Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

b. All Injuries (Continued)

TABLE VII (Cont'd.)

OPEN PITS

CAUSE	CANI STEO	HAW- KINS	HILL- TRUMBULL	HOLMAN CLIFFS	HUMB OLDT	OHIO	REPU BLIC	SARG -ENT	TIL DEN	WAN- LESS	TOTAL
Falling Material	2				1						3
Persons Falling (Slipping & Stumbling)	1										1
Haulage	1										1
Machinery (Moving)	1										1
Explosion Of Kerosene Fumes		1									1
Falling From Ladder, Car, Scaffold, Etc.		1									1
Burns		1									1
Handling Material		1			1						2
Lifting Or Pulling			1					1			2
Flying Objects					1						1
Drilling Equipment					1						1
TOTALS	5	4	1	0	4	0	0	1	0	0	15

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11. ACCIDENTS AND PERSONAL INJURY

b. All Injuries (Continued)

TABLE VII (Cont'd.)

SURFACE (UNDERGROUND MINES)

CAUSE	AGNEW	BUNKER HILL	CAMBRIA-JACKSON	CLIFFS SHAFT	LLOYD	MAAS	MATHER MINE, "A" SHAFT	MATHER MINE, "B" SHAFT	SPIES-VIRGIL	TOTAL
Cages And Skips			1							1
Struck By Bulldozer Blade				1						1
Handling Material				1						1
Persons Falling (Slipping & Stumbling)				1	1					2
Machinery (Moving)					1					1
Flying Objects					1					1
Lifting Or Pulling					1					1
Loading Equipment, Shovels, Cranes, Etc.						1				1
Falling Material								1		1
TOTALS	0	0	1	3	4	1	0	1	0	10

OTHER OPERATIONS

CAUSE	ELECTRIC POWER DIVISION	GARAGE, STHSE. & SHOPS	MISCELLANEOUS	TOTAL
Drilling Equipment	0	1	0	1
TOTALS	0	1	0	1

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11. ACCIDENTS AND PERSONAL INJURY

b. All Injuries (Continued)

TABLE VIII

FREQUENCY RATES, ALL COMPENSABLE INJURIES

YEAR	TOTAL MAN DAYS WORKED	NUMBER OF COMPENSABLE INJURIES NON-FATAL	FATAL	FREQUENCY * RATE
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 1/4	171	4	20.30
1944	993,272 1/2	121	3	15.61
1945	915,665 3/4	107	1	14.74
1946	747,079	101	0	16.89
1947	1,071,219	149	7	18.20
1948	1,160,896 1/4	145	3	15.94
1949	1,013,442	126	1	15.66
1950	1,165,301 1/2	145	5	16.09
1951	1,359,479 3/4	136	2	12.69
1952	1,197,416 1/2	152	5	15.87
1953	1,234,755 1/4	152	2	15.39
1954	884,848	99	0	13.99

* Based on One Million Man-Hours Of Labor.

TABLE VIII-A

SEVERITY RATES, ALL COMPENSABLE INJURIES

YEAR	NON-FATAL DAYS LOST	RATE	FATAL DAYS LOST	DAYS LOST ALL INJURIES	SEVERITY * RATE
1939	3,264	.723	6,000	9,264	2.051
1940	3,442	.602	30,000	33,442	5.852
1941	5,403	.735	30,000	35,403	4.819
1942	5,851	.500	12,000	17,851	2.177
1943	10,355	1.201	24,000	34,355	3.986
1944	7,759	.976	18,000	25,759	3.242
1945	7,624	1.041	6,000	13,624	1.860
1946	7,994	1.337	0	7,994	1.337
1947	9,946	1.161	42,000	51,946	6.062
1948	14,526	1.564	18,000	32,526	3.502
1949	5,833	.719	6,000	11,833	1.390
1950	7,063	.757	30,000	37,063	3.976
1951	10,657	.979	12,000	22,657	2.083
1952	17,716	1.849	30,000	47,716	4.981
1953	8,587	.869	12,000	20,587	2.084
1954	6,502	.919	0	6,502	0.919

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

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11. ACCIDENTS AND PERSONAL INJURY

b. All Injuries (Continued)

TABLE IX

COMPARISON OF COMPENSABLE ACCIDENTS, INCLUDING FATALITIES
(BY MINES)

Mine Or Plant	FREQUENCY 1953	FREQUENCY 1954	SEVERITY 1953	SEVERITY 1954
AGNEW	22.62	0.00	.893	.000
BUNKER HILL	31.16	13.91	.941	.737
CAMBRIA-JACKSON	15.56	3.10	.747	.065
CANISTEO	11.01	21.49	.198	.760
CLIFFS SHAFT	14.78	14.14	.577	.754
ELEC. POWER DIV.	0.00	0.00	.000	.000
GENERAL ROLL	0.00	0.00	.000	.000
HAWKINS	17.70	16.43	.793	.900
HILL-TRUMBULL	14.84	5.06	15.109	.040
HOLMAN CLIFFS	2.76	0.00	.124	.000
HUMBOLDT	0.00	23.59	.000	1.209
LLOYD	7.64	29.50	.168	2.070
MAAS	23.87	7.10	.707	3.386
MATHER MINE, "A" SHAFT	21.17	18.11	.887	1.390
MATHER MINE, "B" SHAFT	18.21	33.68	.875	1.034
MISCELLANEOUS	0.00	0.00	.000	.000
MISCELLANEOUS-HIBBING	0.00	0.00	.000	.000
OHIO	8.60	0.00	20.641	.000
REPUBLIC	0.00	0.00	.000	.000
SARGENT (OPEN-PIT)	0.00	47.80	.000	2.247
SPIES-VIRGIL	4.78	17.74	.177	.467
STHSE. & SHOPS	10.54	3.44	1.728	.062
TILDEN	0.00	0.00	.000	.000
WANLESS	0.00	0.00	.000	.000
All Properties	15.39	13.99	2.084	.919

11. ACCIDENTS AND PERSONAL INJURY

b. All Injuries (Continued)

TABLE X

COMPENSABLE INJURIES INCLUDING FATALITIES

Mine Or Plant	Tons Of Ore Produced	Hours Of Labor	No. Of Fatalities	No. Of Comp. Inj.	Days Lost, Fatalities	Compensable Days Lost	Total Days Lost Fatalities & Comp.	Frequency	Severity
AGNEW	*222,910	228,389		0		0	0	0.00	.000
BUNKER HILL	440,000	575,134		8		424	424	13.91	.737
CAMBRIA-JACKSON	237,700	322,827		1		21	21	3.10	.065
CLIFFS SHAFT	444,307	848,443		12		640	640	14.14	.754
LLOYD	156,600	203,422		6		421	421	29.50	2.070
MAAS	401,117	563,732		4		1,909	1,909	7.10	3.386
MATHER MINE, "A" SHAFT	915,405	993,998		18		1,382	1,382	18.11	1.390
MATHER MINE, "B" SHAFT	909,351	920,472		31		952	952	33.68	1.034
SPIES-VIRGIL	146,740	169,109		3		79	79	17.74	.467
TOTALS	3,874,130	4,825,526	0	83	0	5,828	5,828	17.20	1.208
CANISTEO	528,658	232,665		5		177	177	21.49	.760
HAWKINS	**558,860	243,439		4		219	219	16.43	.900
HILL-TRUMBULL	393,822	197,820		1		8	8	5.06	.040
HOLMAN CLIFFS	558,045	209,123		0		0	0	0.00	.000
HUMBOLDT	169,356	169,528		4		205	205	23.59	1.209
OHIO	101,776	66,082		0		0	0	0.00	.000
SARGENT (OPEN-PIT)	74,998	20,918		1		47	47	47.80	2.247
TILDEN	20,838	383		0		0	0	0.00	.000
WANLESS	0	3,788		0		0	0	0.00	.000
TOTALS	2,406,353	1,143,746	0	15	0	656	656	13.11	.574
ELEC. POWER DIV.		92,747		0		0	0	0.00	.000
GENERAL ROLL		611,592		0		0	0	0.00	.000
MISCELLANEOUS		62,605		0		0	0	0.00	.000
MISC. - HIBBING		51,760		0		0	0	0.00	.000
STHSE. & SHOPS		290,809		1		18	18	3.44	.062
TOTALS		1,109,513	0	1	0	18	18	0.90	.016
GRAND TOTALS	6,280,483	7,078,785	0	99	0	6,502	6,502	13.99	.919

* Agnew production composed of 118,665 tons from Allworth and 104,245 tons from Agnew.

** Hawkins production composed of 162,704 tons from McKillican, 295,160 tons from Hawkins and 100,996 tons from I.H.C. fine ore pile.

THE CLEVELAND-CLIFFS IRON COMPANY
SAFETY DEPARTMENT, ACCIDENT STATISTICS, YEAR - 1954

Mine Or Plant	Position Rating	Hours Of Labor	No. Of Fatalities	Compensable Injuries	Non-Comp. 1 - 7 Days	Compensable Days Lost	Days Lost, Non-Comp., 1 - 7 Days	Lost-Time Inj. Includ. Fatalities	Days Lost, All Injuries & Fatalities	Frequency	Severity	Avg. Days Lost Per Injury
CAMBRIA-JACKSON	1	322,827		1	3	21	10	4	31	12.39	.096	8
AGNEW	2	228,389		0	7	0	22	7	22	30.65	.096	3
SPIES-VIRGIL	3	169,109		3	1	79	2	4	81	23.65	.479	20
BUNKER HILL	4	575,134		8	6	424	16	14	440	24.34	.765	31
CLIFFS SHAFT	5	848,443		12	5	640	14⅔	17	654⅔	20.04	.771	38
MATHER MINE, "B" SHAFT	6	920,472		31	12	952	35	43	987	46.72	1.072	23
MATHER MINE, "A" SHAFT	7	993,998		18	12	1,382	33	30	1,415	30.18	1.424	47
LLOYD	8	203,422		6	7	421	19	13	440	63.90	2.163	34
MAAS	9	563,732		4	7	1,909	19	11	1,928	19.51	3.420	175
TOTALS		4,825,526		83	60	5,828	170⅔	143	5,998⅔	29.63	1.243	42
OHIO	1	66,082		0	0	0	0	0	0	0.00	.000	0
WANLESS	2	3,788		0	0	0	0	0	0	0.00	.000	0
TILDEN	3	383		0	0	0	0	0	0	0.00	.000	0
HOLMAN CLIFFS	4	209,123		0	1	0	3	1	3	4.78	.014	3
HILL-TRUMBULL	5	197,820		1	1	8	4	2	12	10.11	.061	6
CANISTEO	6	232,665		5	0	177	0	5	177	21.49	.760	35
HAWKINS	7	243,439		4	4	219	14	8	233	32.86	.957	29
HUMBOLDT	8	169,528		4	0	205	0	4	205	23.59	1.209	51
SARGENT	9	20,918		1	0	47	0	1	47	47.80	2.247	47
TOTALS		1,143,746		15	6	656	21	21	677	18.36	.592	32
GENERAL ROLL	1	611,592		0	0	0	0	0	0	0.00	.000	0
ELEC. POWER DIVISION	2	92,747		0	0	0	0	0	0	0.00	.000	0
MISCELLANEOUS	3	62,605		0	0	0	0	0	0	0.00	.000	0
MISC. - HIBBING	4	51,760		0	0	0	0	0	0	0.00	.000	0
STHSE. & SHOPS	5	290,809		1	1	18	5	2	23	6.88	.079	12
TOTALS		1,109,513		1	1	18	5	2	23	1.80	.021	12
GRAND TOTALS		7,078,785		99	67	6,502	196⅔	166	6,698⅔	23.45	.946	40

Underground
Open-Pit
Independent Unit

FREQUENCY = NO. OF LOST TIME ACC. X 1,000,000 / MAN HOURS WORKED

SEVERITY = NO. OF DAYS LOST X 1,000 / MAN HOURS WORKED

THE CLEVELAND-CLIFFS IRON COMPANY

SAFETY DEPARTMENT, ACCIDENT STATISTICS, YEAR - 1954

MICHIGAN Mine Or Plant	Position Rating	Hours Of Labor	No. Of Fatalities	Compensable Injuries.	Non-Comp. 1 - 7 Days	Compensable Days Lost	Days Lost, Non-Comp., 1 - 7 Days	Lost-Time Inj. Includ. Fatalities	Days Lost, All Injuries & Fatalities	Frequency	Severity	Avg. Days Lost Per Injury
MARQUETTE RANGE:												
GENERAL ROLL	1	611,592		0	0	0	0	0	0	0.00	.000	0
ELEC. POWER DIVISION	2	92,747		0	0	0	0	0	0	0.00	.000	0
OHIO	3	66,082		0	0	0	0	0	0	0.00	.000	0
MISCELLANEOUS	4	62,605		0	0	0	0	0	0	0.00	.000	0
TILDEN	5	383		0	0	0	0	0	0	0.00	.000	0
STHSE. & SHOPS	6	290,809		1	1	18	5	2	23	6.88	.079	12
CAMBRIA-JACKSON	7	322,827		1	3	21	10	4	31	12.39	.096	8
BUNKER HILL	8	575,134		8	6	424	16	14	440	24.34	.765	31
CLIFFS SHAFT	9	848,443		12	5	640	14½	17	654½	20.04	.771	38
MATHER MINE, "B" SHAFT	10	920,472		31	12	952	35	43	987	46.72	1.072	23
HUMBOLDT	11	169,528		4	0	205	0	4	205	23.59	1.209	51
MATHER MINE, "A" SHAFT	12	993,998		18	12	1,382	33	30	1,415	30.18	1.424	47
LLOYD	13	203,422		6	7	421	19	13	440	63.90	2.163	34
MAAS	14	563,732		4	7	1,909	19	11	1,928	19.51	3.420	175
TOTALS		5,721,774		85	53	5,972	151½	138	6,123½	24.12	1.070	44
MENOMINEE RANGE:												
SPIES-VIRGIL	1	169,109		3	1	79	2	4	81	23.65	.479	20
GRAND TOTALS		5,890,883		88	54	6,051	153½	142	6,204½	24.10	1.053	44

