extension of the stocking trestles, and other construction work on surface. He made plans for the timber yard stripping and grading of the stockpile ground. Underground, the chief construction work was the concreting of the 6th Level pump house.

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	122	28	115	265	98.3
General Engineering	2	2	$\frac{1}{2}$	$4\frac{1}{2}$	1.7
TOTAL	124	30	$115\frac{1}{2}$	$269\frac{1}{2}$	
%	46.0	11.1	42.9		100.0

T. ADOLPH KAUPPIA, Mining Engineer, was in charge of the engineering work at the Maas and Negaunee Mines during the year and at the Tilden Mine during the shipping season. He planned and supervised the construction of the 6th Level trench at the Maas Mine.

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>
Maas Mine	95	9	56	160	59.7
Negaunee Mine	$45\frac{1}{2}$	2	36	$83\frac{1}{2}$	31.2
Tilden Mine	-	11	$3\frac{1}{2}$	$14\frac{1}{2}$	5.4
General Engineering	$3\frac{1}{2}$	1	$5\frac{1}{2}$	10	3.7
TOTAL	144	23	101	268	
%	53.7	8.6	37.7		100.0

MAXWELL H. MADSEN, Mining Engineer, was in charge of the engineering work at the Cliffs-Shaft Mine during the entire year. Although only quarterly surveys were made at this property, he did considerable surveying each month of the development work and made special reports of the progress each month also.

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	66	26	155	247	94.5
Republic Mine	-	$4\frac{1}{2}$	-	$4\frac{1}{2}$	1.7
General Engineering	1	$1\frac{1}{2}$	$7\frac{1}{2}$	10	3.8
TOTAL	67	32	$162\frac{1}{2}$	$261\frac{1}{2}$	
%	25.6	12.2	62.2		100.0

W. HARLOW STANNARD, Draftsman, did a great deal of special drafting work in the office during the year. He made many annual report tracings and spent much time in posting the geology on these maps. He posted the drill hole sections for the Geological Department each month. He also assisted the field crews in some of their special jobs.

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	-	-	47½	47½	18.8
Cambria-Jackson Mine	-	2	7½	9½	3.8
Cliffs-Shaft Mine	-	-	2	2	.8
Lloyd Mine	-	-	1	1	.4
Maas Mine	---	2	14½	16½	6.5
Mather Mine A Shaft	-	-	25½	25½	10.0
Mather Mine B Shaft	-	-	20½	20½	8.1
Morris Mine	-	-	8	8	3.2
Negaunee Mine	-	3	2	5	2.0
Spies Mine	-	1	3	4	1.6
Geological Department	-	-	43	43	17.0
Cliffs 7th Addition	-	-	9	9	3.6
General Engineering	-	6	45½	51½	20.4
Republic Mine	-	1	8½	9½	3.8
TOTAL	-	15	237½	252½	
%	-	5.9	94.1		100.0

LAWRENCE K. VIALI, Draftsman, spent most of his time during the year in making new working tracings and mounted maps for the various mines. Our tracings get very hard use and must be replaced quite often. Furthermore, there were many new maps needed, especially for the Mather Mine A Shaft. He also posted some of the drill records for 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>
Athens Mine	-	-	28	28	11.0
Cambria-Jackson Mine	-	---	19	19	7.5
Cliffs-Shaft Mine	-	-	4½	4½	1.8
Lloyd Mine	-	-	4	4	1.6
Maas Mine	-	-	33½	33½	13.2
Mather Mine A Shaft	-	-	57½	57½	22.6
Morris Mine	-	-	8	8	3.1
Negaunee Mine	-	-	7	7	2.7
Spies Mine	-	-	7½	7½	2.9
Geological Department	-	-	19	19	7.5
General Engineering	-	-	66½	66½	26.1
TOTAL	-	-	254½	254½	
%	-	-	100.0		100.0

GEORGE B. MANZOLINE, Draftsman, entered the Department on December 23rd. He started the work of bringing the Cliffs Power & Light Company maps up to date. These maps show the power and service lines, customers, etc. The five days he spent in the Department were all spent on this work.

EDGAR G. CURTIS, Surveyor, did most of the surveying at the Athens, Cambria-Jackson, Maas and Negaunee Mines. He had two helpers throughout the year to assist in the underground surveys, office calculations and map posting.

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	61½	4	42	107½	41.6
Cambria-Jackson Mine	8½	2	8	18½	7.2
Maas Mine	39½	5	50½	95	36.7
Negaunee Mine	16½	-	21	37½	14.5
TOTAL	126	11	121½	258½	
%	48.7	4.3	47.0		100.0

C. ARTHUR KOSKI, Surveyor, assisted Mr. Madsen in the quarterly surveys at the Cliffs-Shaft Mine and located drill holes, surveyed development raises, drifts, etc. between times. He also did surveying at the Cambria-Jackson, Lloyd and Spies Mines with one or two helpers as needed.

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	½	-	2½	.9
Cambria-Jackson Mine	33½	7	18	58½	21.8
Cliffs-Shaft Mine	61½	10	48	119½	44.5
Lloyd Mine	2	1	-	3	1.1
Maas Mine	1	-	2	3	1.1
Mather Mine A Shaft	-	2	-	2	.7
Mather Mine B Shaft	-	5	1	6	2.2
Negaunee Mine	½	-	½	1	.4
Spies Mine	3	-	1	4	1.5
Tilden Mine	-	2½	-	2½	.9
General Engineering	1	8	58	67	24.9
TOTAL	104½	36	128½	269	
%	38.8	13.4	47.8		100.0

F. ALFRED KOSKI, Surveyor, during the early part of the year did the surveying at the Mather A, Lloyd and Spies Mines, but as the year advanced more and more of his time was taken up at the Mather A Shaft. In May, he was transferred to Mather B Shaft where work was just commencing for developing the property. He spent the balance of the year there, giving lines and grades for construction work in connection with the temporary buildings, shaft collar and timber tunnels. He made the surveys and supervised the stockpile grading and the excavating for the new engine house.

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	.4
Maas Mine	-	-	$\frac{1}{2}$	$\frac{1}{2}$.2
Mather Mine A Shaft	41	$7\frac{1}{2}$	$20\frac{1}{2}$	69	26.6
Mather Mine B Shaft	-	$149\frac{1}{2}$	15	$164\frac{1}{2}$	63.5
Spies Mine	15	-	9	24	9.3
TOTAL	57	157	45	259	
%	22.0	60.6	17.4		100.0

P. DANIEL ISAACSON, Surveyor, made the surveys at the Mather Mine A Shaft, Lloyd and Spies Mines. Most of his time, however, has been at the Mather A property and by the end of the year he was entirely occupied with the surveys at this mine.

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	10	1	4	15	5.6
Mather Mine A Shaft	100	$12\frac{1}{2}$	56	$168\frac{1}{2}$	63.2
Spies Mine	60	-	19	79	29.7
General Engineering	-	-	4	4	1.5
TOTAL	170	$13\frac{1}{2}$	83	$266\frac{1}{2}$	
%	63.8	5.1	31.1		100.0

ERNEST A. OJA, Surveyor, has only done surface surveying during the year. Owing to Doctor's orders he is not permitted to go underground, but he made the surveys for Section 11, 47-27 and Republic, besides locating drill holes and doing many miscellaneous jobs as they were required. He also ran some of the base lines for the geophysical surveys of the Geological Dept.