FREQUENCY = NO. OF LOST TIME ACC. X 1,000,000 / MAN HOURS WORKED

SEVERITY = NO. OF DAYS LOST X 1,000 / MAN HOURS WORKED

THE CLEVELAND-CLIFFS IRON COMPANY
SAFETY DEPARTMENT, ACCIDENT STATISTICS, YEAR - 1954

MINNESOTA Mine Or Plant	Position Rating	Hours Of Labor	No. Of Fatalities	Compensable Injuries	Non-Comp. 1 - 7 Days	Compensable Days Lost	Days Lost, Non-Comp., 1 - 7 Days	Lost-Time Inj. Includ. Fatalities	Days Lost, All Injuries & Fatalities	Frequency	Severity	Avg. Days Lost Per Injury
MESABA RANGE:												
MISC. - HIBBING	1	51,760		0	0	0	0	0	0	0.00	.000	0
WANLESS	2	3,788		0	0	0	0	0	0	0.00	.000	0
HOLMAN CLIFFS	3	209,123		0	1	0	3	1	3	4.78	.014	3
HILL-TRUMBULL	4	197,820		1	1	8	4	2	12	10.11	.061	6
AGNEW	5	228,389		0	7	0	22	7	22	30.65	.096	3
CANISTEO	6	232,665		5	0	177	0	5	177	21.49	.760	35
HAWKINS	7	243,439		4	4	219	14	8	233	32.86	.957	29
SARGENT (OPEN-PIT)	8	20,918		1	0	47	0	1	47	47.80	2.247	47
TOTALS		1,187,902		11	13	451	43	24	494	20.20	.416	21

MESABA RANGE:		1,187,902		11	13	451	43	24	494	20.20	.416	21
MARQUETTE RANGE:		5,721,774		85	53	5,972	151½	138	6,123½	24.12	1.070	44
MENOMINEE RANGE:		169,109		3	1	79	2	4	81	23.65	.479	20

FREQUENCY = NO. OF LOST TIME ACC. X 1,000,000 / MAN HOURS WORKED SEVERITY = NO. OF DAYS LOST X 1,000 / MAN HOURS WORKED

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

b. All Injuries (Continued)

TABLE XII

SHOWING TIME PERIODS WHEN COMPENSABLE INJURIES OCCURRED

TIME	NUMBER	WORKING PERIOD
8:00 A.M. TO 12:00 NOON	36	FIRST HALF OF DAY SHIFT
12:00 NOON TO 4:00 P.M.	27	SECOND HALF OF DAY SHIFT
4:00 P.M. TO 8:00 P.M.	8	FIRST HALF OF AFTERNOON SHIFT
8:00 P.M. TO 12:00 MIDNIGHT	12	SECOND HALF OF AFTERNOON SHIFT
12:00 MIDNIGHT TO 4:00 A.M.	7	FIRST HALF OF NIGHT SHIFT
4:00 A.M. TO 8:00 A.M.	9	SECOND HALF OF NIGHT SHIFT
TOTALS	99	

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

b. All Injuries (Continued)

TABLE XIII

SHOWING OCCUPATION OF INJURED WORKERS

COMPENSABLE INJURIES

UNDERGROUND		SURFACE		OPEN-PIT	
Miner	34	Laborer	3	Maintenance Mechanic	4
Timberman	9	Blacksmith	2	Shovel Operator	2
Scraper Operator	11	Truck Driver	2	Mining Engineer	1
Motorman	1	Welder	1	Research Engineer	1
Motor Brakeman	3	Mechanic	1	Truck Foreman	1
Trammer Boss	1	Scraperman	1	Truck Driver	1
Repairman	1			Dumpman	1
Skiptender	3			Carpenter-A	1
Chuteman	1			Screen Plant Laborer	1
Welder	1			Cyclone Plant Helper	1
Shift Boss	1			Wagon Drill Helper	1
Shaft Miner	2				
Grizzly Sub. Attendant	4				
Electrician	1				
TOTALS	73		10		15

TABLE XIII-A

GENERAL STOREHOUSE

Drill Helper	1
TOTAL	1

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection

With few exceptions, all safety inspections are made while in company of a supervisor. Once a month a labor union safety committeeman accompanies the Safety Inspector. At the request of the Central Safety Committee, the company Safety Inspector reports all recommendations made by the supervisor and also makes out his own report on safety suggestions and recommendations. The union safety committeeman is always asked to make a report and in most cases he does. Some of these reports are very brief, others are quite long. Noticeable in all of the union reports is the fact that they nearly always make recommendations which have been discussed by the company Safety Inspector and supervisor. Very few have their own original ideas.

After each safety inspection, the company Safety Inspector meets with the mine superintendent or mine captain, or both, to discuss recommendations or suggestions. In most cases, corrections are made immediately but at times, because of a shortage of men, there is some delay.

Cooperation of all superintendents, heads of departments and other supervisors has been excellent.

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Idle Properties

The filling of old test-pits and shafts is proceeding satisfactorily. Considerable filling of test-pits was done on Mather Mine, "A" Shaft property near Barn Street and South of the Standard Oil bulk station.

Each mine is responsible for fencing and protecting or filling of hazardous places on their property.

A check of all idle property was made during the fall of the year before the snow fell. Nearly all fences were in good condition, having been repaired by Mr. Peter DeRoche's crew.

A check is being made of all filled pits to see if there is any subsidence of the fill.

At the old North-Jackson Mine there was a cave-in of one of the old shafts the later part of November and this was filled by crews from the Mather Mine, "B" Shaft. Pumping of water from the old North-Jackson Mine was the cause of the cave-in. The pits have been checked at least once every week during the winter months.

As soon as the snow is gone this spring we will check all of the idle properties.

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Fire Patrol Inspections

These inspections are being made as usual, after the last shift preceding each idle period and once each 24-hours thereafter until the mine resumes normal operation. In most cases, these inspections are made by the supervisors who also check and oil automatic pumping equipment, report broken timber, check power switches, etc.

It is my belief that these inspections have saved the company considerable expense.

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

TABLE XIV

1954

Mine Or Plant	Violations Of Standards	Safety Suggestions	Recommendations	Fire Hazard	Total
BUNKER HILL	28	58	20	4	110
CAMBRIA-JACKSON	14	38	16	3	71
CLIFFS SHAFT	21	76	25	4	126
DIAMOND DRILLS	0	0	0	0	0
GEN. STHSE. & SHOPS	1	15	4	11	31
HUMBOLDT	0	50	6	13	69
LLOYD	18	50	9	4	81
MAAS	32	73	18	5	128
MATHER MINE, "A" SHAFT	21	120	26	14	181
MATHER MINE, "B" SHAFT	33	125	31	15	204
OHIO	1	15	15	9	40
REPUBLIC	0	3	2	12	17
RESEARCH LABORATORY	0	10	1	4	15
SPIES-VIRGIL	4	10	8	3	25
TILDEN	0	0	0	0	0
TOTALS	173	643	181	101	1,098

TABLE XV

1953

Mine Or Plant	Violations Of Standards	Safety Suggestions	Recommendations	Fire Hazard	Total
ATHENS	6	15	21	2	44
Cambria-JACKSON	8	13	13	3	37
CLIFFS SHAFT	21	48	16	5	90
DIAMOND DRILLS	0	0	0	0	0
GEN. STHSE. & SHOPS	0	0	0	0	0
HUMBOLDT	0	0	1	1	2
LLOYD	9	7	5	4	25
MAAS	43	42	19	8	112
MATHER MINE, "A" SHAFT	3	21	5	6	35
MATHER MINE, "B" SHAFT	2	24	8	3	37
NEGAUNEE SHAFT	12	21	6	8	47
OHIO	0	0	1	0	1
REPUBLIC	0	0	0	0	0
RESEARCH LABORATORY	0	0	0	0	0
SPIES-VIRGIL	3	2	3	1	9
TILDEN	0	0	0	2	2
TOTALS	107	193	98	43	441

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Blasting Inspections

A continuous inspection of blasting practices is made by the department and supervisors at the mines, but there are still violations of our rules and some unsafe practices are used by the miners.

Numerous complaints received by this department are investigated and in most cases, failure has been caused by those doing the blasting; but, there are times when the manufacturers are at fault, such as electrical blasting caps burning or blowing out on the sides and failing to explode the dynamite charge. As a whole, blasting supplies are very well made and dependable.

Our supervisors check blasting procedure of all contracts six times a year and make out a written report to show methods used and violations committed. These reports are checked by the Captain, Superintendent and the Safety Department. During the past year, there were 1,002 inspections with 225 violations, most of them minor in nature, such as failure to tamp charged holes.

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

TABLE XVI

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

MINE	NO. OF INSPECTIONS	NO. OF VIOLATIONS REPORTED
BUNKER HILL MINE	85	24
CAMBRIA-JACKSON MINE	41	33
CLIFFS SHAFT MINE	120	25
LLOYD MINE	49	23
MAAS MINE	80	16
MATHER MINE, "A" SHAFT	307	1
MATHER MINE, "B" SHAFT	176	6
SPIES-VIRGIL MINE	144	97
TOTALS	1,002	225

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Rules And Regulations

A new safety rule book was completed during the year for Michigan Open-Pit & Concentration Plants and distributed to employees.

Considerable work was also done on revised safety rules for underground and surface employees and a foremens' rule book which will cover both underground and surface. We are trying to be very particular in making up these rules so as to avoid conflict with labor union interpretation. The company attorneys will give final O.K. to all new rule books.

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

TABLE XVII

RULE BOOKS DISTRIBUTED AT MICHIGAN MINES AND PLANTS

Mine Or Plant	Surface	Underground	Total
BUNKER HILL MINE	0	0	0
CAMBRIA-JACKSON MINE	0	3	3
CLIFFS SHAFT MINE	0	3	3
ELEC. POWER DIV.	1	0	1
ENGR. & GEOL. DEPTS.	0	0	0
HUMBOLDT	1	0	1
LLOYD MINE	0	2	2
MAAS MINE	1	3	4
MATHER MINE, "A" SHAFT	0	6	6
MATHER MINE, "B" SHAFT	0	2	2
OHIO MINE	2	0	2
SPIES-VIRGIL MINE	0	0	0
STHSE. & SHOPS	3	0	3
TILDEN MINE	0	0	0
MISCELLANEOUS	0	0	0
CLIFFS SHAFT LAB.	0	0	0
TOTALS	8	19	27

11. ACCIDENTS AND PERSONAL INJURY

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 XVIII

Type Of Inspection	Ag-new	Bunk. Hill	Camb. Jack.	Cliffs Shaft	Lloyd	Maas	Mather-A	Mather-B	Neg. Shaft	Spies-Virgil	Total
HOISTING ROPES	48	197	195	537	414	198	225	216	13	224	2,267
SKIP & CAGE ROADS	52	34	134	98	24	18	29	49	3	46	487
LADDER ROADS	52	35	11	98	12	17	29	36	3	46	339
CAGE SAFETY CATCHES	12	7	8	48	25	5	12	12	0	12	141
SLACK ROPE ALARMS	0	3	6	7	16	7	3	12	0	12	66
HOIST INSPECTIONS	0	30	12	30	36	36	24	24	2	24	218
FIRE EXTINGUISHERS	2	1	2	2	2	1	2	2	0	2	16
FIRE EQUIPMENT	3	1	2	0	0	2	1	0	0	0	9
FIRE PREVENTION	2	20	16	18	16	18	11	6	0	11	118
HOIST ENGINEERS' SPECIAL REPORT	50	0	0	0	0	0	0	0	0	0	50
TOTALS	221	328	386	838	545	302	336	357	21	377	3,711

Mine Or Plant	Fire Extinguishers	Fire Prevention	Fire Equipment	Total
CANISTEO	2	13	3	18
DIAMOND DRILLS	2	0	0	2
ELEC. POWER DIV.	16	8	0	24
GENERAL OFFICE	2	0	0	2
HAWKINS	2	39	3	44
HIBBING OFFICE	2	1	0	3
HILL-TRUMBULL	2	17	3	22
HOLMAN CLIFFS	2	21	3	26
HUMBOLDT	2	6	0	8
MATHER INN	2	0	0	2
OHIO	2	18	0	20
RENTED BUILDINGS	2	0	0	2
REPUBLIC	0	1	0	1
RESEARCH LABORATORY	2	1	0	3
SARGENT (OPEN-PIT)	2	2	3	7
STHSE., SHOPS & GARAGE	2	1	0	3
TILDEN	0	13	0	13
WANLESS	1	0	1	2
TOTALS	45	141	16	202

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

TABLE XIX

TYPES AND TOTALS OF FIRE EXTINGUISHERS INSTALLED AT VARIOUS PROPERTIES

Mine Or Plant	2½ - 3 Gal. Soda-Acid	1 - 5 Gal. Non-Freeze	2½ Gal. Foam Type	1 - 1½ Qt. Vaporizing	1 - 3½ Gal. Vaporizing	15 lb. Dry Powder	20 - 30 lb. Dry Powder	4 lb. Dry Powder	Automatic Carb.Diox.	5,10,15,30 lb. Carb.Diox.	150 lb. Dry Powder Engine	Total
AGNEW	1	1		3			10					15
BUNKER HILL	11	5		23	2	8	17	5				71
CAMBRIA-JACKSON	11			12	2		10					35
CANISTEO	4	3	1	53		9	11					81
CLIFFS SHAFT	18	5	1	36			15					75
DIAMOND DRILLS		3		5			7	5				20
GEN. STHSE. & SHOPS	20	20	1	66			2	2				111
HAWKINS	10	6		40			18					74
HILL-TRUMBULL	5	1		28		17	18					69
HOLMAN CLIFFS	9			57		6	23	2				97
HUMBOLDT		10		5			39					54
LLOYD	7	2	1	21	4	4	5					44
MAAS	6	1	1	25	6		7					46
MATHER INN	14			5			1	2				22
MATHER MINE, "A" SHAFT	9	12		42			60					123
MATHER MINE, "B" SHAFT	20	7		46	5	1	50	1				130
OHIO	6			31			12	2				51
SARGENT (OPEN-PIT)		1		5		1	2				1	10
SPIES-VIRGIL	4	13		19	4	4	6	9				59
TILDEN		5		39	1	3	3					51
WANLESS	1	2		10	2		6				1	22
McCLURE PLANT (ELEC.POWER-DIV.)				3	2		2					7
CARP PLANT " " "				4	1		2			1		8
HOIST PLANT " " "				2	2		2					6
REPUBLIC PLANT " " "				1	1		1			1		4
ESCANABA PLANT " " "				1	1		1			1		4
AUTRAIN PLANT " " "				1	2		1			1		5
DIESEL PLANT " " "			5	3							1	9
STEAM PLANT " " "				2					5	12		19
HIBBING OFFICE	4		1	3	1							9
ISHPEMING GEN. OFFICE	7			8								15
RENTED HOUSES	3			17		1		2				23
RESEARCH LABORATORY	4			5			7					16
TOTALS	174	97	11	621	36	54	338	30	5	16	3	1,385

11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Disciplinary Action

Action was taken in only 133 cases compared to 229 cases in 1953.