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	-	87	60	147	56.4
Cliffs 7th Addition	-	1	9	10	3.8
Cliffs-Shaft Mine	-	-	$1\frac{1}{2}$	$1\frac{1}{2}$.6
Cambria-Jackson Mine	-	2	$1\frac{1}{2}$	$3\frac{1}{2}$	1.3
Maas Mine	-	2	$5\frac{1}{2}$	$7\frac{1}{2}$	2.9
Mather Mine A Shaft	-	5	$6\frac{1}{2}$	$11\frac{1}{2}$	4.4
Mather Mine B Shaft	-	11	$6\frac{1}{2}$	$17\frac{1}{2}$	6.7
Negaunee Mine	-	3	$2\frac{1}{2}$	$5\frac{1}{2}$	2.1
Spies Mine	-	1	$3\frac{1}{2}$	$4\frac{1}{2}$	1.7
Republic Mine	-	$22\frac{1}{2}$	5	$27\frac{1}{2}$	10.5
Tilden Mine	-	2	-	2	.8
Geophysical Surveying	-	$21\frac{1}{2}$	$\frac{1}{2}$	22	8.4
Geological Department	-	1	-	1	.4
TOTAL	-	159	102	261	
%	-	60.9	39.1		100.0

CLIFFORD AMEL, Helper, has assisted in most of the surface surveys during the year. He, too, is prevented by Doctor's orders from very much underground work, although he is permitted to go on main level surveys where no raise-climbing is required. During the summer he had charge, as surveyor, for the party running lines for the geophysical surveys of the Geological Department. He had charge of the photographing and printing for the Annual Report. He also assisted in the surveys at Republic and in Section 11, besides other miscellaneous surface work during 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>
General Engineering	-	67½	102½	170	64.0
Cambria-Jackson Mine	--	2	-	2	.8
Lloyd Mine	1	-	-	1	.4
Maas Mine	-	2	-	2	.8
Mather Mine A Shaft	1	4½	½	6	2.3
Mather Mine B Shaft	-	10	2½	12½	4.7
Negaunee Mine	-	3	-	3	1.1
Spies Mine	-	1	-	1	.4
Tilden Mine	-	1½	-	1½	.6
Republic Mine	-	24	4	28	10.5
Geophysical Surveying	-	36½	1	37½	14.0
Cliffs 7th Addition	-	1	-	1	.4
TOTALS	2	153	110½	265½	
%	.8	57.6	41.6		100.0

LOUIS R. MILLER, Helper, was one of the survey crew for the Negaunee District throughout the year. Toward the end of the year he started running a transit and did considerable survey work. During December, owing to poor health, he was unable to continue his underground 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>
General Engineering	-	-	16	16	6.8
Athens Mine	49½	1	47½	98	41.8
Cambria-Jackson Mine	13	1	5	19	8.1
Maas Mine	32½	5½	29	67	28.6
Mather Mine A Shaft	-	1½	3	4½	1.9
Negaunee Mine	12	1	17	30	12.8
TOTALS	107	10	117½	234½	
%	45.6	4.3	50.1		100.0

ALFRED B. NAULT, Helper, assisted in the surveys at the Cliffs-Shaft and Cambria-Jackson Mines throughout the year. He also assisted at the other mines as needed.

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	23 $\frac{1}{2}$	6	18 $\frac{1}{2}$	48	18.2
Cliffs-Shaft Mine	62 $\frac{1}{2}$	5 $\frac{1}{2}$	46 $\frac{1}{2}$	114 $\frac{1}{2}$	43.4
Maas Mine	1	-	-	1	.4
Mather Mine A Shaft	8	4	6 $\frac{1}{2}$	18 $\frac{1}{2}$	7.0
Spies Mine	4	-	-	4	1.5
General Engineering	1 $\frac{1}{2}$	13	50	64 $\frac{1}{2}$	24.4
Athens Mine	3	-	1 $\frac{1}{2}$	4 $\frac{1}{2}$	1.7
Lloyd Mine	-	1	-	1	.4
Negaunee Mine	1	-	-	1	.4
Mather Mine B Shaft	-	5	$\frac{1}{2}$	5 $\frac{1}{2}$	2.0
Tilden Mine	-	1 $\frac{1}{2}$	-	1 $\frac{1}{2}$	0.6
TOTALS	104 $\frac{1}{2}$	36	123 $\frac{1}{2}$	264	
%	39.6	13.6	46.8		100.0

RAYMOND E. OJA, Helper, was injured while skiing shortly after the first of the year and was laid up until the middle of June. During the summer and fall, he assisted in surface surveys and it was not until December that he was able to resume his regular underground duties. During the balance of the year he assisted in the surveys at the mines in the Negaunee District.

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	3	-	-	3	1.9
Cambria-Jackson Mine	3	2	-	5	3.2
Maas Mine	2	2	-	4	2.6
Mather Mine A Shaft	5	-	1	6	3.9
Negaunee Mine	-	3	-	3	1.9
Spies Mine	2	-	-	2	1.3
General Engineering	-	45 $\frac{1}{2}$	33 $\frac{1}{2}$	79	50.8
Geophysical Surveying	-	25	-	25	16.1
Cliffs 7th Addition	-	1	-	1	0.6
Republic Mine	-	25 $\frac{1}{2}$	2	27 $\frac{1}{2}$	17.7
TOTALS	15	104	36 $\frac{1}{2}$	155 $\frac{1}{2}$	
%	9.6	66.9	23.5		100.0

RALPH K. OJA, Helper, assisted in the surveys at the Mather Mine A Shaft and Spies Mine, together with work at the other properties when needed. During the latter part of the year, as more survey work at the Mather Mine A Shaft was required, he spent all his time at this property and will shortly become a 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>
Athens Mine	$\frac{1}{2}$	-	-	$\frac{1}{2}$.2
Cambria-Jackson Mine	4	-	-	4	1.7
Cliffs-Shaft Mine	$\frac{1}{2}$	-	$\frac{1}{2}$	1	.4
Lloyd Mine	$9\frac{1}{2}$	$1\frac{1}{2}$	3	14	5.9
Mather Mine A Shaft	$94\frac{1}{2}$	$15\frac{1}{2}$	$40\frac{1}{2}$	$150\frac{1}{2}$	63.4
Spies Mine	34	$\frac{1}{2}$	4	$38\frac{1}{2}$	16.2
General Engineering	-	$4\frac{1}{2}$	$24\frac{1}{2}$	29	12.2
TOTAL	143	22	$72\frac{1}{2}$	$237\frac{1}{2}$	
%	60.2	9.3	30.5		100.0

RUSSELL J. PAULL, Helper, entered the Department on March 25th. Most of his time was spent assisting in the surveys at the Mather Mine A Shaft.

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	-	6	$32\frac{1}{2}$	$38\frac{1}{2}$	19.0
Cambria-Jackson Mine	$1\frac{1}{2}$	-	1	$2\frac{1}{2}$	1.2
Lloyd Mine	$1\frac{1}{2}$	$1\frac{1}{2}$	$\frac{1}{2}$	$3\frac{1}{2}$	1.7
Maas Mine	-	-	2	2	1.0
Mather Mine A Shaft	80	$15\frac{1}{2}$	25	$120\frac{1}{2}$	59.4
Spies Mine	32	-	4	36	17.7
TOTAL	115	23	65	203	
%	56.7	11.3	32.0		100.0

JOHN R. SLEEMAN, Helper, entered the Department on February 12th and assisted in the surveys in the Negaunee District throughout the balance 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>
General Engineering	$4\frac{1}{2}$	4	34	$42\frac{1}{2}$	18.2
Athens Mine	$48\frac{1}{2}$	2	$26\frac{1}{2}$	77	32.8
Cambria-Jackson Mine	17	3	5	25	10.6
Maas Mine	$31\frac{1}{2}$	4	22	$57\frac{1}{2}$	24.5
Negaunee Mine	$13\frac{1}{2}$	-	10	$23\frac{1}{2}$	10.0
Cliffs-Shaft Mine	-	-	$4\frac{1}{2}$	$4\frac{1}{2}$	1.8
Mather Mine A Shaft	-	-	$1\frac{1}{2}$	$1\frac{1}{2}$	0.6
Spies Mine	-	-	$\frac{1}{2}$	$\frac{1}{2}$	0.2
Republic Mine	-	3	-	3	1.3
TOTAL	115	16	104	235	
%	48.9	6.8	44.3		100.0

JAMES R. MAGNUSON, Helper, was employed in the Department between May 26th and July 21st, assisting in running base lines for the Geological Departments' geophysical surveying. His time was all charged against this work.

JIM JENKIN, Helper, was employed between July 14th and August 31st, assisting in the geophysical surveys for the Geological Department. He was transferred to the Geological Department on September 1st. His time was all charged to the geophysical surveying.

JOHN E. HAYDEN, JR., was employed as helper from January 6th to March 29th. He assisted in the surveys at all of the mines. He left the Department on April 1st to return to college.

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

<u>Property</u>	<u>Underground</u>	<u>Field</u>	<u>Office</u>	<u>Total</u>	<u>%</u>
Athens Mine	2½	-	-	2½	3.8
Cambria-Jackson Mine	1	-	-	1	1.5
Cliffs-Shaft Mine	1	-	½	1½	2.3
Maas Mine	1	-	-	1	1.5
Mather Mine A Shaft	6½	½	2	9	13.7
Negaunee Mine	1½	-	-	1½	2.3
Spies Mine	14	-	1½	15½	23.7
General Engineering	-	-	15½	15½	23.7
Cliffs 7th Addition	-	-	18	18	27.5
TOTAL	27½	½	37½	65½	
%	42.0	.8	57.2		100.0

RAYMOND S. WINDSAND, Helper, entered the Department on December 16th as helper at the Mather Mine A Shaft. All his time for the balance of the month was charged to this property.

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

E. DISTRIBUTION OF TIME

The Mather Mine A Shaft naturally took most of the time as a survey crew of three men was underground practically all the time. The Spies-Virgil Mine took more of the engineer's time in spite of its small size, due to the time spent in travel and the frequent trips necessary due to lines for development. The General Engineering item covers a great deal of miscellaneous work that was not directly chargeable to any one mine or property. It is interesting to note that, with the exception of the Cliffs-Shaft Mine, there were more days spent underground or in the field than in the office.

The following table shows the distribution of time for the year, divided between underground, field and office, for the different properties, 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>
General Engineering	16½	349	756	1,121½	20.7
Athens Mine	240	11½	260	511½	9.4
Cambria-Jackson Mine	164½	30	143½	338	6.2
Cliffs-Shaft Mine	191½	41½	263	496	9.2
Lloyd Mine	75½	9	64½	149	2.8
Maas Mine	203½	31½	215½	450½	8.3
Mather Mine A Shaft	464	96½	365	925½	17.1
Mather Mine B Shaft	-	180½	46	226½	4.2
Negaunee Mine	93½	15	98	206½	3.8
Spies Mine	234½	6½	135½	376½	7.0
Tilden Mine	-	18½	3½	22	.4
Geological Department	-	26½	64	90½	1.7
Republic District	-	55	18	73	1.4
Geophysical Surveying	-	108	1½	109½	2.0
Cliffs 7th Addition	-	3	36	39	.7
Cliffs Power & Light Co.	-	-	5	5	.1
Morris Mine	-	-	16	16	.3
Stenography	-	-	256½	256½	4.7
TOTALS	1,683½	982	2,747½	5,413	
%	31.1	18.1	50.8		100.0

F. COSTS

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

	<u>1945</u>	<u>1946</u>	<u>1947</u>
Salaries	\$30,073.34	\$40,802.33	\$57,754.59
Auto Expense	2,506.99	2,373.78	3,333.94
Furniture and Fixtures	27.65	261.51	361.11
Heat, Light & Power	617.29	789.69	1,026.51
Insurance	86.00	124.32	145.48
Postage	28.99	33.70	27.82
Repairs	67.77	112.88	80.00
Stationery and Printing	126.23	153.65	234.72
Supplies	3,695.97	3,450.24	5,053.10
Taxes	46.72	46.69	46.55
Traveling and Entertainment	210.15	159.64	508.32
Telephone and Telegraph	122.24	96.08	101.34
Papers and Periodicals	12.24	21.43	16.33
Unemployment Insurance Tax	390.15	529.87	849.90
General - Unclassified	228.33	491.79	653.78
Old Age Benefit Tax	300.15	407.63	587.93
Depreciation	104.07	104.07	104.08
Equipment	995.15	788.58	1,358.17
Group Annuity Premiums	-	-	201.18
TOTALS	\$39,639.43	\$50,748.18	\$72,444.85

H. AUTOMOBILES

The Ford two-door sedan furnished by Four Wheels, Inc. was operated throughout the year. The Company-owned Ford and Chevrolet station-wagons also were operated throughout the year.

The following table shows the mileage covered in 1947, 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>1947</u>	<u>Total</u>	
Ford Sedan	15,926	22,271	Aug. 17, 1946
Ford Station-Wagon	5,068	45,489	Jan. 24, 1941
Chevrolet Station-Wagon	8,179	47,420	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 and the heavy demand for ore kept the Department exceedingly busy throughout the year. No shaft gauging was done during the year. The field work required for the geophysical surveys of the Geological Department prevented any extension of the triangulation system and the surface mapping that had been planned for the summer.

ATHENS MINE

The extension of the ground subsidence was watched during the year. Elevations on the foundations of the Dry showed no appreciable settlement, but there is a pull that is evident by cracks in the floor and walls. A number of concreted iron pins were set near the north and east boundary lines of the property as most of our old survey points have been lost.