Even with the reduced working schedule, the losing of too much time from work was the cause for most disciplinary actions (37) at all properties.

Table Number XX covers the interesting tabulation of 1954 disciplinary actions.

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

TABLE XX

CAUSES AND NUMBER OF DISCIPLINARY ACTIONS

Mine Or Plant	Excessive Absenteeism Due to Alcoholism	Reporting To Work Under The Influence Of Liquor	Violation Of Rules	Violation Of "No Smoking" Rule	Losing Too Much Time	Leaving Job Without Authority	Insubordination	Sleeping On The Job	Horse-Play	Carelessness In Performing Work	Fighting Underground	Misuse Of Equipment	Unsatisfactory Performance On The Job	Reading Pocket Novels On Job	Changing Shifts, No Permission	Taking Visitors Underground Without Permission	Not Guarding All Entrances To Blasting Area	Taking too Much Time For Lunch	Failing To Report Condition Of Working Place	Total
AGNEW																				0
BUNKER HILL		1		3	6		1			1										12
CAMBRIA-JACKSON		1			2		2			3										8
CANISTEO					2															2
CLIFFS SHAFT		1			3	5				1		1	1	1						13
CHEMICAL LABORATORY																				0
DIAMOND DRILLS					1															1
GENERAL STOREHOUSE	1	1																		2
GENERAL SHOPS																				0
HAWKINS			1							2										3
HILL-TRUMBULL	1				3		1													5
HOLMAN CLIFFS					2					3										5
HUMBOLDT																				0
LLOYD				2						2										4
MAAS		3		1	6	1				2										13
MATHER MINE, "A" SHAFT		5			6		2	5		3										21
MATHER MINE, "B" SHAFT		4	9	2	5		5	2	1								6	2	2	38
OHIO					1									1						2
PELLETIZING PLANT																				0
REPUBLIC																				0
SARGENT											1									1
SPIES-VIRGIL				1											1	1				3
WANLESS																				0
TOTALS	2	16	10	9	37	6	11	7	1	17	1	1	1	2	1	1	6	2	2	133

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Central Safety Committee

The committee met twelve times during the year. Classification of accidents is usually the first order of business in order to place responsibility for each compensable accident. All injuries and accidents are discussed and means of their prevention is attempted. The committee is composed of all superintendents, heads of departments, certain engineers and safety personnel.

Reports of all meetings have been submitted to all members for future reference. The committee also worked on revised safety rules.

Supervisors Safety Committee

This committee also meets once each month, usually a week before the meeting of the Central Safety Committee. These men also classify the compensable accidents which later are passed on by the superintendents and heads of departments.

These meetings are very interesting and bring out the details of accident prevention. Nearly every member has some problem which is discussed with the hope of coming up with the right answer. Ideas are also exchanged which are for the benefit of all members. Reports of these meetings are also submitted to all properties.

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Lake Superior Mines Safety Exchange

The purpose of this exchange is to keep informed on accident prevention work being done in the Lake Superior District. Eleven of the iron mining companies are members. Each month, accident statistics are exchanged and reports of the unusual accidents are reported, along with new ideas and equipment.

Lake Superior Mines Safety Council

This council has the reputation of being one of the best, if not the best, in the United States. Meetings are held on each of the mining ranges of Michigan and Minnesota each year. The annual meeting is held in Duluth, Minnesota with an attendance of about 800.

Our company has been a member since the council was first organized and has taken an active part in the organization of meetings and presenting papers on safety.

National Safety Council

Again, our company is a charter member and Mr. Wm. Conibear gave a paper at the first meeting which was held in Milwaukee, Wisconsin in 1912.

The council is the greatest safety organization in the world and covers every type of safety. We receive much valuable information from the council. We also have contributed to the council by presenting papers on safety and working as committee chairmen and committee members, and assisting in making up sound slide films and movies and data sheets.

Safety Banner Flags

The "Banner Flag" is presented each of the following for the best safety record within the company - Underground, Open-Pit and Independent Unit.

The awards for 1954 were as follows: -

Underground	- Cambria-Jackson Mine	Severity - 0.096
Open-Pit	- Ohio Mine	Severity - 0.000
Independent Unit	- Elec. Power Division	Severity - 0.000

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11. ACCIDENTS AND PERSONAL INJURY

d. Ventilation

The department spent much time assisting in ventilation at the various properties. Because of the changing conditions in underground mining, ventilation systems are continually being revised. As a whole, our ventilation has been very good. All mines are equipped with first-class ventilating mine fans and auxiliaries.

During the year, there have been major changes in the ventilation systems in the Mather Mine and Bunker Hill- Athens Mines which required considerable study and change.

At the Cliffs Shaft Mine, because of the sinking of the new "C" Shaft, the ventilation system was somewhat disturbed because of mine air entering the shaft and exhausting to surface, causing some short-circuiting. Also, the condensation of air in the shaft has now made it quite damp. This will all be corrected when air-lock doors have been installed on each open level. This is important because of electrical equipment in the shaft and the headframe.

Dust Sampling And Analysis

The number of dust samples taken during the year was down considerably from 1953 because of the "Cut" in Safety Department personnel. Total number of samples for 1953 was 389 compared to 223 in 1954.

The average counts, with few exceptions, are better than those of previous years. The maximum recommended count is 10 million in ore and 5 million in rock.

Not recorded for the annual report are dust counts taken in the Humboldt operation and Mather Mine, "B" Shaft, Headframe, because these were test samples taken while testing new methods and equipment.

At Mather Mine, "B" Shaft, an experiment was made with the use of a wetting agent and also plain water being sprayed or misted on all belt transfer points. After a 60-day trial the compound "M" had failed to do a better job of dust allaying than plain water. At the present time, the original fan dust collecting system is in use and doing a fair job.

At the Humboldt Mine there is still considerable work to do on the dust collection system but it has already been improved and work continues for more improvement.

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11. ACCIDENTS AND PERSONAL INJURY

d. Ventilation (Continued)

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

TABLE XXI

DUST SAMPLES COLLECTED -- ROCK AND ORE WORK

Mine Or Plant	1954 Misc.	1954 In Ore	1954 In Rock	1954 Total	1933 - 1954 Total
ATHENS *	0	0	0	0	843
BUNKER HILL	6	0	8	14	14
CAMBRIA-JACKSON	1	0	8	9	376
CLIFFS SHAFT	0	10	12	22	1,942
HUMBOLDT	26	0	0	26	30
LLOYD	0	2	2	4	768
MAAS	2	15	2	19	857
MATHER MINE, "A"	6	7	23	36	892
MATHER MINE, "B"	41	11	7	59	430
NEGAUNEE *	0	0	0	0	830
PRINCETON **	0	0	0	0	85
RESEARCH LAB.	0	0	0	0	39
SPIES	0	14	0	14	203
TILDEN	0	0	0	0	91
MISCELLANEOUS	0	0	0	0	162
MESABA RANGE	20	0	0	20	20
Totals	102	59	62	223	7,582

* Now a part of the Bunker Hill Mine

** No longer in operation

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

d. Ventilation (Continued)

TABLE XXII

VARIOUS OCCUPATIONS WHERE DUST SAMPLES WERE COLLECTED

Occupation	BUNKER HILL	CAMBRIA-JACKSON	CLIFFS SHAFT	HUMBOLDT	LLOYD	MAAS	MATHER MINE, "A" SHAFT	MATHER MINE, "B" SHAFT	MESABA RANGE	SPIES-VIRGIL	TOTAL
DRILLING	8	2	9		3	7	18	6		10	63
SCRAPING			9		1	9	6	12		3	40
LOADING CARS (LOADER)		6	2				4				12
GENERAL MINE AIR						2	1	6			9
CHARGING HOLES						1				1	2
CRUSHING ORE	2			20				4			26
LAYING TRACK							2				2
SURFACE CONVEYOR GALLERY	1			6				20			27
NEAR SKIP DUMP	2						4				6
NEAR SHAKER SCREEN	1							11			12
UNDERGROUND CONVEYOR		1									1
LOADING (TRAY) - SHAFT			2								2
WAREHOUSE							1				1
CRUSHING & PULVERIZING									20		20
TOTALS	14	9	22	26	4	19	36	59	20	14	223

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11. ACCIDENTS AND PERSONAL INJURY

d. Ventilation (Continued)

TABLE XXIII

AVERAGE LIGHT FIELD COUNT OF ALL SAMPLES TAKEN

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

* Not In Operation During This Period

(Table Continued - Next Page)

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11. ACCIDENTS AND PERSONAL INJURY

d. Ventilation (Continued)

TABLE XXIII (Cont'd.)

AVERAGE LIGHT FIELD COUNT OF ALL SAMPLES TAKEN

Mine Or Plant	1940	1941	1942	1943	1944	1945	1946
ATHENS	9.89	7.28	25.80	4.90	8.33	6.64	4.17
CAMBRIA-JACKSON				12.10	6.21	17.05	11.99
CLIFFS SHAFT	7.77	8.18	7.55	5.99	6.23	8.18	6.34
LLOYD	11.73	8.05	6.95	5.01	14.45	6.49	9.38
MAAS	8.71	17.29	8.46	12.48	8.78	8.17	9.29
MATHER MINE, "A" SHAFT		2.42	5.58	6.64	7.57	8.39	7.72
MATHER MINE, "B" SHAFT *							
NEGAUNEE	10.79	14.02	17.02	4.65	11.81	11.92	6.67
PRINCETON				10.59	6.32	8.48	
SPIES-VIRGIL	8.40	6.97			5.59	14.22	3.59
TILDEN		49.60				24.18	66.92
GARDINER MACKINAW **							
MISCELLANEOUS			3.00				

* Not In Operation During This Period

** No Longer In Operation

(Table Continued - Next Page)

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11. ACCIDENTS AND PERSONAL INJURY

d. Ventilation (Continued)

TABLE XXIII (Cont'd.

AVERAGE LIGHT FIELD COUNT OF ALL SAMPLES TAKEN

Mine Or Plant	1947	1948	1949	1950	1951	1952	1953	1954
ATHENS *	7.39	7.49	7.07	4.71	4.15	2.71	2.37	
BUNKER HILL								1.19
CAMBRIA-JACKSON	9.30	13.81	6.86	9.50	8.32	4.54	6.80	1.38
CLIFFS SHAFT	8.64	5.12	6.26	3.46	4.90	2.76	4.45	2.79
HUMBOLDT							1.59	27.57
LLOYD	11.17	12.97	11.72	11.32	6.28	4.72	5.17	4.58
MAAS	6.08	21.08	10.55	4.45	4.84	4.93	7.06	5.25
MATHER MINE, "A" SHAFT	10.88	9.50	8.40	7.01	8.75	5.86	5.15	3.77
MATHER MINE, "B" SHAFT	2.23	4.16	2.46	6.68	5.04	5.40	5.56	6.41
MESABA RANGE								20.28
NEGAUNEE *	7.05	5.48			2.27	1.70	2.60	
PRINCETON **								
RESEARCH LAB. ***					5.81	5.57	7.14	
SPIES-VIRGIL	11.65	5.24	10.12	18.78	6.05	5.29	4.75	4.14
TILDEN ***	33.65	2.93	4.38	3.74	6.34		3.05	
GARDNER MACKINAW **								

* Now a part of the Bunker Hill Mine.

** No longer in operation.

*** No samples taken during Year 1954.

11. ACCIDENTS AND PERSONAL INJURY

d. Ventilation (Continued)

TABLE XXIV

COMPARISON OF DUST COUNTS IN RAISING TO DRIFTING

Mine	Average In Raising	Average In Drifting	General Average *
BUNKER HILL		1.13	1.19
CAMBRIA-JACKSON		1.46	1.38
CLIFFS SHAFT	1.68	4.94	2.79
LLOYD		3.67	4.58
MAAS		5.49	5.25
MATHER MINE, "A" SHAFT	3.81	3.39	3.77
MATHER MINE, "B" SHAFT		1.66	6.41
SPIES-VIRGIL	5.55	4.54	4.14

* Includes Miscellaneous And General Air Samples.

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11. ACCIDENTS AND PERSONAL INJURY

d. Ventilation (Continued)

TABLE XXV

AVERAGES IN ORE COMPARED TO AVERAGES IN ROCK

Mine	Average In Ore	Average In Rock	General Average *
BUNKER HILL		1.13	1.19
CAMBRIA-JACKSON		1.46	1.38
CLIFFS SHAFT	3.26	2.60	2.79
LLOYD	5.48	3.67	4.58
MAAS	5.71	6.36	5.25
MATHER MINE, "A" SHAFT	7.13	2.22	3.77
MATHER MINE, "B" SHAFT	6.59	2.40	6.41
SPIES-VIRGIL	4.14		4.14

* Includes Miscellaneous And General Air Samples.

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11. ACCIDENTS AND PERSONAL INJURY

d. Ventilation (Continued)

TABLE XXVI

COMPARISON OF AVERAGE DUST COUNTS IN VARIOUS OPERATIONS

Operation	BUNKER-H	CAMB. JACK.	CLIFFS SHAFT	LLOYD	MAAS	MATHER-A	MATHER-B	SPIES-VIRGIL
MAIN LEVELS:								
Drilling In Rock (Wet)	1.13	.99				2.09	2.20	
Loading Rock		1.62	2.71			2.46		
Scraping Ore (Steel Scraper Slide)					3.92			
Charging Holes					3.29			
SCRAPING TRANSFER DRIFTS: *								
Drilling In Ore (Wet)					4.61		4.54	
Scraping Ore					9.72			
Scraping Rock					6.36			
Drilling In Ore(Auger)					3.54	3.22		
Drilling In Ore(Rotary)					1.78	2.48		
Drilling In Rock(Wet)				3.67		1.49	.59	
Scraping Ore & Breaking Chunks				7.32		9.12	6.17	4.76
RAISES:								
Drilling In Ore(Auger)								7.74
Drilling In Rock(Wet)			1.68			3.81		
SHAFT SINKING:								
Drilling In Rock(Wet)			1.91					
Using Hydro-Mucker			1.91					
STOPES:								
Drilling In Ore (Wet)			1.51	3.64				3.45
Scraping Ore			4.01		7.85			
Scraping Rock			3.50					
Drilling In Ore(Auger)					3.86			
Charging Holes								3.22
AVERAGE COUNTS FOR:-								
SHAFT SINKING			1.91					
MAIN LEVELS	1.13	1.34	2.71		3.60	2.20	2.20	4.54
SUB-LEVEL DRIFTS				3.67	6.24	3.22	.59	
SCRAPING TRANSFER DRIFTS				7.32	7.05	9.12	6.17	4.76
RAISES			1.68			3.81		7.74
STOPES			3.29	3.64				3.43
GENERAL AVERAGE:	1.19	1.38	2.79	4.58	5.25	3.77	6.41	4.14

* Combined with Sub-Level Drifts in this section.

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

e. Mine Safety, First-Aid And Mine Rescue Courses

First-Aid Training

First-aid training was conducted by members of the Safety Department with a total of 71 men completing the course as presented and prescribed by the U.S. Bureau of Mines. Also, we had refresher courses in artificial respiration, using the new Neilson method (back-pressure, arm-lift).

Mine-Rescue Training

One hundred and seventy-five (175) employees received mine rescue training during the year. Of these men, 25 received the initial course of 24 hours and the others an 8-hour refresher course.

These men are well distributed among all the mines so in case of an emergency a crew could be called in a very short time.

All training was conducted by personnel of the Safety Department, who are certified by the U.S. Bureau of Mines as Mine Rescue Instructors.

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

e. Mine Safety, First-Aid and Mine Rescue Courses (Continued)

TABLE XXVII

MINE RESCUE TRAINING - MICHIGAN MINES

JUNE, JULY, 1954

Mine	No. Of Men
BUNKER HILL	26
CAMBRIA-JACKSON	10
CLIFFS SHAFT	19
ENGINEERING DEPT.	7
GEOLOGICAL DEPT.	2
LLOYD	7
MAAS	22
MATHER MINE, "A" SHAFT	32
MATHER MINE, "B" SHAFT	35
SPIES-VIRGIL	15
TOTAL	175

FIRST-AID TRAINING - MICHIGAN MINES

SEPTEMBER, 1954

BUNKER HILL	25
MATHER MINE, "B" SHAFT	45
SAFETY DEPARTMENT	1
TOTAL	71

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

e. Mine Safety, First-Aid and Mine Rescue Courses (Continued)

TABLE XXVIII

FIRST-AID SUPPLIES DISTRIBUTED

MATERIAL	NO. DISTRIBUTED
1" Compresses (Band-Aids)	66,000
Ounces Of Merthiolate	113
1" Roller Bandage	131
2" Roller Bandage	127
3" Roller Bandage	100
Rolls Of Adhesive Tape (½-in.)	146
Picric Acid Gauze Pads (For Burns)	178
Plain Gauze Pads	453
Leather Finger Cots	82
Merthiolate Applicators	2,579
Oz. Of Aromatic Spirits Of Ammonia	33
Oz. Of Absorbent Cotton	21
Tubes Of "Surfacaine" (For Cuts & Burns)	37
Triangular Bandages	38
Pairs Of Scissors	6
Bottles, 1 Oz., Medicine	24
2" Compress Bandages	176
3" Compress Bandages	92
5/8 Oz. Tubes Of Foille Ointment (For Burns)	6
Knuckle-Bandages	1,872
TOTAL	72,214

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

f. Miscellaneous

Gave assistance to local fire departments by giving training in first-aid to the injured and instruction in use of rescue breathing apparatus.

Together with the Geological Department, collected samples and check for radon in all mines. Work was completed and conditions were found to be satisfactory.

Took part in Negaunee Business and Professional Mens' Association.

Together with other company employees, attended meeting on new cage safety catches being manufactured by E. Long Company of Canada. These seem to be a great improvement over our present safety catches.

Instructed all employees in the use of Self-Rescuers which had recently been installed.

A new safety device (dead-man control) for a drill sharpening machine was made at the Mather Mine, "A" Shaft, which should prevent injury to operator.

All safety goggles of all employees were checked during the year and records made of the same.

Special classes were conducted by the department for supervisors on the handling of injured persons. Also, made changes in basket type stretchers so injured could be secured better to stretcher.

Assisted in preparations to honor 40-year employees and took part in the program.

Assisted in making up exhibit for mining Industry Institute which was set up at the Tracy Mine.

A number of small fires occurred underground in the Marquette Range mines but none were of much consequence. All were extinguished with first-aid fire extinguishers or died out before located.

On the Mesaba Range the Mackillican Garage was burned. It was a complete loss. Cause of fire was use of oil salamanders, one of which was turned over.

The vulcanizer shelter house at the Hawkins Mine also burned; a complete loss. The fire started either by electrical short or a lighted cigarette.

One other fire was caused because of failure to bleed off gas after use of torch and resulted in the loss of an acetylene hose and torch.

11. ACCIDENTS AND PERSONAL INJURY

f. Miscellaneous (Continued)

Comparison Of Available Accident Statistics

Because accident statistics for the year 1954 are not available from the National Safety Council or the Lake Superior Mines Safety Council or other organizations until early summer, we must, of necessity, use the 1953 rating to compare with our records. Table XXIX gives this comparison.

11. ACCIDENTS AND PERSONAL INJURY

f. Miscellaneous (Continued)

TABLE XXIX

COMPARISON OF FREQUENCY, SEVERITY RATINGS

(Taken From Available Statistics)

	FREQUENCY	SEVERITY
1953 National Rating, All Mining, Including Coal	24.09	3.80
1953 " " , Coal Mining	25.81	4.79
1953 " " , Other Mining (Not Including Coal)	22.95	3.14
1953 " " , Metal Mining (Underground)	30.67	3.52
1953 Lake Superior District Mines (28 Companies Reporting)	14.38	1.98
1954 The Cleveland-Cliffs Iron Co., Compensable Injuries	13.99	.919
1954 " " " " " , All Injuries	23.45	.946
1954 " " " " " , Open-Cut Mining	20.75	.677
1954 " " " " " , Concentrating Plants	12.33	.376
1954 " " " " " , Top Slicing	30.65	.096
1954 " " " " " , Sub-Level Caving	16.92	2.210
1954 " " " " " , Stoping	28.60	.995
1954 " " " " " , Block Caving	34.95	1.142
1954 " " " " " , Shaft Sinking & Develop.	19.62	.608
1954 " " " " " , General Shops	6.88	.079
1954 " " " " " , Elec. Power Division	0.00	.000
1954 " " " " " , General Roll	0.00	.000

1953
LAKE SUPERIOR DISTRICT

FREQUENCY	SEVERITY
14.38	1.98
9.14	1.47
9.60	1.55
19.56	0.70
24.05	3.48
24.37	2.28
27.73	0.91
22.10	14.70
9.79	1.37

ANNUAL REPORT OF THE MINING ENGINEERING DEPARTMENT FOR THE YEAR ENDING DECEMBER 31, 1954

The publication of the bound volumes that contain maps of yearly mining activities, photographs of construction progress, open pit cross-sections and logs of drill holes for the mines and explorations operated by The Cleveland-Cliffs Iron Company during 1954 has been curtailed. In lieu of this record-type of Annual Report, which has been a yearly function of the Engineering Department since 1891, prints of all maps for each of the operating units will be made and filed so that we may have on record the work that was performed during 1954.

The following table shows the companies for which sets of working tracing prints were prepared and the Michigan mine or mines in which that company has interest:

Company	Mines	
	For Itself	As Operating Agent
The Cleveland-Cliffs Iron Company	Bunker Hill	Athens
	Cambria-Jackson	Humboldt
	Lloyd	Mather
	Maas	
	Ohio	
	Republic	
	Spies-Virgil	
	Tilden	
The Athens Iron Mining Company for Pickands Mather & Company		Athens
The Negaunee Mine Company Partner: Bethlehem Steel Company		Mather Mine "A" Shaft "B" Shaft
Humboldt Mining Company Partner: Ford Motor Company		Humboldt

Prior to the curtailment directive, the Annual Report maps of the Agnew, Hawkins and Sargent Mines were prepared for the International Harvester Company.

B. MAP REPORTS

At the end of each month, the Mining Engineers assigned to the soft ore properties, inspect the underground workings and post the monthly mining progress, the advance of the development contracts and the exploration drill holes. Two sets of these monthly progress maps are made; one set to be used by the Manager and the other set sent to the Superintendent for his use. Numerous prints of the various sub-level maps upon which there was active mining operations are printed, trimmed and folded to pocket size. These maps are carried by the mine captain, foremen and shift bosses who use them to assist them in their day to day production planning.

The next few paragraphs describe the map reports sent out by the Engineering Department:

ATHENS MINE

Two sets of monthly progress maps, with mining advancement colored in red, were sent to Mr. A. D. Chisholm, General Manager, and Mr. W. A. Knoll, General Superintendent, of the Pickands Mather & Company throughout the year.

CAMBRIA-JACKSON MINE

A set of Cambria-Jackson surface and level maps were forwarded to Mr. George Smainis of the Teal Lake Mining Company.

CLIFFS-SHAFT MINE

One set of mining progress maps of the Bancroft and Section 10 Leases were forwarded to the Duluth office of the Oliver Iron Mining Division after each of the tri-annual surveys, showing the work done during that four-month period in color. The final issue of these progress maps for the year 1954 also show the ore areas that were used in calculating the estimate of ore reserves as reported to the Michigan State Tax Commission.

HUMBOLDT MINE

Two sets of monthly progress maps, showing stripping and mining advancement, were prepared and sent to Mr. R. L. Bodor, Manager, Mining Properties, and Mr. M. E. Willmott, Resident Manager, of the Ford Motor Company.

Annual maps were also sent to Mr. Harry B. Weber, fee-owner of the Weber Lease.

MATHER MINE

A complete set of working maps of both "A" and "B" Shafts were forwarded to Dr. Donald M. Fraser, Chief Geologist of the Bethlehem Steel Company, at the end of each quarter, showing the mining progress in color.

MICHIGAN STATE TAX COMMISSION

During the first part of September, copies of all maps which show any active workings were sent to Mr. Harry J. Hardenberg, Deputy State Geologist. Outlined on the maps are the known ore areas which are used in the calculating of the ore reserve tonnages. A supplementary map report was sent to the Michigan State Tax Commission at the end of the year, reporting any large increase in ore reserves discovered since the appraisal date of October 1st. Upon discontinuance of the making of the annual report-size prints, the large 50' to the inch working maps were prepared and will be used as a permanent record of the ore reserve tonnages as reported to the Michigan State Tax Commission. These will be kept on file at the Ishpeming Engineering Department.

NEGAUNEE MINE

Prints of the yearly progress of the Bunker Hill Mine's levels were sent to the Negaunee Mine fee-owners.

OHIO MINE

Maps of the yearly mining progress, both stripping and ore operations, were sent to the Department of Conservation, State of Michigan, from whom we lease the Beaufort Property. Tables, showing the production from the various leases, the concentrate and heavy media tonnages, percentage recovery, etc., were sent to the State of Michigan in accordance with the Beaufort Lease mill reject agreement.

Messrs. William G. Maas and Richard G. Maas, representing Mrs. Rose Maas and the Maas Land Company, received yearly progress maps, showing work performed on the Portland Property.

The Ford Motor Company received itemized exploration expenditures and maps, showing the location of drill holes and any test work that may have been performed on the Titan Lands during 1954.

C. MINING LEASES

The following mining leases and options for leases were executed and placed on file during 1954:

Lease No. 112

Option for fifty-year mining lease from Harry Clausen and wife to The Cleveland-Cliffs Iron Company, dated December 3, 1953, expires December 31, 1955, covering the $S\frac{1}{2}$ of $NW\frac{1}{4}$, $SW\frac{1}{4}$ of $NE\frac{1}{4}$ and $NW\frac{1}{4}$ of $SE\frac{1}{4}$, Section 26, 42-22, Delta County (Perkins Area).

Lease No. 113

Option for fifty-year mining lease from Edwin P. Johnson and wife to The Cleveland-Cliffs Iron Company, dated November 20, 1953, expires December 31, 1955, covering the $E\frac{1}{2}$ of $SW\frac{1}{4}$ and $SW\frac{1}{4}$ of $SE\frac{1}{4}$, Section 26, 42-22, Delta County (Perkins Area).

Lease No. 114

Option for fifty-year mining lease from Gust A. Johnson to The Cleveland-Cliffs Iron Company, dated November 20, 1953, expires December 31, 1955, covering the $W\frac{1}{2}$ of $SW\frac{1}{4}$, Section 26, 42-22, Delta County (Perkins Area).

Lease No. 115

Option for fifty-year mining lease from Carl Ohlen to The Cleveland-Cliffs Iron Company, dated December 17, 1953, expires December 31, 1955, covering the $SE\frac{1}{4}$ of $NE\frac{1}{4}$, Section 27, 42-22, Delta County (Perkins Area).

Lease No. 116

Option for fifty-year mining lease from Henry Soderstrom and wife to The Cleveland-Cliffs Iron Company, dated January 20, 1954, expires December 31, 1955, covering the $NE\frac{1}{4}$ of $SE\frac{1}{4}$, Section 21, 42-22, Delta County (Perkins Area).

Lease No. 117A

Option for fifty-year mining lease from Fred Stegath and wife to The Cleveland-Cliffs Iron Company, dated December 28, 1953, expires December 31, 1955, covering the mineral rights in the $N\frac{1}{2}$ of $N\frac{1}{2}$, Section 26, 42-22, Delta County (Perkins Area).