The development of the new ore body north of the main dike on the 9th Level, and above, has required frequent surveys for drill holes, raises, etc. as well as main level drifting. The block caving development above the 8th Level in the fire area was carefully surveyed from time to time and lines given for the various raises and sub-levels. The planning and subsequent starting of both 4th Level drifting and scraper drifts were given the necessary attention. Lines for main level and sub-level development, raises, etc. were given as needed throughout the year. On April 13th the shaft was plumbed from the 8th to 4th Levels to check the 4th Level surveys. The surveys on the lower levels had been checked between each other, and while there was no reason to expect any discrepancy on the 4th Level, it was deemed best to make the check before any mining was done along the Athens-Lucky Star boundary line.

CAMBRIA--JACKSON MINE

Grades were given on surface for completing the grading and landscaping, and the new buildings and changes were mapped.

Early in the year, measurements were taken and plans made for rebuilding the 6th Level shaft pocket. The new cross-cut to develop the 5th Level ore south of the Hartford #2 shaft, was planned, and lines given for its development later in the year. The 7th Level reached the Mather A Shaft workings on their -185' Sub-Level exactly as expected. The connection with the Mather A workings was planned, consisting of a raise from their 3rd Level to meet a cross-cut from the Cambria 7th Level. This cross-cut was completed before the end of the year and the Mather Mine is extending their 3rd Level toward the boundary between the two mines. Surveys were run and lines given to the various sub-levels as needed. The development of the ore body extending from the Mather Mine at the West end of the property required constant attention until it was fully developed.

CLIFFS-SHAFT MINE

Lines and elevations were given for the installation of the steel shaft pockets and dumps in both A and B shaft houses. The hoisting rope sheaves were re-aligned for the Mechanical Department. Lines and grades were given for the installation of a 24" pipe for mine water discharge past the stockpile grounds.

Besides the four quarterly surveys, monthly surveys were made of development drifts and raises for the superintendent. Lines were given for drill holes, raises, etc.

LLOYD MINE

About the middle of the year it was decided to resume the development of the 9th Level by the winze from the 8th. The cutting out of the hoist station and raise for pocket and skip dump was supervised by Mr. Haivala and it required considerable time before the timbering was completed and the sinking started. By the end of the year the winze was down 161' to within about 3' of the proposed 9th Level. There was comparatively little surveying required during the year for sub-level development as most of this had been done previously and by the end of the year mining had almost reached the 8th Level.

MAAS MINE

A special survey was run on surface for the layout of the steel trestle on the West stocking ground. The location and height of piers was determined and the piers were ordered, but delivery was postponed until 1948. The new trestle will utilize the steel girders from the dismantled South trestle at the Athens Mine. There was no main level development during the year, but the sub-level caving above the 4th Level and the open stopes above the 5th and 6th Levels required frequent lines. Plans for a trench pocket were made for the 6th Level shaft station and the excavating and installation of the shaft pocket was supervised. This trench is in addition to the regular shaft pocket, rather than a replacement, as the design was somewhat different from similar trench pockets at other mines. A new skip cleaning layout was prepared, involving an incline raise with scraper, and discharging into the trench. This work required considerable planning so that the construction would not interfere with the regular 6th Level operation.

MATHER MINE - "A" SHAFT

Grading of the stockpile ground was continued easterly and grades were given as needed. Construction of additional pier bases for the extension of stocking trestles was supervised. These trestle extensions were completed late in the year. The east timber tunnel was completed in September, holing from the easterly end to the concrete entrance from the shaft. Estimates and plans were made for grading the east timber yard late in the year and grade stakes given as required. During the grouting of the ground under the air compressors, transit readings were taken on the compressor shafts to check any movement that might occur due to the pressure exerted on the grouting. The excavation of the ventilation compartment on the west side of the shaft was supervised and watched for possible settlement of shafthouse foundations.

The rapid development of the underground workings by stopes, sub-level caving and regular top-slicing methods of mining, was so extensive that almost daily lines or grades were required. The extension of the main levels, cross-cuts, turnouts and drill hole locations also needed lines frequently. The concreting of the 6th Level pumphouse and the 3rd Level fan installation were supervised. Daily conferences were held at the mine office to plan mining, exploring and other operations.

MATHER MINE - "B" SHAFT

The construction of the concrete collar at the shaft and adjacent timber tunnels required constant attention all summer. The staking out and grade stakes for the temporary buildings were provided as necessary. The installation of permanent and temporary water and sewer lines and other facilities were planned and supervised. Plans were prepared for moving the residences from the site of the permanent buildings and lines and grades were given at the new location. Estimates were made for grading the stockpile ground and grade stakes were put in as needed and the work supervised. The Cliff's Power & Light Company made a new alignment of their tower line around the shaft and building site. This new alignment was surveyd and mapped. The new spur of the Lake Superior & Ishpeming Railroad Company to the proposed "B" Shaft shipping pocket was also mapped.

In the shaft, bearer sets were lined in and regular sets were checked from time to time. Tests of various types of drill bits were made and the results tabulated.

NEGAUNEE MINE

As mining approached the 14th Level, very little surveying was needed, consisting of lines on that level for new cross-cuts, and a few raises. A few sub-level surveys were run.

SPIES-VIRGIL MINE

Early in the year the cross-cut on the 1330' Sub-Level holed to the drift from the bottom of the ventilation shaft. It was impossible to get a check on the surveys because of water conditions, as the pump installation for taking the water from the upper mine workings had not been completed. The development of the ore body to the south needed constant attention for holing sub-level drifts, lines for raises, etc. Plans for stope development were made in advance and the work supervised as it progressed. The drainage problem was a serious one, and much thought was given as to the best solution. Sumps were

planned and the excavation supervised. The 6th Level development was planned and the enlargement of the shaft plat and the construction of the trench supervised. Lines and grades were given for the extension toward the East Deposit as needed.

TILDEN MINE

Drilling programs for blasts in the various benches and pits were prepared and the holes located. Blasts were calculated and supervised. A few small stripping estimates and plans were made and the pit crests surveyed toward the end of the shipping season.

J. MISCELLANEOUS

STOCKPILES

The ore in stock at the various mines was estimated and reported as of November 1st. There was not sufficient ore in stock at the Athens, Cliffs-Shaft, Lloyd or Mather Mines to make a survey. The Princeton stockpile was cleaned up during November, showing an overrun of 307 tons from our estimate made in 1946.

The following table shows the comparison of standard and special ore in stock as of November 1, 1946 and November 1, 1947. The Tilden Silica stockpile is not included.

<u>Mine</u>	<u>Nov. 1, 1946</u>	<u>Nov. 1, 1947</u>	<u>Difference</u>
Athens	26,975	5,336	-21,639
Cambria-Jackson	73,515	2,808	-70,707
Cliffs-Shaft	45,526	0	-45,526
Lloyd	248,343 (1)	98,323	-150,020 (2)
Maas	98,680	32,432	-66,248
Mather A Shaft	702	3,948	+3,246
Negaunee	71,114	63,335	-7,779
Princeton	143,479	14,165	-129,314
Spies-Virgil	51	7,873	+7,822
TOTALS	708,385	228,220	-480,165

(1) Includes 247,940 tons of Silica ore.

(2) Includes 98,323 tons of Silica ore.

TRIANGULATION SURVEYS

There was no triangulation surveying done during 1947. It was hoped that the work which was started last year could be completed to include the Athens Mine and adjacent property, but the press of other work prevented this.

SURFACE TRAVERSE SURVEYS

In Section 4, 47-27, where the Geological Department is conducting a diamond drill exploration, new concreted iron pins were set and tied in with the old surveys. Old survey stations were found and lines brushed out to facilitate the location of future drill sites. This section has not yet been tied into the triangulation system, but we hope to be able to do this work next year.

A long traverse survey was run along the east and south lines of Section 11, 47-27 on old survey lines to tie in old stations with the triangulation system. This survey was run partly to find what old survey stations still were in place, and to locate, on the triangulation system, as many of the section boundary markers as possible. The Legal Department had requested a description of all these markers and, because of this survey, we were able to supply the information. All but one of the fifteen markers were found. Many of the old survey stations inside this Section have been found and tied into the triangulation system. Section 11 was surveyed and mapped in 1914 and 1915 and since then there have been many changes in roads, residences, railroad tracks, etc. Additional surveys were run to re-map these changes, so that now our maps are up to date.

There have been many changes, such as new houses, additions to old houses, removals of houses and other buildings, changes of roads, etc. in the Jackson Iron Company's Addition to the City of Negaunee in Section 1, 47-27, since our original surveys and maps were made many years ago. This Addition was re-mapped during the summer and the maps brought up to date. This was necessary as we are acquiring property in this Addition.

GEOPHYSICAL SURVEYS

During the summer and fall, the Geological Department had several crews in Sections 4 and 11, 47-27 running magnetometer surveys, under the direction of Professor William A. Longacre of the Michigan College of Mining & Technology. These magnetometer readings were made along time meridian lines conforming to our coordinate survey system. It was necessary for the Engineering Department to run base lines at 800' intervals across both these sections, from which the Geological Department crews could turn off their survey lines. One surface crew of four men, two of them choppers, was busy for several months on this work, running about 10 miles of base lines.

REPUBLIC DISTRICT

Mr. Brewer spent some time examining certain lands south and east of the Republic Mine that might be of value in connection with the proposed Republic Mine operation. He looked over the ground and examined the title records for owners. He assisted Mr. G. R. Jackson in securing options to purchase lands in Sections 8 and 17, 46-29. He conferred with the Legal Department as to the chain of title and assisted in clearing up flaws in the titles. The options obtained covered about half of Section 8 and all but two 40 acre parcels in Section 17.

Some of the old survey stations were found in the southeastern part of Section 7, 46-29, on top of the hill, but all those on the west side, where the old mine operation was conducted, were gone. A new series of concreted iron pins was set and surveyed on the west side of the hill, and tied in with the old surveys. After the options were obtained and before snow prevented finishing the work, two surveys were run, one going southeasterly into the center of Section 17 and the other easterly into Section 8 toward the southeast corner. Next year these surveys will be connected near the east quarter corner of Section 17.

CLIFFS 7TH ADDITION TO THE CITY OF ISHPERING

The Plat of the Cliffs 7th Addition to the City of Ishpeming was completed, executed by the Company and presented to the City Council early in May. It was not accepted by the City until July 9th, the reason being that the city officials wanted to find out as to the cost of public improvements and how they were to be financed. There was considerable delay in the Auditor General's Department at Lansing so that it was October before we were informed that the plat had been accepted. Arrangements were made with the City Manager and the Land Department for sewer and water installation. No lots had been leased by the end of the year.

HARD ORE WAREHOUSE AND STORAGE YARD

The erection of the diesel plant for the Cliffs Power & Light Company with its fuel storage tank, cooler, and the miscellaneous accompanying structures in the storage yard at the Brownstone, together with the proposed new warehouse, necessitated a rearrangement of railroad tracks and other facilities. The entire yard was mapped and tentative lay-outs submitted to the interested parties for approval. Lines and grades were given for construction purposes as needed.

GROUND WATER LEVELS

A great deal of attention was paid, during the year, to ground water, especially in connection with the mining operations at Mather A and B shafts. The sudden inrush of water at the Mather A shaft in February focused attention to the 50 to 60 feet of water above ledge over the mine workings. It was realized that by the end of 1948 nearly two million tons of ore would have been removed from a comparatively limited area and that, while a surface subsidence was not anticipated for several years, nevertheless minor cracks to surface would permit this water to enter the underground workings in unknown quantities. A study of the ground water situation, as affecting Sections 1 and 2, 47-27, was made. We were assisted by Mr. W. T. Stuart of the U. S. Geological Survey Ground Water Division, who has been working in the field for several years studying the ground water situation in the Iron River District, under the direction of Mr. Theis, Division Director. Mr. Stuart has been helping the Inland Steel Company regarding the surface ground water situation at the Morris Mine, and was called into consultation in our problems also.

The first step was the draining of the Lily Pond, a small lake of perhaps 30 acres, near the center of the two Mather properties. Soundings were taken late in the winter through the ice, and showed only about five feet of water, and varying depths of mud beneath. A survey showed that the standing water could be entirely drained into the Negaunee City sewer system by deepening that part of Partridge Creek. Arrangements were made with the City of Negaunee and ditch excavation was started early in May. It was finished on June 25th and accomplished its purpose of draining the entire pond. An attempt was made to excavate a sump at the west end of the pond to lower the ground water, but there was not adequate pumping equipment available to handle the water and the project was discontinued. During the summer the Geological Department put down five test holes adjacent to Mather A workings, leaving slotted pipes in the holes so measurements could be taken of ground water elevations. There were several standpipes left in former drill holes where similar readings could be taken and beginning September 1st, regular monthly readings have been made. The following table shows the results of these readings and information obtained from these holes:

Hole No.	Collar Elevation	Water Elevation		Ledge Elevation	Depth of Water on Ledge
		Sept. 1, 1947	Jan. 1, 1948		
22 (Old)	1413.7	1387.8	1387.0	1302.	+85'
32 (Old)	1458.4	1409.4	1407.9	1374.	+33'
40 (Old)	1463.8	1394.8	1395.8	1413.	-17'
38A (New)	1466.1	1391.3	1390.1	1338.	+52'
54 (New)	1460.2	1390.2	1389.2	1342.	+47'
55 (New)	1463.5	1390.5	1390.1	1337.	+53'
56 (New)	1461.4	1401.0	1399.4	1332.	+67'
57 (New)	1450.1	1420.1	1425.1	1344.	+81'

Hole No. 22 is near the west end of the former Lily Pond and No. 57 is south of Mather A Shaft, while the others are scattered in between. These readings show that the water table rises about 42 feet in the 2800 feet between No. 22 and No. 57. The elevation of ledge below the Lily Pond is about 30 feet lower than over the Mather A Mine workings.