Lease No. 117B

Option for fifty-year mining lease from Gordon Stegath and wife to The Cleveland-Cliffs Iron Company, dated December 3, 1953, expires December 31, 1955, covering the mineral rights in the $N\frac{1}{2}$ of $N\frac{1}{2}$, Section 26, 42-22, Delta County (Perkins Area).

Lease No. 117C

Option for fifty-year mining lease from Mellicent Stegath et al. to The Cleveland-Cliffs Iron Company, dated November 23, 1953, expires December 31, 1955, covering the mineral rights in the $N\frac{1}{2}$ of $N\frac{1}{2}$, Section 26, 42-22, Delta County (Perkins Area).

Lease No. 117D

Option for fifty-year mining lease from Elva Wilford Stegath to The Cleveland-Cliffs Iron Company, dated November 28, 1953, expires December 31, 1955, covering the mineral rights in the $N\frac{1}{2}$ of $N\frac{1}{2}$, Section 26, 42-22, Delta County (Perkins Area).

Lease No. 117E

Option for fifty-year mining lease from Richard B. Stegath and Alice Stegath Jordan to The Cleveland-Cliffs Iron Company, dated January 2, 1954, expires December 31, 1955, covering the mineral rights in the $N\frac{1}{2}$ of $N\frac{1}{2}$, Section 26, 42-22, Delta County (Perkins Area).

Lease No. 118

Option for fifty-year mining lease from Madeline Katz et al. to The Cleveland-Cliffs Iron Company, dated January 6, 1954, expires December 31, 1955, covering the mineral rights in the $E\frac{1}{2}$ of $SW\frac{1}{4}$ and $SW\frac{1}{4}$ of $SE\frac{1}{4}$, Section 23, 42-22, Delta County (Perkins Area).

Lease No. 119

Option for fifty-year mining lease from William DeKeyser and wife to The Cleveland-Cliffs Iron Company, dated February 5, 1954, expires December 31, 1955, covering the $W\frac{1}{2}$ of $NE\frac{1}{4}$ and $SE\frac{1}{4}$ of $NE\frac{1}{4}$, Section 28, 42-22, Delta County (Perkins Area).

Lease No. 120

Option for fifty-year mining lease from Dorothy Gustafson to The Cleveland-Cliffs Iron Company, dated February 19, 1954, expires December 31, 1955, covering the $NW\frac{1}{4}$ of $SW\frac{1}{4}$, Section 22, 42-22, Delta County (Perkins Area).

Lease No. 121

Option for fifty-year mining lease from Edwin P. Johnson, Jr. and wife to The Cleveland-Cliffs Iron Company, dated February 19, 1954, expires December 31, 1955, covering the $N\frac{1}{2}$ of $NW\frac{1}{4}$, $SW\frac{1}{4}$ of $NW\frac{1}{4}$, and $NW\frac{1}{4}$ of $SW\frac{1}{4}$, Section 25 and the $SE\frac{1}{4}$ of $SE\frac{1}{4}$, Section 26, 42-22, Delta County (Perkins Area).

Lease No. 122

Option for fifty-year mining lease from Fred L. Mitchell and wife to The Cleveland-Cliffs Iron Company, dated August 18, 1954, expires December 31, 1955, covering the $SW\frac{1}{4}$ of $SW\frac{1}{4}$, Section 22, 42-22, Delta County (Perkins Area).

Lease No. 123

Option for fifty-year mining lease from Edwin P. Johnson, Jr. and

wife to The Cleveland-Cliffs Iron Company, dated August 20, 1954, expires December 31, 1955, covering the SE¼ of NE¼ and NE¼ of SE¼, Section 26, Delta County (Perkins Area).

Lease No. 124

Option for fifty-year mining lease from William DeKeyser et al. to The Cleveland-Cliffs Iron Company, dated September 17, 1954, expires December 31, 1955, covering the SW¼ of NE¼, Section 27, 42-22, Delta County (Perkins Area).

Lease No. 125

Fifty-year mining lease from The Department of Conservation of the State of Michigan to The Cleveland-Cliffs Iron Company, dated October 5, 1954, expires October 5, 2004, covering the fee of:

N½ of SE¼, Section 22, 42-22
NW¼ of SW¼, Section 23, 42-22

and the mineral rights in:

E½ of SW¼, Section 22, 42-22
S½ of SE¼, Section 22, 42-22
SW¼ of SW¼, Section 23, 42-22
SE¼ of NW¼, Section 25, 42-22
NE¼ of SW¼, Section 25, 42-22
NE¼ of NE¼, Section 27, 42-22
NE¼ of NW¼, Section 27, 42-22
NW¼ of SE¼, Section 27, 42-22

all in Delta County (Perkins Area).

Lease No. 126

Option for fifty-year mining lease from Edward H. Stromberg et al. to The Cleveland-Cliffs Iron Company, dated October 22, 1954, expires December 31, 1955, covering the NW¼ of NE¼, Section 27, 42-22, Delta County (Perkins Area).

Lease No. 127

Option for fifty-year mining lease from Edward Dohbel to The Cleveland-Cliffs Iron Company, dated December 16, 1954, expires December 15, 1957 but with privilege of a one-year extension, covering the SE¼ of NW¼, NE¼ of SW¼, NW¼ of SE¼, and SW¼ of SE¼, Section 26, 43-22, Delta County (Osier Area).

Lease No. 128

Option for fifty-year mining lease from Oscar Elo to The Cleveland-Cliffs Iron Company, dated December 16, 1954, expires December 15, 1957 but with privilege of a one-year extension, covering the SW¼ of SW¼, Section 36, 43-23, Delta County (Rock Area).

Lease No. 129

Option for fifty-year mining lease from Alrick Mikkila and wife to The Cleveland-Cliffs Iron Company, dated December 16, 1954, expires December 15, 1957 but with privilege of a one-year extension, covering the SE¼ of NW¼, Section 36, 43-23, Delta County (Rock Area).

Lease No. 130

Option for fifty-year mining lease from Albert Cayer and wife to The Cleveland-Cliffs Iron Company, dated December 16, 1954, expires December 15, 1957 but with privilege of a one-year extension, covering the E½ of NE¼ of SE¼ and E3/4 of SE¼ of SE¼, Section 14, 43-22, Delta County (Osier Area).

Lease No. 131

Option for fifty-year mining lease from Lorin Rinard and wife to The Cleveland-Cliffs Iron Company, dated December 16, 1954, expires December 15, 1957 but with privilege of a one-year extension, covering the SW¼ of NE¼, Section 23, 43-22, Delta County (Osier Area).

Lease No. 132

Option for fifty-year mining lease from Albert Juneau and wife to The Cleveland-Cliffs Iron Company, dated December 16, 1954, expires December 15, 1957 but with privilege of a one-year extension, covering the SE¼ of SW¼, Section 13, 43-22, Delta County (Osier Area).

The following mining leases were terminated during 1954:

Lease No. 101

Pittsburgh & Lake Superior Iron Company to The Cleveland-Cliffs Iron Company, dated January 1, 1952, covering the SW¼, Section 22, 47-26, Marquette County. Notice served April 26, 1954, termination effective July 31, 1954.

Lease No. 109

McDermott Estate et al. to The Cleveland-Cliffs Iron Company, dated April 1, 1953, covering the W½ of E½, Section 25, 43-35, Iron County. Notice served November 26, 1954, termination effective April 1, 1955.

The following mining lease was amended in 1954:

Lease No. 92B (Empire Project)

The Cascade Corporation to The Cleveland-Cliffs Iron Company, dated May 1, 1950, covering the NW¼ of SE¼, Section 19, 47-26 and entire Section 20, 47-26. Amendment dated January 4, 1954 defined beginning of the exploration period and extended the exploration area.

D. THE FORCE

The Staff of the Mining Engineering Department has been reduced in the excess of 30% during the year, 1954. The organization was streamlined to the bare essential jobs in an effort to parallel the reduction of mine operations and the decline in ore sales. The curtailment, both field work and drilling, the delaying of the Republic Mine construction and the development of the Republic Townsite and Negaunee Plats were some of the factors and reasons for this reduction in personnel.

First Reduction, May 15th

Name	Classification
Donald P. Chartier	Helper
James C. Cleven	Helper
Clyde H. Dodge	Helper
William M. Leaf	Helper
Carl F. Lemin, Jr.	Helper
Paul E. Poutanen	Helper
Bernard L. Regan	Helper
Elmer R. Ring	Helper
Harold A. St. John	Helper
Clarence J. Stone	Helper
Francis A. Wills	Helper

Second Reduction, June 30th

Name	Classification
Robert R. Swanson	Surveyor
Merrill R. Prin	Draftsman
William G. Dunstan	Helper
Donald G. Johnson	Helper
Paul E. Sundberg	Helper

Third Reduction, October 15th
Seasonal Closing of the Ohio Mine Operation

Name	Classification
Holland L. Werner	Helper

On July 1st, Russell J. Paull's employment was terminated due to lack of interest, ability and inefficiency. At that time he was Surveyor "B", working in the Empire Area doing survey control work for the geophysical exploration.

On April 1st, Kenelm C. Winslow, Mining Engineer, was transferred to the office of the Project Engineer to assist him with the work of the Empire Project, Republic Mine and the proposed Pelletizing Plant.

Harley E. Clickner, Mining Engineer assigned to the Maas Mine, was inducted into the Armed Forces on June 15th.

Robert L. Sundeen, Assistant Mining Engineer at the Mather Mine, "B" Shaft, terminated his employment on August 15th to accept a similar position with the North Range Mining Company.

Upon completion of two year's service with the Armed Forces, Clyde H. Dodge and John P. Clark, Helpers, returned to the Engineering Department on February 15th and July 1st respectively.

Leamon G. McGee, Mining Engineer--Pit Foreman, reentered the Engineering Department upon the seasonal closing of the Ohio Mine on October 15th and was immediately assigned to the Mather Mine, "A" Shaft's survey crew to replace Wilburt H. Thomas, who was absent due to sickness.

George B. Manzoline, Architectural Draftsman, reentered the Engineering Department on a transfer from the Mechanical Department on June 15th.

LeRoy Hosking, Assistant Superintendent at the Humboldt Mine, reentered the Engineering Department on March 1st to plan and design plats and additions to the City of Negaunee necessary for the house moving required for the Maas Mine Operation.

The customary field season, which runs from June 15th to September 15th and employs third and fourth year college students as compassmen and field geologists, was discontinued this year in light of the Company-wide austerity program.

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

Name	Position	Entered	Left	1954 Employment
Carl Brewer	Recorder-Consultant			12 Months
Grant T. Hollett	Chief Mining Engineer			12 Months
Eric G. Beinlich, Jr.	Engineer			12 Months
Harley E. Clickner	Engineer		June 15th	5½ Months
Joseph D. Crites	Engineer			12 Months
Robert B. Davis	Engineer			12 Months
Robert G. Fountain	Engineer-Ass't Recorder			12 Months
Robert J. Flynn	Engineer			12 Months
Oiva W. Hakala	Engineer			12 Months
Albert Henry	Engineer			12 Months
Allen H. Heikkinen	Engineer			12 Months
LeRoy Hosking	Engineer	March 1st		10 Months
R. Charles Kincaid	Engineer			12 Months
Lionel N. Larson	Engineer			12 Months
Leamon G. McGee	Engineer	October 15th		2½ Months
John F. Magnuson	Engineer			12 Months
Robert L. Sundeen	Engineer		August 15th	7½ Months
Victor E. Swan	Engineer			12 Months
Kenelm C. Winslow	Engineer		April 1st	3 Months
P. Daniel Isaacson	Ass't Engineer			12 Months
C. Arthur Koski	Ass't Engineer			12 Months
F. Alfred Koski	Ass't Engineer			12 Months
W. Harlow Stannard	Chief Draftsman			12 Months
Lembit L. Liivoja	Draftsman			12 Months
Anselm H. Mantyla	Draftsman			12 Months
George B. Manzoline	Draftsman	June 15th		6½ Months
Merrill R. Prin	Draftsman		June 30th	6 Months
Louis R. Miller, Jr.	Blueprint Machine Operator			12 Months
Jean C. Jensen	Stenographer			12 Months
Clifford H. Amel	Surveyor			12 Months
Robert E. Anderson	Surveyor			12 Months
Clarence P. Ayotte, Jr.	Surveyor			12 Months
Allan L. Bjork	Surveyor			12 Months
Herbert S. Kelly	Surveyor			12 Months
Alfred B. Nault	Surveyor			12 Months
Ernest A. Oja	Surveyor			12 Months
Russell J. Paull	Surveyor		July 31st	7 Months
Joseph J. Scoleri	Surveyor			12 Months
John R. Sleeman	Surveyor			12 Months
Robert R. Swanson	Surveyor		June 30th	6 Months
Martin D. Tasson	Surveyor			12 Months
Arnold E. Townsend	Surveyor			12 Months
Allan E. Wakkuri	Surveyor			12 Months
Clyde C. Anderson	Helper			12 Months
Donald P. Chartier	Helper		May 15th	4½ Months
John P. Clark	Helper	July 1st		6 Months
James C. Cleven	Helper		May 15th	4½ Months
Henry C. Coron	Helper			12 Months

Name	Position	Entered	Left	1954 Employment
Clyde H. Dodge	Helper	February 15th	May 15th	3 Months
William G. Dunstan	Helper		June 30th	6 Months
Arthur W. Hemmila	Helper			12 Months
Donald G. Johnson	Helper		June 30th	6 Months
Donald E. Lampi	Helper			12 Months
William M. Leaf	Helper		May 15th	4½ Months
William R. Lehmann	Helper			12 Months
Carl F. Lemin, Jr.	Helper		May 15th	4½ Months
Paul E. Poutanen	Helper		May 15th	4½ Months
Bernard L. Regan	Helper		May 15th	4½ Months
Elmer R. Ring	Helper		May 15th	4½ Months
Harold A. St. John	Helper		May 15th	4½ Months
Clarence J. Stone	Helper		May 15th	4½ Months
Paul E. Sundberg	Helper		June 30th	6 Months
Arnold E. Sundell	Helper			12 Months
Wilburt H. Thomas	Helper			12 Months
Holland L. Werner	Helper		October 15th	9½ Months
Francis A. Wills	Helper		May 15th	4½ Months
Raymond S. Windsand	Helper			12 Months

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

Name	Date Entered	Length of Service
Carl Brewer	August, 1906	36 Years, 3 Months
Grant T. Hollett	August, 1940	14 Years, 4½ Months
Eric G. Beinlich, Jr.	July, 1952	2 Years, 6 Months
Joseph D. Crites	May, 1953	1 Year, 8 Months
Robert B. Davis	August, 1951	3 Years, 4 Months
Robert J. Flynn	April, 1953	1 Year, 8 Months
Robert G. Fountain	August, 1951	3 Years, 4 Months
Oiva W. Hakala	July, 1951	3 Years, 6 Months
Allen H. Heikkinen	August, 1952	2 Years, 5 Months
Albert Henry	June, 1953	1 Year, 6 Months
LeRoy Hosking	March, 1954	10 Months
R. Charles Kincaid	July, 1951	3 Years, 6 Months
Lionel N. Larson	October, 1951	3 Years, 2½ Months
John F. Magnuson	March, 1950	4 Years, 10 Months
Leamon G. McGee	July, 1952	1 Year, 6 Months
Victor E. Swan	April, 1951	3 Years, 9 Months
P. Daniel Isaacson	November, 1940	9 Years, 4½ Months
C. Arthur Koski	June, 1941	10 Years, 1 Month
F. Alfred Koski	January, 1936	14 Years, 9 Months
W. Harlow Stannard	November, 1940	14 Years, 2 Months
Lembit L. Liivoja	January, 1952	2 Years, 11½ Months
Anselm H. Mantyla	July, 1948	6 Years, 5½ Months
George B. Manzoline	December, 1947	4 Years, 9½ Months
Louis R. Miller, Jr.	August, 1945	9 Years, 3½ Months
Jean C. Jensen	July, 1951	3 Years, 5½ Months
Clifford H. Amel	May, 1944	10 Years, 7½ Months
Robert E. Anderson	July, 1948	6 Years, 6 Months

Name	Date Entered	Length of Service
Clarence P. Ayotte, Jr.	April, 1948	6 Years, 8½ Months
Allan L. Bjork	April, 1952	2 Years, 9 Months
Herbert S. Kelly	May, 1948	6 Years, 7 Months
Alfred B. Nault	September, 1946	8 Years, 3½ Months
Ernest A. Oja	March, 1943	11 Years, 10 Months
Joseph J. Scoleri	May, 1951	3 Years, 7½ Months
John R. Sleeman	February, 1947	7 Years, 10½ Months
Martin D. Tasson	August, 1948	4 Years, 5 Months
Arnold E. Townsend	August, 1952	2 Years, 4½ Months
Allan E. Wakkuri	January, 1951	3 Years, 11½ Months
Clyde C. Anderson	December, 1950	4 Years, 1 Month
John P. Clark	May, 1952	9 Months
Henry C. Coron, Jr.	April, 1953	1 Year, 8½ Months
Arthur W. Hemmila	June, 1953	1 Year, 7 Months
Donald E. Lampi	April, 1951	3 Years, 9 Months
William R. Lehmann	February, 1953	1 Year, 10 Months
Arnold A. Sundell	February, 1951	3 Years, 11 Months
Wilburt H. Thomas	January, 1951	4 Years
Raymond S. Windsand	December, 1947	7 Years, ½ Month

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 and at the mines at one time or another.

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

Name	Days Worked	Overtime	Sick	Absent
Grant T. Hollett	236			18
Eric G. Beinlich, Jr.	251	10		14
Harley E. Clickner	106	1½		11½
Joseph D. Crites	250			5
Robert B. Davis	242			13
Robert J. Flynn	249			6
Oiva W. Hakala	246	2½		11½
Allen H. Heikkinen	254	4		5
Albert Henry	246-3/4	2-3/4		11
LeRoy Hosking	209			6
R. Charles Kincaid	246	1		10
Lionel N. Larson	246	6½	2	13½
Leamon G. McGee	53			
John F. Magnuson	251	6½	1	9½
Robert L. Sundeen	166	19		11
Victor E. Swan	246		2	7
Kenelm C. Winslow	63			
P. Daniel Isaacson	247	5½		13½
C. Arthur Koski	252½	8½		11
F. Alfred Koski	248½	11		17½
W. Harlow Stannard	241½		3	10½
Lembit L. Liivoja	248	3½		10½
Anselm H. Mantyla	245	3½		13½

Name	Days Worked	Overtime	Sick	Absent
George B. Manzoline	127½		1½	10
Merrill R. Prin	117½	3½		13
Louis R. Miller, Jr.	237½		6½	6
Jean C. Jensen	251	3½	½	7
Clifford H. Amel	244	1	1	11
Robert E. Anderson	249½	7½	2	11
Clarence P. Ayotte, Jr.	247	5	1	12
Allan L. Bjork	241½	1	3½	11
Herbert S. Kelly	247	4	1	11
Alfred B. Nault	247	2		10
Ernest A. Oja	244			11
Russell J. Paull	131	1		18
Joseph J. Scoleri	247	4		11
John R. Sleeman	247½	8½	3	13
Robert R. Swanson	113	1	1	14
Martin D. Tasson	231-3/4	1-3/4	15	10
Arnold E. Townsend	234½			20½
Allan E. Wakkuri	247	2		10
Clyde C. Anderson	240	7	10	12
Donald P. Chartier	85	1		11-3/4
John P. Clark	117			11
James C. Cleven	81			14-3/4
Henry C. Coron, Jr.	200		42	13
Clyde H. Dodge	54		1	10-3/4
William G. Dunstan	110½	½	1	16
Arthur W. Hemmila	251	6		10
Donald G. Johnson	115		1	11
Donald E. Lampi	239			16
William M. Leaf	88	3		10-3/4
William R. Lehmann	247	4	1	11
Carl F. Lemin, Jr.	72		10	13-3/4
Paul E. Poutanen	83		2	10-3/4
Bernard L. Regan	75		10	10-3/4
Elmer R. Ring	78			17-3/4
Harold A. St. John	84		1	10-3/4
Paul E. Sundberg	106½	2½	4	18½
Arnold A. Sundell	243			14
Clarence J. Stone	80		4½	10-3/4
Wilburt H. Thomas	212	3	34	12
Holland L. Werner	190		1	11
Francis A. Wills	80	1	3	13-3/4
Raymond S. Windsand	247	5½	1	12½

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

Name	Underground	Field	Office	Total
Grant T. Hollett	2	63½	170½	236
Eric G. Beinlich, Jr.	56	14½	180½	251
Harley E. Clickner	59	2½	44½	106

Name	Underground	Field	Office	Total
Joseph D. Crites		199½	50½	250
Robert B. Davis	46½	30½	165	242
Robert J. Flynn		220½	28½	249
Oiva W. Hakala	50	11½	184½	246
Allen H. Heikkinen		170¼	83-3/4	254
Albert Henry		142	104-3/4	246-3/4
LeRoy Hosking		93½	115½	209
R. Charles Kincaid	74½	4½	167	246
Lionel N. Larson	97¼	32½	116¼	246
Leamon G. McGee	10	26¼	16-3/4	53
John F. Magnuson	108½	21	121½	251
Robert L. Sundeen	93	8	65	166
Victor E. Swan		119	127	246
Kenelm C. Winslow	1	2-3/4	59-1/4	63
P. Daniel Isaacson	90¼	11	145-3/4	247
C. Arthur Koski	176	26½	50	252½
F. Alfred Koski		170¼	78¼	248½
W. Harlow Stannard		1	240½	241½
Lembit L. Liivoja			248	248
Anselm H. Mantyla			245	245
George B. Manzoline			127½	127½
Merrill R. Prin			117½	117½
Louis R. Miller, Jr.			237½	237½
Jean C. Jensen			251	251
Clifford H. Amel		171½	72½	244
Robert E. Anderson	79¼	17	153¼	249½
Clarence P. Ayotte, Jr.	145	12	90	247
Allan L. Bjork	105½	27½	108½	241½
Herbert S. Kelly	95	20½	131½	247
Alfred B. Nault	125¼	1½	120¼	247
Ernest A. Oja		162	82	244
Russell J. Paull		87	44	131
Joseph J. Scoleri	137½	13	96½	247
John R. Sleeman	96	46	105½	247½
Robert R. Swanson		102	11	113
Martin D. Tasson		163¼	68½	231-3/4
Arnold E. Townsend	113½	29½	91½	234½
Allan E. Wakkuri	129-3/4	3½	113-3/4	247
Clyde C. Anderson	130	28½	81½	240
Donald P. Chartier		76½	8½	85
John P. Clark		98	19	117
James C. Cleven		51	30	81
Henry C. Coron, Jr.		149	51	200
Clyde H. Dodge		39	15	54
William G. Dunstan	43	14½	53	110½
Arthur W. Hemmila	123-3/4	5½	121-3/4	251
Donald G. Johnson	45½	27	42½	115
Donald E. Lampi		168	71	239
William M. Leaf	42	20	26	88
William R. Lehmann	109½	36½	101	247
Carl F. Lemin, Jr.		39	33	72
Paul E. Poutanen	51		32	83

Name	Underground	Field	Office	Total
Bernard L. Regan		60½	14½	75
Elmer R. Ring		76	2	78
Harold A. St. John			84	84
Paul E. Sundberg	63	3	40½	106½
Arnold A. Sundell	123-3/4	1½	117-3/4	243
Clarence J. Stone	53		27½	80
Wilburt H. Thomas	112¼	5	94-3/4	212
Holland L. Werner		147½	42½	190
Francis A. Wills	46		34	80
Raymond S. Windsand	100½	33½	113	247

The following sheet shows in tabular form, the personnel of the Engineering Department and the mines to which they were assigned during the majority of the year:

MINING ENGINEERING DEPARTMENT PERSONNEL - 1954

	BUNKER HILL	CAMBRIA-JACKSON	CLIFFS-SHAFT	HUMBOLDT	LLOYD	MAAS
MINE ENGINEER	E. G. Beinlich	J. F. Magnuson		A. Henry	J. F. Magnuson	L. N. Larson
ASS'T MINE ENGINEER			C. A. Koski			
SURVEYOR	J. R. Sleeman	H. S. Kelly	A. L. Bjork	C. H. Amel	H. S. Kelly	R. E. Anderson
HELPER	C. C. Anderson		R. S. Windsand			

	MATHER "A"	MATHER "B"	OHIO	REPUBLIC	SPIES	TILDEN
MINE ENGINEER	O. W. Hakala	R. C. Kincaid	A. H. Heikkinen	J. D. Crites		No
ASS'T MINE ENGINEER	P. D. Isaacson			R. J. Flynn		Operations
SURVEYOR	C. P. Ayotte J. J. Scoleri	A. B. Nault A. E. Wakkuri			A. E. Townsend	1954
HELPER	W. R. Lehmann W. T. Thomas	A. W. Hemmila A. A. Sundell	H. L. Werner			

	NEGAUNEE & REPUBLIC TOWNSITES	MARQUETTE RANGE GENERAL SURVEY CONTROL
MINE ENGINEER	R. Hosking	
ASS'T MINE ENGINEER	V. E. Swan	F. A. Koski
SURVEYOR	E. A. Oja	M. D. Tasson
HELPER	J. P. Clark D. E. Lampi	H. C. Coron

OFFICE	
ENGINEER	R. B. Davis
DRAFTSMEN	W. H. Stannard (Chief) L. L. Liivoja A. H. Mantyla G. B. Manzoline
DEPT. CLERK	J. C. Jensen
PRINTER	L. R. Miller

E. DISTRIBUTION OF TIME

The following table shows the distribution of time for the year at the different properties and jobs and the percentage of time spent on each property:

Property	Total	%
Bunker Hill Mine	755¼	6.178
Cambria-Jackson Mine	400½	3.276
Cliffs-Shaft Mine	842	6.888
Humboldt Mine	695¼	5.688
Lloyd Mine	225-3/4	1.847
Maas Mine	673½	5.510
Mather Mine		
"A" Shaft	1,588	12.967
"B" Shaft	1,461¼	11.954
Ohio Mine	435¼	3.560
Republic Mine (E&A CC491-A-a2)	920	7.526
Spies Mine	304¼	2.489
Mining Engineering General	1,410½	11.539
Minnesota Mines General	18½	.152
Geological Expense General	13	.107
Deferred Accounts:		
Lakeview	63	.516
Lobb	87	.713
MacKenzie	37-3/4	.310
Rifle Range	62½	.512
Republic Townsite	364¼	2.979
Morris Mine	16¼	.134
Research Laboratory	3½	.025
Cliffs Realty Company	6	.050
Electric Power Department	4	.032
E&A CC285 (Maas Drifting)	5	.037
E&A CC345 (Negaunee Shaft)	4½	.034
E&A CC437 (Spies Surface & Underground)	6½	.054
E&A CC521 (North Lake Project)	76	.623
E&A CC522 (Empire)	375	3.068
E&A CC560 (Cliffs-Shaft Site)	29½	.242
E&A CC561 (McDermott)	51¼	.420
E&A CC565 (Republic Pelletizing Plant)	12½	.103
E&A CC591 (Perkins)	135½	1.109
E&A CC592 (Imperial)	2¼	.019
E&A CC593 (Allen Forty)	21¼	.174
E&A CC597 (Cascade East End)	62	.507
E&A CC600 (Titan)	6¼	.052
E&A CC619 (Bunker Hill-Athens Drifting)	224	1.833
E&A CC623 (Bunker Hill Underground Drilling)	53	.434
E&A CC640 (Maas-Automatic Pumping System)	19-3/4	.162
E&A CC642 (Sterling Addition)	48½	.397
E&A CC654 (Eagle Mills)	329-3/4	2.698
Mather Mine E&A's		
E&A NM44 O-B-c (Steel Supports)	19¼	.158
E&A NM44 O-B-d (Belt Drift)	16	.130