In December the Layne-Northwest Company put down two test holes east and southeast of the stockpile ground to determine the possibility of a deep well pump to lower ground water. The result of these two holes showed a rather tight formation that would not yield more than 300 gallons per minute. The low permeability of the surface material indicates that any seepage to underground workings through cracks or caves to surface will probably not be in large quantities. Additional test holes will be put down early next year.

Readings of ground water levels at the Maas, Negaunee and Athens Mines were continued monthly during the year. The following table shows a comparison of readings:

Test Hole No.	MAAS MINE Elevation of Water		Difference 1947	Original Elevation	Total Difference
	Jan. 1, 1947	Jan. 1, 1948			
1W	1249.6	1261.1	+11.5	1317.0	-55.9
2W	1240.8	1252.0	+11.2	1318.8	-66.8
5W	1247.1	1251.5	+4.4	1366.6	-115.1
9W	1269.9	1271.4	+1.5	1281.8	-10.4
13W	1303.6	1304.2	+0.6	1340.0	-35.8
14W	1288.2	1286.4	-1.8	1323.8	-37.4
15W	1310.4	1309.2	-1.2	1326.3	-17.1
16W	1280.6	1279.6	-1.0	1324.8	-45.2
18W	1255.0	1257.4	+2.4	1319.4	-62.0
20W	1259.8	1263.1	+3.3	1319.0	-55.9
21W	1236.8	1247.8	+11.0	1229.1	+18.7
<u>NEGAUNEE MINE</u>					
6A	1178.1	1180.7	+2.6	1197.0	+16.3
7	1182.3	1187.8	+5.5	1195.1	+7.3
<u>ATHENS MINE</u>					
104W	1295.6	1296.3	+0.7	1299.5	+3.2
105W	1299.8	1299.0	-0.8	1301.5	+2.5
106W	1297.0	1297.1	+0.1	1302.4	+5.3

The rise of the water level in Maas holes 1W and 2W is not readily understood as the rise has been steady since September and was relatively stationary before that time. The small fluctuation during the year in levels in the other holes are more uniform and are seasonal. Hole No. 13W is perhaps the best indication of the drop in water levels. It is both farthest west and farthest from the caved ground of any of the holes, and it is interesting to note the decreasing lowering of the water level as the years pass on. The following table shows the water elevation in Hole 13W at the beginning of each year:

<u>Date</u>	<u>Elev.</u>	<u>Difference</u>
1940	- 1343.0	
1941	- 1332.2	-10.8
1942	- 1321.2	-11.0
1943	- 1313.3	-7.9
1944	- 1309.8	-3.5
1945	- 1305.6	-4.2
1946	- 1304.9	-0.7
1947	- 1303.6	-1.3
1948	- 1304.2	+0.6

Messrs. Theis and Stuart had expressed their opinion that evidence of surface water seepage into the mine could be detected by temperature readings of water encountered underground. It was their opinion that the temperatures of underground water would help determine the rapidity with which this water percolated downward from surface. A test at the Maas Mine showed that surface ground water was 45°, on the 3rd Level, about 1,000 feet lower, the water temperature was 47° and on the 6th Level, 400 feet lower, it was 53°. Apparently the 3rd Level water spent little time in descending the 1,000 feet while the 6th Level water coming from a different surface source, took longer. It is interesting to note that the temperature of the big water flow at Mather A Shaft in February, was about 56°.

COAL ESTIMATES

In April a survey crew was sent to Green Bay and Escanaba to measure the coal in stock on the docks for the Coal Department. The results were given to the Dock Superintendents in cubic feet, because the different grades of coal each had a separate factor. From time to time during the year the coal piles at the mines were estimated for the mine records.

IRON COUNTY OPTIONS

The Company had been offered, through the Geological Department, the NW $\frac{1}{4}$ of Section 26 and the NE $\frac{1}{4}$ of Section 27, 43-35, in the Iron River District, for exploration purposes. Mr. Brewer investigated the ground water situation on these descriptions from data secured from Mr. Stuart of the U. S. Geological Survey. The surface and mineral ownerships on both descriptions are quite complicated. Mr. Brewer spent some time preparing maps showing the conditions that might be expected. The results of these studies showed these conditions were not as serious as was first thought. Options for leases are being prepared by the Legal Department.

TRESPASS

In July, the Inland Steel Company called upon the Engineering Department to assist in correcting a fence trespass in the NW $\frac{1}{4}$ of Section 2, 47-28. The fence that was supposed to be along the East-West center line of the W $\frac{1}{2}$ of the

NW $\frac{1}{4}$ was not on the line. The true line was run and a new fence built on the correct line.

WATER AND SEWER SYSTEMS

The Gwinn water and sewer systems were transferred to Forsyth Township as a donation as of September 13, 1947. Mr. Brewer conferred with the Legal Department and with the township officials prior to preparation of the various documents. He also has had several conferences with the Ishpeming Township officials relative to the transfer of the North Lake water system to that Township.

HOLIDAYS

The following holidays were granted during the year:

- January 1st - - - - - New Years Day.
- February 22nd - - - - - Washington's Birthday.
- May 30th - - - - - Memorial Day.
- July 4th - - - - - Independence Day.
- September 1st - - - - - Labor Day.
- November 27th - - - - - Thanksgiving Day.
- December 24th ($\frac{1}{2}$) - - - - Christmas Eve.
- December 25th and 26th - Christmas.

Carl Brewer

Recorder

CB:DWC
5-4-48
-3-

MECHANICAL DEPARTMENT
ANNUAL REPORT
YEAR 1947

AGNEW MINE:

This is an underground mine taken over from International Harvester Company on March 1st. It is located at Hibbing, Minnesota and has been producing about 250,000 tons per year. It was operated by the International Harvester Company from 1902-1920 and 1930-1946 and still has close to two million tons available. The surface equipment consists of steel head frame and one long stucco building inclosing office, change house, hoist and compressor room and shops, with garage in separate building.

In engine house the 3-ton skips are run in balance by an Ottumwa Iron Works hoist with drum 60" x 60", controlled by post brake and driven thru herringbone gear by 150 H.P., 430 RPM, slip ring, 2200 volt General Electric motor. The hoist rope is 1" in diameter.

The cage hoist is the same size and make as skip hoist except it is driven by a 100 H.P. motor and has either a manual control from the cage or from engine room. The cage is counterweighted and 1" hoisting ropes are used.

An Ingersoll-Rand Type PRE-2, 12½" - 20" x 14" compressor driven by 225 H.P., 257 RPM General Electric motor supplies the air at 90# P.S.I. It is equipped with receiver and aftercooler and has a 5-step control.

The underground haulage locomotives are driven by a synchronous converter set of General Electric make, Type TCC-6-100-1200. The 100 K.W. is too light to carry both locomotives and the new double drum slushers that we have installed so a second set is being installed.

The underground water is controlled by a 2000 G.P.M. duplex well pump with several horizontal centrifugals of smaller capacity held as spares. To hold the water below the 700 foot level, which keeps the contracts dry, it is necessary to run the Layne & Bowler deep well pump about 16 hours per day. During a violent electric storm in September lightning struck the house over pump and it was burned, causing a two weeks delay. In August the 18" discharge line location had to be changed due to heavy stripping by Butler Bros. on the South Agnew property and a new 16" line was installed. About 1800 feet of pipe was salvaged and stored at the Hawkins Mine.

A 4-yard steam shovel is located at stock pile but a 120-B electric was rented from Butler Bros. to load out stock pile this season, which proved cheaper than using the steam machine.

ATHENS MINE:

On surface it was necessary to remove 350 feet of double track steel trestle located over caving ground and move it to the Maas Mine. No. 31 electric shovel, an 80-B with 2½-yard dipper, was moved here from Tilden Mine and used to load out the stock pile, replacing the steam machines formerly used. At engine house the compressors received their annual cleaning of intercooler and jackets. The 24" diameter intake on Ingersoll-Rand machine was changed to a location on west side of engine house to stop rusting of intake screens due to moisture from cooling pond. It was found the skip hoist drum shell had worn down from a thickness of 1-5/8" to 1-1/8" and action was started toward securing a new shell.

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ATHENS MINE: (Continued)

Underground four new cross heads were installed on Prescott plunger pump on the 2400 foot level. Two 40 H.P. Sullivan double drum hoists were received and installed on block caving test.

ATKINS MINE:

Stripping continued in the pit when the equipment was not needed for ore loading. In February a second hand drag line bucket was secured for the No. 55 shovel and was used in grading the pit banks for the upper flight of 30" belt conveyor. No. 49 shovel took care of the stripping program until a section of track supporting the rotating frame broke in May. No. 51 shovel was shifted from Hill-Trumbull Mine and replaced No. 49 until new track and supporting rollers were installed in June. In July a new 54-B was received and started operating, allowing No. 51 to be returned to the Hill-Trumbull. In July the 30" belt conveyor system was received and installation was completed and started in August. Due to breakdown of 85-B shovel in Hawkins pit in August it was necessary to rob No. 49 shovel of its drive motor, which left this machine idle for two months. A stocking conveyor was completed by October 6th., which eliminated any delays due to shortage of cars.

It was found the 40 foot square garage was too small to take care of engine repairs so a concrete block lean-to was added to the north side of building for this work. A new concrete floor in main garage replaced the old one spoiled when the fire occurred last October. A 5-ton overhead crane was added.

Near the garage, during the fall, a 10,000 gallon diesel oil station to supply trucks and shovels was installed, improving the refueling operation and allowing oil to be purchased wholesale.

At the end of ore season the pan feeder gave trouble due to wheel bushings. The feeder was sent to Holman Mine for an overhaul.

CAMBRIA-JACKSON MINE:

On surface the new concrete block machine shop was completed, the machines set in place and all equipment transferred from the old shop by August 1st. This building is a big improvement over the old shop and should last for the life of the mine. At the engine house the Laidlow-Dunn-Gordon compressor gave no more trouble after the Ario compressor oil was replaced with DTE heavy medium. The cleaning of valves is now on a definite schedule and no further trouble is anticipated. In September a new 54-B diesel shovel, our No. 65, was received from Bucyrus-Erie Company and started work in the stock pile. This is a 2 $\frac{1}{2}$ -yard machine driven by a Buda diesel engine. After stock pile was finished the machine was moved to Mather Mine "B" Shaft in December to strip the rock ridge at engine house location. The old steam shovel No. 59 was cut up for scrap after we salvaged the four 24" I beams 40 feet long supporting the floor. In October a steam line was run from dry boiler to top tram floor to heat dump plates in shaft house.

Underground the Prescott horizontal duplex pump bought second hand from Holmes Mine was erected on 7th. level as a spare. This has a capacity of 300 GPM against 800 foot head. With this combination the eight pumps used by Republic on 5th, 6th and 7th level can be removed. None of them are in good condition. A new type skip and double cage were hung in the east skipway in June.

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CANISTEO MINE:

Stripping continued during January, February, March and April using the new 5-yard Harnischfeger electric shovel No. 63 on the north bank and Nos. 48 and 61 shovels on the south bank. In March and April the No. 48 shovel was overhauled ready for ore operation which started May 5th. In April a new Bay City 20-ton cranemobile was received and used to unload the several carloads of second hand conveyor equipment purchased from Anderson Dam.

At the washing plant a new stock pile conveyor belt was installed in June and used during ore car shortage. Tests were run on rotoscope that proved a worth while saving could be made by salvaging -14 to +60 mesh iron and two Hardinge machines were purchased in October to be installed during winter repair season.

Ore operations were completed October 25th, and shovels put back on south bank stripping. A 4" water line was installed on south bank to replace an excavated water main of the Oliver Iron Mining Company. In September a new Tournadozer was received for test and has given longer life on large tires than the caterpillar tractors. In October No. 63 shovel broke a main bearing on hoist drum which shut it down for 4 days. Grades and culverts are being installed ready for drag line and conveyor belt stripping in 1948.

CLIFFS SHAFT MINE:

The only new piece of equipment installed for the year was an after-cooler in engine house large enough to take care of the three compressors. It is of Ingersoll-Rand make and was completed in December. An air receiver secured from Mather Mine "A" Shaft second hand Ingersoll-Rand compressor was set up to replace one of the old ones in poor condition.

In the crusher building the pan conveyor required two overhauls for the year and the No. 8 crusher was equipped with a new mantle, new spindle, new bottom, and new eccentric, which makes it almost a new machine. The lump ore stocking car was rebuilt with stronger bottom.

In both shaft houses the timber pockets were in such poor condition it was necessary to rebuild them in structural steel and plate. This "B" shaft pocket work fitted in with shaft retimbering job when the mine shut down for several days in April. A shut down of 11 days was necessary at "A" shaft in July to complete steel pocket and replace head sheave supporting stringers.

In engine house all compressors were equipped with new type channel valves which have proven a big improvement over the old style disc type. A new coat of light paint was placed not only on machines but to the walls, giving the interior a brighter and cleaner appearance.

A new IR-54 drill sharpener replaced the old IR-50 in drill shop and the old machine was moved to general shops as it was much better than the one there.

The 80-B electric shovel moved in from Tilden Mine loaded out the stock piles but was not as fast as the steam machine. This can be corrected when the new electric machines are received in 1948. Plans are underway to shorten the boom 5 feet on the 80-B this winter, which should give it a faster swing.

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HAWKINS MINE:

This is the largest of the three mines taken over from International Harvester Company on March 1st. and is located at Nashwauk, Minnesota. The shipments to date are over 15,000,000 tons and the available ore is about 5,000,000. It was operated by International Harvester Company from 1902 to 1945 as an open pit, using 70-ton steam locomotives and hauling crude ore to washing plant located about two miles south of pit. At the end of this season the tracks in pit were removed and work started grading and putting in foundations for new belt conveyor system to hoist the ore from pit bottom to surface and haul with diesel locomotives to present washing plant. Seven new 20-ton diesel Euclid trucks were received in September for stripping operations and were busy to January 1st. removing the wash ore which would be tied up under the conveyor system and stocking in pit. For pit loading two 85-B electric shovels are used. Two 60-ton diesel Plymouth locomotives were purchased from War Assets Administration and will do most of the track haulage from pit to washing plant.