Property	Total	%
E&A NM 44 O-B-f (Discharge End Excavation)	18	.147
E&A NM 81A (Drifting, All Levels)	2-3/4	.022
E&A NM 81C (Equipment, All Levels)	111½	.912
E&A NM 90BC (9th Level Conveyor Drift-Dicharge End)	26	.223
E&A NM 90BD (Load End Excavation)	1	.009
E&A NM 92A (9th Level Pumphouse & Sumps)	3	.025
E&A NM 94-5-d (5th Level Drifting)	19½	.160
E&A NM 94-8-d (8th Level Drifting)	1½	.012
E&A NM 94-8-v (8th Level Ventilation)	4	.032
E&A NM 94-9-b2 (9th Level Plat)	20-3/4	.170
E&A NM 94-10-d (10th Level Drifting)	30¼	.247
E&A NM 97A (Rock Drifting, All Levels)	31-3/4	.260
Land Offer 2644	½	.006
Land Offer 2874	1	.009
Land Offer 3119	½	.006
Land Offer 3400	3	.024
Land Offer 3527	1	.009
Outside Exploration 1155	28½	.233
Outside Exploration 1158	34½	.282
Outside Exploration 1162	½	.006
	12,224½	100.000%

F. COSTS

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

	1952	1953	1954
Salaries	$252,469.75	$287,600.45	$275,507.92
Travel & Entertainment	4,581.24	4,480.99	1,497.21
Dues & Subscriptions	88.41	185.65	100.00
Telephone & Telegraph	503.42	570.33	530.25
Printing, Stationery & Special Supplies	14,788.39	10,252.94	10,929.32
Heat, Light, Power & Water	691.57	1,085.34	985.03
Furniture & Fixtures	158.60	2,479.72	2,222.86
Unemployment Insurance	2,492.34	2,177.52	2,299.38
Auto Expense	4,007.82	7,581.21	9,220.88
Old Age Benefit Tax	3,243.66	3,047.05	4,050.08
Donations		375.80	49.47
Group Annuity Premiums	1,719.71	2,707.35	6,201.90
Repairs & Maintenance	85.96	1,091.93	830.69
Insurance	230.72	688.31	921.19
Postage & Express	113.95	129.04	233.62
State Franchise, Property & Miscellaneous Taxes	48.55	50.63	50.63
Depreciation - Buildings & Equipment	78.00	3,034.00	2,956.00
Cleaning & Janitor Supplies		36.40	254.44

	1952	1953	1954
Personal Injury Expense	$ 7.50	$	$
Field & Specialized Equipment including Maintenance	548.87	15,080.07	3,335.44
Rentals	15.00	55.00	13.33
Miscellaneous	3,913.43	6,954.37	2,749.06
Totals	$289,786.89	$349,664.10	$324,938.70

H. AUTOMOBILES

The Ford Ranch Wagon (1952 model) was operated throughout the year by the Republic Mine engineering crew; the Ford Ranch Wagon (1953 model) by the surface survey crews; the Chevrolet Carry-All (1949 model) by the Negaunee and Republic Townsites crew; the Chevrolet Carry-All (1950 model) by the Humboldt Mine engineering crew; and the Chevrolet Handyman (1953 model) by the Ohio Mine engineering crew.

The following table shows the mileage covered in 1954, the total mileage to the end of the year and the date the cars were received in the Department:

Car	Miles 1954	Miles Total	Date Received
Ford Ranch Wagon (1952 model), #29	15,068	35,290	6/20/52
Ford Ranch Wagon (1953 model), #48	15,790	24,070	7/30/53
Chevrolet Carry-All (1949 model), #21	8,889	57,702	6/13/49
Chevrolet Carry-All (1950 model), #22	9,447	49,450	6/1/50
Chevrolet Handyman (1953 model), #49	16,864	23,100	8/14/53

I. MINES

The following brief summary itemizes the special work done at the various properties during the year.

BUNKER HILL MINE - Eric G. Beinlich, Mining Engineer

(1) The Mining Engineer spent considerable time throughout the year on the planning and development of the 14th Level crusher and conveyor system.

(2) The transfer of the Athens air compressor to the Bunker Hill engine house required "lines and grades" work during the construction of the foundation.

(3) A detailed study of the hoisting operations through the Bunker Hill Shaft was made in an effort to eliminate and reduce unnecessary delays.

(4) Survey control was supplied for the seismic study made in the Western portion of the Bunker Hill Property, so that ledge contours could be plotted and a program developed for the removal of subsurface waters.

(5) Plans were made and liner plates designed for the skip loading pockets on the 6th, 10th, 12th and 14th Levels.

(6) The surface subsidence surveys, which are made in the spring and in the fall, disclosed a rather uniform settling of the Athens surface. A new subsidence crack appeared late in the year approximately at the Athens-Bunker Hill Property line.

(7) A study and report were made on the feasibility of changing the analysis limitations of the Athens-Bunker Hill ore.

(8) A study of roof bolting at the Bunker Hill Mine was made and, from the results, the best-suited bolt for our conditions was selected.

(9) The shaft was plumbed twice from the 12th to the 14th Level in order to establish courses and coordinates on this newly developed 14th Level.

(10) The capital expenditure forecast required considerable time on the part of the Mining Engineer at various intervals throughout the year.

CAMBRIA-JACKSON MINE - John F. Magnuson, Mining Engineer

(1) The Mining Engineer conducted an underground mapping school for the shift bosses and underground foremen.

(2) The engineering personnel assigned to this property assisted in the mine equipment inventory and the mining operations time study.

(3) A percussion machine, long-hole test work program was supervised by the Mining Engineer. These test holes were used with a fair degree of accuracy to outline the ore horizons of the individual ore deposits which prevail at this property.

CLIFFS-SHAFT MINE - James P. Meyers, Mining Engineer-Geologist

(1) During the construction of the concrete headframe and the erection of the steel portion, the Mining Engineer and his survey crew were called upon for "lines and grades" work, design, layout and concrete inspection.

(2) The erection of the temporary engine house, hoist and head sheaves required engineering assistance.

(3) The alteration of the surface plant, specifically, the new tunnel, boiler house, garage, conveyor gallery, motor generator foundations and railroad car loading pocket facilities, called for survey control work, layout and inspection during their construction.

(4) The survey crew mapped all the air, water, steam and electrical conduit lines which had been moved in the process of the construction of the new surface plant or installed during that period.

(5) Tri-annual surveys were conducted, the maps posted and reports compiled and forwarded to the Oliver Iron Mining Division.

(6) During the shaft sinking operation, "C" Shaft was plumbed several times and the alignment and elevations of the steel sets were checked.

(7) The rock excavation pertinent to the ore pass raises and skip loading pockets made it necessary to perform continual survey control work.

(8) The Mining Engineer assisted in the preparation of shrinkage stope mining method plans.

(9) The routine underground surveys necessary for the mining and development contracts and the locating and surveying of diamond drill holes were taken care of as called for throughout the year.

HUMBOLDT MINE - Albert Henry, Mining Engineer

(1) The Mining Engineers located, sampled and surveyed all the jet pierced blast holes. They assisted in the loading of these holes after calculating and designing the hole spacing and burden.

(2) Monthly pit progress maps were compiled and the geological information transferred to the pit cross-sections.

(3) Crude ore, surface and rock stripping estimates were periodically prepared for various sections of the pit as the mining progressed.

(4) Water samples were taken from the tailings pond and the Lake Lory swamp inlet at monthly intervals throughout the year. Records of the suspended solids are being kept.

(5) Soundings were taken in the swamp area adjacent to and West of the pit to determine the depths of muck; the information necessary to construct a permanent access road and dike.

(6) A utility map, that is, the location of all water, electrical conduit, oxygen and sewer lines, was prepared.

(7) A new baseball diamond and field were laid out, inasmuch as the present Humboldt Township baseball park will be abandoned due to pit proximity.

(8) The increase in size of the tailings pond required the estimating of fill quantities needed.

LLOYD MINE - John F. Magnuson, Mining Engineer

(1) As a result of several stockpile volume surveys and corresponding railroad shipment weights, a new factor of 13.40 cu. ft./ton was established.

(2) The normal routine work of surveying and mapping the mining and development contracts, plus assisting the superintendent in various items, was taken care of by the one, two-man engineering crew assigned to this and the Cambria-Jackson Mine.

MAAS MINE - Lionel N. Larson, Mining Engineer

(1) Considerable time was spent on the planning, layout work and survey control pertinent to the proposed incline conveyor system between 6th and 7th Levels.

(2) The Mining Engineer compiled records of mine water, checked pumping logs and assisted in the planning and selection of the proposed automatic pumping system.

(3) Additional iron pins were established in the vicinity of the Maas Mine Cave Area in order to facilitate the subsidence survey and study. Benchmarks were established on angle irons which were welded to the headframe columns for the precise measuring of the headframe "lean".

(4) The construction of the new addition to the dry building, the remodeling of the main office and the repair of the Negaunee No. 2 Air Shaft all required engineering assistance.

MATHER MINE

"A" Shaft - Oiva W. Hakala, Mining Engineer

(1) The culmination of all the precise survey work extended by the Mining Engineering Department's crews was reached on December 23rd at which time the 8th Level main haulage drift connecting "A" and "B" Shafts "holed through". This connection, the third completed between these two shafts, represents the ultimate in survey control; the alignment being perfect and the grade differential .02' or 1/4".

(2) The continuing development program, that is, the driving of main level haulage drifts and cross-cuts on the 3rd, 7th, 8th and 9th Levels and the plats, pocket, trench, pumphouse and sump rock excavations, constantly required the services of the two, two-man survey crews assigned to this property throughout the year.

(3) The Mining Engineer spent considerable time on the experimentation and study concerning the use of rock bolts as an alternate means of roof support, thus replacing the steel sets at a saving of approximately 30%.

(4) Stockpile surveys were made in both the spring and the fall and the quantities calculated in order to determine a new cu. ft./ton factor. The treatment of the ore has been significantly changed, that is, the loading, crushing, screening, etc., plus the fact that the structure of the ore is variable, therefore, making it necessary to alter the factor from time to time.

(5) A grid system of concreted iron pins was established throughout the Golf Club Area in anticipation of surface subsidence over the largest void created by the active mine workings. Both elevation and alignment will be checked on a bi-annual basis.

(6) The engineering personnel assisted in a time study of the ore hoisting operations.

"B" Shaft - R. Charles Kincaid, Mining Engineer

(1) A monthly check of the water elevations in the North Jackson Pits was continued in order to follow the results of the pumping from the underground workings of the old Sand Shaft.

(2) Several check surveys were made on the 8th Level in conjunction with the Mather Mine, "A" Shaft--Mather Mine, "B" Shaft connection on that level.

(3) The excavation and development of the 8th Level crusher box, conveyor drift and discharge raise required day to day survey control.

(4) The survey crews posted the ore development analysis maps, the stope analysis and the block cave draw records.

(5) The Mining Engineer assisted the Safety Department in the two ventilation surveys made during the year. Air volumes were calculated and the fire maps posted and filed at the mine office.

OHIO MINE - Allen H. Heikkinen, Mining Engineer

(1) In order to revamp the tail track pocket-loading facilities, surveys were made and profiles drawn so that the proposed changes could be suggested to the D. S. S. & Ry.

(2) The Mining Engineer calculated and supervised all of the pit blasts made throughout the operating season.

(3) New estimates of the ore reserves and stripping quantities were made so that this data would be available for depletion and amortization rates as required for federal tax purposes.

(4) A contour survey was made of the area South of the present tailings basin in order to determine the advisability of additional purchases for enlargement of this basin.

REPUBLIC MINE - Joseph D. Crites, Mining Engineer

(1) The location of the proposed tailings dike was staked in the field, profiles drawn and earth estimates calculated. Benchmarks were established at various intervals during this survey so that at the time of construction, this data would be available.

(2) Profiles were made on 100' stations in preparation for the development of the pit cross-sections.

(3) The Mining Engineers spent considerable time coordinating and inspecting the work of the contractors during the construction phase of the crusher and mill building.

(4) A plan and profile were developed for the 20" mill supply line between the Michigamme River and the mill building.

(5) Profiles were prepared and ledge elevations indicated for the footings of the crushing section, conveyor supports and mill building and the originally proposed pelletizing plant.

(6) The mine access road required constant engineering assistance during the time of its construction.

SPIES MINE - Arnold E. Townsend, Surveyor

(1) The Surveyor assigned to this property took care of the diamond drill hole location work as called for in the exploration programs of the McDermott, Allen and Spies Properties, in addition to the mapping and surveying duties at the Spies Mine.

(2) Some time was also spent doing survey control work for the electromagnetic surveys of the McColeman and Glocke Properties and the Gibbs City Area.

TILDEN MINE - Allen H. Heikkinen, Mining Engineer

No operation during 1954.

J. MISCELLANEOUS

ORE ESTIMATES

The following table shows a comparison of the tonnages as reported to the Michigan State Tax Commission:

Mine	Tons	
	As of 8/31/53	As of 8/31/54
Athens	1,880,023	1,518,244
Bunker Hill	2,159,313	3,263,759
Cambria-Jackson	487,245	477,588
Cliffs-Shaft	1,747,976	1,600,472
Lloyd	323,135	214,607
Maas	4,000,578	3,851,937
Mather		
"A" Shaft	3,945,957	4,987,166
"B" Shaft	16,720,418	19,607,265
Spies	185,960	193,038
Total Developed Ore	31,450,605	35,714,076
Undeveloped Reserves		
Section 3, 47-27	302,378	302,378
Grand Total All Ores	31,752,983	36,016,454

STOCKPILES

Estimates of the ore in stock were made by the Engineering Department at the Bunker Hill, Cambria-Jackson, Cliffs-Shaft, Lloyd, Maas and Spies Mines and the "B" Shaft of the Mather Mine.

The following table shows the comparison of ore in stock on November 1, 1953 and November 1, 1954:

Mine	Nov. 1, 1953	Nov. 1, 1954
Bunker Hill		
Athens	34,099	127,476
Bunker Hill	9,120	167,763
Cambria-Jackson	0	106,350
Cliffs-Shaft	57,116	181,896
Lloyd	188,154	222,611
Maas	37,865	273,199
Mather		
"A" Shaft	186,399	644,317
"B" Shaft	90,533	170,411
Spies	72,758	132,701
Tilden	79,987	18,874
Totals	756,031	2,045,598

COAL PILES

The coal piles at the Ishpeming Steam Plant were cross-sectioned and "in stock" quantities calculated and supplied to the Electric Power Department.