The shops are large and complete, having been used in the past by the I. H. Co. as central repair station for all the mines they owned on the Mesabi Range. An adjoining shed is amply large to house all the steam locomotives with equipment to service them. Other buildings are electric repair shop, heating plant, supply warehouse, oil house, garage and storage shed.

The washing plant is a full unit size. The ore is dumped from railroad side dump cars into a receiving bin where it passes over screens on to a belt conveyor that raises it to the top of the mill. From there it is treated by gravity system using standard log washers and classifiers driven by one motor thru countershafting. This system is being changed to individual drives. Two Hancock jigs treated some of the ore but this will be replaced with a sink float outfit. A new change house is being built this fall to take care of the washing plant crew. It was also necessary to enlarge the ore bin and relocate the sub-station. When planned improvements are completed this plant will be as up to date as those at our other mines.

HILL-TRUMBULL MINE:

In pit stripping operations during first of the year were confined to a narrow ledge on south side of pit, using No. 34 shovel. The extreme cold weather cracked the boom in February. In August an ore slide damaged No. 57 shovel and during the same month No. 58 shovel broke its crowd motor base. In November No. 34 shovel was moved to shops for a general overhaul.

Washing plant operations started April 28th. but jig plant did not get going until May 5th. The largest improvement in plant was installing a ball mill on table floor and conveyor for its discharge to jig plant. A second 5' x 14' screen was received from Allis-Chalmers and set up at 36" conveyor belt discharge, splitting the load between the two screens. The summer operation proved the conveyor belt discharge should be higher to get proper distribution between screens and this work is being done this winter. The Pettibone-Mulliken tailings pump installed on test gave such good performance that a second one was bought and the two pumps in series took care of tailings sand for the season, after the load was balanced between them. The hydrotator from Holman plant was set up for test against two Selective Media concentrators to determine some changes for next year. The plant shut down on November 8th.

At the shops repairs were completed on two electric locomotives and the 30-yard cars ready for ore season. During the summer most repairing was on Euclid trucks.

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HOLMAN-CLIFFS MINE:

At new site of washing plant, erection of structural steel started in January and work was rushed, using a 20-ton Bay City cranemobile rented from Duluth. Our 15-ton Browning cranemobile arrived in April and the two were kept busy at crushing and screening plant as well as wash plant until the plant was completed and started operating July 14th. It produced ore to the limit with very few breakdowns until the season closed November 6th. A bad storm in September injured No. 3 conveyor belt, which had not been covered, and delayed operations for 12 hours. On Akins classifiers it was found necessary to replace the 7½ H.P. with 15 H.P. motors.

In the pit a new road was cut thru the north bank reducing length of haul to dump. In May No. 57 shovel was returned to shops and converted into a dragline. After two months operation this was changed back to shovel operation. In August a new pit sump was dug on north side to drain water off the ore. With the belt conveyor removing ore from pit to washing plant, all rail was removed and the steam locomotives are being offered for sale. Two Tornadozers are being tried out on pit work.

The shops were busy for the year as shovels Nos. 32, 35, 55, 57 and 16-B came in for an overhaul. A second hand 4-foot radial drill that was broken in transit last year was repaired and set up in machine shop. At the truck repair shop, besides the regular repair work, five Walters trucks that had given poor service were overhauled by a factory representative and put back on test. In November grading was started and foundations put in for a 40' x 120' storage garage, an 80' x 80' Central Warehouse and a 40' x 60' Central Warehouse service garage. These were located to the south and east of the present shop buildings and are built of steel.

At the old washing plant location a site was graded in the tailings basin to install foundations for a fine ore plant. This will be completed and ready to operate for the 1948 ore season.

LLOYD MINE:

Very few changes were made on surface. In engine house cylinder oil tests on air compressor proved less carbon was deposited on the valves using D.T.E. heavy medium oil than any other make and this was adopted for this machine. In shaft house the skip pockets and dump were overhauled in March and gave no trouble the rest of the year. In change house a new Brownell stoker replaced the worn out one.

Underground a winze hoist was set up on 8th. level to sink a shaft 200 feet. The skip hoist from Wade Mine equipped with 125 H.P. motor is being used. A cage in balance will hoist the ore in cars to 8th. level and there the ore is dumped in skip pocket.

MAAS MINE:

In engine house the skip drum shell which was in poor condition was braced inside and kept running until the new steel plate drum shell was received in August from Lake Shore Engineering Company. This was installed during the week the mine shut down for vacations. The south compressor developed trouble in

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MAAS MINE: (Continued)

right hand cross head guide due to a clogged oil line and cracked a guide casting from excess heat. Guide was smoothed by grinding and gave no more trouble. In July it was necessary to change air suction intake pipe for compressors when a loading ramp was installed on north side of building.

The heating boiler cracked around the fire box in May. An examination showed the boiler full of sand that came from the deep well pump water being used around the mine. A settling tank was put in at well to let the sand settle out before reaching boiler.

Underground the pumps gave trouble due to sump not being kept clean. The mud wore the valve seats and they became loose in the casting. The casting cut and had to be rebushed, causing an almost endless round of repairing. Steel seats are being tried to find if their life is longer than the bronze. On 5th. level a 500 GPM high speed Gould centrifugal from the Cliffs Shaft Mine was installed on this level to assist until a third plunger pump purchased from Worthington Pump and Machinery Corporation was received. This arrived in November and is being installed. The Prescott pump on 3rd. level that has been running since 1913 developed a crack in one main bearing and is being repaired. One crank pin had to be replaced in this unit.

MATHER MINE "A" SHAFT:

On surface the top tram cars burned out several motors during the cold weather and it was necessary to replace them with 15-ton diesel trucks from the Tilden Mine. These operated until shipping season when the top tram units were overhauled and some of the parts giving trouble were corrected. The steel strestles were extended with 375 feet added to north and 250 feet to south trestle using five steel and concrete supporting columns. Worden-Allen Company fabricated the structural steel.

In March four Ingersoll-Rand compressors of the same size as the two installed in engine house were secured, second hand from a government ordnance plant near St. Louis. Two will be installed here and two at Mather "B" Shaft. The foundations for these were installed by the Intrusion-Prepakt Company, who not only solidified the porous ground under the first two units but built piling and protected the boiler room retaining wall when the last two foundations were put in. The third and fourth units are now on the foundations and will be completed in the near future.

On both cage and skip hoists the hoisting ropes were replaced as they had been in use four years and most of them had hoisted 750,000 tons. This does not include the workout in February when the skips were used as bailers and ran steady for several shifts. The cage hoist was equipped with a second post brake on pinion shaft as a safety precaution if the other failed.

Due to more heat being needed to keep the shaft from freezing the contract was given to Walker-Jamar Company, Duluth, to add a second boiler in heating plant, install hot water tanks in change rooms and put in a fan and unit heaters to blow sufficient hot air down the shaft to stop freezing. Due to slow delivery of material the installation will not be completed until early in 1948.