SHAFT GAUGING

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

Mine	Date
Bunker Hill	April 26th
	December 11th
Cambria-Jackson	March 20th
	September 17th
Cliffs-Shaft	July 1st
Lloyd	March 6th
	October 15th
Maas	April 16th
	November 6th
Mather	
"A" Shaft	June 19th
	November 5th
"B" Shaft	July 23rd
Spies	September 24th

REPUBLIC TOWNSITE

The revision of thinking as to the advisability of platting the area in the proximity of Milwaukee Lake and the continual demand of making available some area for house moving facilities made it necessary to study the area in Section 19, 46-29 as an alternate townsite. Several plat designs were prepared and estimates of the site and street grading made. Several different plans for both water supply and sewage disposal were investigated and estimated. Survey control was at a minimum so considerable time was spent in determining section corners and land boundaries so that the area could be accurately defined.

NEGAUNEE PLATS

Proposed Lobb Plat

Several plans of lot layouts, grading, water and sewer systems were developed and cost estimates prepared so that this area could be submitted to the Negaunee City authorities when the Maas Mine house moving operations are necessary.

MacKenzie Field

Additional lots were platted adjacent to the original MacKenzie Addition and the cost of grading, water and sewer systems estimated.

Lakeview

Several lot design layouts of this area were made and grading estimates prepared in order to compare expenditures required to make this area an approved addition to the City of Negaunee.

Sterling

The cost of grading the remaining area at the East end of the Sterling Addition and the necessary water and sewer facilities were estimated and the contract for this work was awarded to A. Lindberg & Sons, who completed their work in September, ready for occupancy.

Rifle Range

The field work necessary for mapping this area was completed and the design of the proposed plat was started.

EAGLE MILLS--PELLETIZING PLANT SITE

(1) Considerable field work was done in this area during the time it was being considered as a possible townsite. Section corners were located and the topography work done was confined to Sections 34 and 35, 48-26. Surveys were run from Negaunee in order to have this area incorporated into the mapping system of Negaunee, the so-called triangulation system.

(2) At the time of the decision that this area would be used as a Pelletizing Plant site, efforts were confined to the establishment of base lines and benchmarks necessary for the cross-sectioning of the area to be graded for

plant construction and track installation. Several surveys were performed as control means for the seismic surveys which were used to determine ledge elevations, for water well possibilities and foundation design.

SURVEY CONTROL - MARQUETTE RANGE

NEGAUNEE DISTRICT

(1) Work was continued on the joint Jones & Laughlin--Cleveland-Cliffs triangulation surveys so that common coordinate values can be established for the boundaries of each company's ownerships.

(2) Several metes and bounds descriptions were resurveyed and the maps corrected to conform to the original documents.

(3) An area South of the Maas Mine was mapped pending lease to the City of Negaunee for garage and warehouse purposes.

CASCADE DISTRICT--EMPIRE AREA

(1) Considerable time was spent on the establishment of survey control in Sections 19, 20 and 27, 47-26. Drill holes were laid out and surveyed and profiles prepared for the electromagnetic geophysical work.

GWINN DISTRICT

(1) At a request from the Land Department, land boundaries were checked to confirm the hotel building trespass.

(2) Property lines were established in the Swanzy Pit Area in regard to the fencing and pit protective program.

MICHIGAMME DISTRICT

(1) Control surveys were established, drill holes located and surveyed and the Imperial Mine Property mapped in anticipation of converting an option into a lease.

SURVEY CONTROL - MENOMINEE RANGE

PERKINS DISTRICT

(1) Lines were brushed, control surveys established, diamond drill holes located, benchmarks set and geophysical profiles drawn for the exploration program currently in progress in this area.

SUMMER FIELD CREWS

The practice of hiring undergraduate Engineers and Geologists temporarily for the summer field mapping and sampling was discontinued this year in order to employ personnel whose employment was terminated on June 15th.

HOLIDAYS

The following holidays were granted during the year:

January 1st	- New Year's Day
July 5th	- Independence Day
September 6th	- Labor Day
November 25th	- Thanksgiving Day
December 24th & 25th	- Christmas
December 31st	- New Year's Eve

Respectfully submitted,

Grant T. Hollett
Chief Mining Engineer

GTH:jcj
3-15-55
-3-

RESEARCH LABORATORY

ANNUAL REPORT - YEAR 1954

The Annual Report for 1954 is subdivided into five main sections. These sections are reported separately and are related to different phases of the work conducted by the Metallurgical Department. These specific sections are: (1) General Testing Program, (2) Pyrolysis and Agglomeration, (3) Research & Development Work and Flotation Projects, (4) Microscopy Section, and (5) Check Sampling Program.

The Annual Report for the Research Laboratory is intended only to briefly discuss the various programs studied during the year. No attempt is made in this report to present test data, conclusions or recommendations that culminated from any specific investigation. There were undoubtedly several small-scale projects completed that are not mentioned in the report. Due to the large number of small-scale projects worked on, they are only discussed in a general manner, and no specific reference is given.

PART I

GENERAL TESTING PROGRAM

MAJOR PROJECTS:

Pilot Mill Tests:

Humboldt Mine:

Paralleling the flotation test program to depress the phosphorous mineral was the investigation employing gravity concentration to produce a concentrate having a desirable phosphorous content. Gravity concentration tests proved to be relatively ineffective when treating the conditioner product, rougher flotation feed, and thickener product. Additional tests are also being conducted employing spirals to effect a concentration in the grinding circuit. Preliminary tests indicate that the ball mill discharge is the most favorable feed for the spirals and that a portion of the crude can be recovered as a high grade concentrate having a desirable phosphorous content. This test program is being continued and as data are accumulated progress reports will be issued.

Empire Area:

Some preliminary work was carried out throughout the year in the pilot section utilizing a partial flowscheme presently in use in the separation of the magnetic taconites.

During the summer, approximately 120 tons of low grade ore from the Empire Area was crushed and trucked to the Research Laboratory. This material, obtained from outcrop, closely resembled the material encountered in the drilling of the Empire Explorations Program.

The pilot mill circuit studied involved only the crushing, rod mill grinding, coarse cobbing and classification. The program involved testing the material at various field strengths of the magnetic separator at a nominal 10 mesh rod mill grind and also the study of the effects of various classifiers following the magnetic separator to eliminate slime and weakly magnetic silicate fractions.

Eventually, the investigation will involve regrinding of the cobbed concentrate and further concentration by magnetic means.

Land Offers & Outside Explorations:

During the year numerous priority samples, identified as various Land Offers and Outside Explorations, were submitted to the Research Laboratory for testing. The majority of the samples submitted under these classifications represented the Canadian Exploration Program. The most important samples in this series were submitted under four claims, namely, Temescamie, Albanel, Sandspit, and Bruce Lake, which were respectively Land Offers 3119, 3120, 3121, and 3163. Many of the samples submitted under this category are subjected to preliminary concentration tests involving magnetic tube tests if the sample has a high magnetite content. Additional testing on any of these samples depends upon recommendations from a committee which reviews the samples with reference to metallurgy, geographic location, possible reserves, and availability.

Ohio Mine:

All of the test work conducted at the Laboratory for the Ohio Mine during 1954 can be classified as routine plant control tests. These included structures of concentrates for royalty payments, heavy media loss determinations, structures of various products, and infrequent heavy liquid tests.

RESEARCH & DEVELOPMENT PROGRAM:

Research and Study:

Considerable time was devoted by the Laboratory's technical staff to studying various techniques and processes that have potential application to the treatment of low grade iron ores. Much of this time, which is distributed to the Research and Study account, includes reading of technical books and papers, administration details and general technical investigations that cannot be directly charged to any one program.

Vibrating Ball Mill:

An experimental model vibrating ball mill, 18" x 36", was loaned to the Research Laboratory by Allis-Chalmers for testing. This ball mill is a recent development which incorporates the principle of vibration to activate the ball charge as compared to the conventional ball mill, which is rotated to produce the ball action required for grinding. As the capacity of the vibrating ball mill far exceeded the capacity of the pilot mill circuit, only a few short tests were conducted. The tests indicated that the vibrating mill has roughly three times the capacity of a conventional mill having the same volume, however no advantages relative to ball wear and power requirements were evident. The test results are detailed in Metallurgical Report No. 105.

Concentrate Shipment Study:

An investigation was conducted to determine the angle of repose and shear angle for pellets and flotation concentrates under various conditions. This program was conducted to determine some of the characteristics of the concentrates and agglomerates that would be shipped by rail and boat to the steel plants. The program was preliminary in nature, however gave some indication as to the problems that would arise in handling and shipping fine flotation concentrates, particularly with respect to moisture content. Details of this study are reported in Research Laboratory's Metallurgical Report No. 129.

Several observation trips were made on ore carriers handling fine ore concentrates to the lower lake ports. Discussions on the observation trips are reported in memoranda issued by the Research Laboratory on June 25th and October 20th.

Sample Shipments:

Samples of crude material and concentrates were shipped to various companies and research laboratories for study and research work.

SERVICE PROJECTS AND RESEARCH & DEVELOPMENT:

Drill Core:

The practice of submitting drill core sections of lean iron formation from underground drill holes and exploration drill holes was continued. The core samples are submitted to the Laboratory by the Geological Department, and represent iron formation having an iron content in the range of 20 to 50 percent. Intrusive material containing less than 20 percent iron is usually screened out by the Geological Department, therefore these samples are not submitted. These drill core samples are submitted daily and rate a high priority as far as being processed as soon as received.

Since the organization of the Metallurgical Department, it was felt that these composites of intermediate grade material built up from the underground mine drill holes and non-metallurgical surface drill holes are valuable in that they represent the various types of lean iron formation existing throughout the active areas of the Marquette Range. As drilling programs prove extremely costly, it has often been felt that the compositing of these core samples may prove to be a useful tool by which a preliminary evaluation of the concentrating characteristics for a specific area may be obtained without the need for a primary drilling campaign. The Laboratory is presently storing these composite samples in the storage building at the rear of the Laboratory.

Time Charges for 1954:

Listed below is a short tabulation for the last four years showing the Laboratory staff and total hours as reported on the Cost Sheets.

	Staff		
Year	Engineers	Technicians	Total Hours
1951	6	11	31,369
1952	6	13	47,958
1953	8	18	66,005
1954 (January 1)	8	18	
1954 (December 31)	8	15*	50,982

* One man on temporary basis.

TIME DISTRIBUTION - YEAR 1954

Account	Hours	Account	Hours
Flotation Study	3466	The Negaunee Mine Co.-NM44L-8-j	5
Cedar Lake	27	McDermott	10
Magnetic Oxide Conversion	1438	Arctic - CC-623	53
Agglomeration Research	14545	D.D.H. 1 - Sec. 25, 43-35	18
Research & Study	1484	D.D.H. 3 - Sec. 25, 43-35	15
Microscopy Section	666	D.D.H. 4 - Sec. 25, 43-25	8
North Jackson	40	D.D.H. 20C - Section 11	65
Vibrating Ball Mill	20	D.D.H. 23B - Section 11	32
Foster - Mag. Oxide Conv.	65	D.D.H. 33 - Sec. 27, 47-26	28
Fitch - Mag. Oxide Conv.	3	D.D.H. 91 - Sec. 25, 43-25	5
Cyclone Tests	131	D.D.H. 148 - Section 1	3
Republic - Mag. Oxide Conv.	606	D.D.H. 149 - Section 1	3

Continued . . . . . .

Account	Hours
Teal Lake	51
Agglomerate & Conc. Ship. Study	898
Cascade - Mag. Oxide Conv.	176
Tilden - Mag. Oxide Conv.	431
Bellevue - Mag. Oxide Conv.	177
Cliffs Shaft Mine	415
Mather Mine "A" Shaft	699
Mather Mine "B" Shaft	942
Cambria-Jackson Mine	146
Ohio Mine	889
Spies Mine	278
Maas Mine	138
Bunker-Hill Mine	328
Humboldt Mine	5191
Perkins - CC-591-F	126
Richmond - D.D.H. 32	23
North Lake - CC-521-F	549
Empire - CC-522-3	2918
Republic - CC-491-F	1564
Imperial - CC-592F	26
Cascade - CC-597F	483

Account	Hours
Empire - CC-522 - Hole 3	365
4	470
5	388
6	357
7	349
8	338
9	363
10	335
11	358
12	304
13	135
14	374
15	440
16	346
17	342
18	179
19	19
Outside Explorations	283
Land Offers	2694
Humboldt Phos. Depression Study	1373
Balling Disc Study	1986

Chemical Charges:

The following records the distribution of chemical charges made by the Chemical Laboratory during 1954. The assays for 1954 totaled 28,063 or a reduction of approximately 6,400 analyses over 1953. The distribution of the chemical analyses as well as time distribution present an overall picture of the projects and studies conducted by the Research Laboratory during 1954.

TOTAL NUMBER OF DETERMINATIONS ANALYZED IN 1954 FROM RESEARCH LABORATORY SAMPLES

Account	Analyses
Maas Mine	269
Mather Mine "A" Shaft	1678
Mather Mine "B" Shaft	933
Cliffs Shaft Mine	911
Humboldt Mine	5903
Humboldt Phosphorous Study	1211
Humboldt Special Study	13
Spies Mine	563
Cambria-Jackson	59
North Jackson	10
South Jackson	120
Lloyd	288
Ohio	977
Agglomeration Research	367
Tilden	24
Republic	479
Fitch	45
Magnetic Oxide Conversion	410
Arctic Hole 1	16
" " 2	43
" " 3	12
Pelletizing Research (Pilot Mill Feed)	1
Flotation Research	10
Flotation Study	141
Cliffs Group Ore Research	100
Experiments & Investigation	233
Research & Study	68
Empire Deferred Account	251
Bellevue Deferred Account	98

Account	Analyses
Section 19 Hole 7	878
" 19 Hole 9	13
" 19 Hole 10	10
" 19 Hole 11	142
" 19 Hole 12	692
" 19 Hole 13	161
" 19 Hole 14	341
" 19 Hole 15	288
" 19 Hole 16	263
" 19 Hole 17	227
" 19 Hole 18	102
" 19 Hole 19	159
" 24 Hole 89	25
" 24 Hole 90	10
" 24 Hole 91	60
" 25 Hole 1A	21
" 25 Hole 2	9
" 25 Hole 3	28
" 25 Hole 4	36
" 25 Hole 18	5
" 27 Hole 32	615
" 27 Hole 33	399
E. & A. 440	15
E. & A. 522-3	1008
E. & A. 522F	455
E. & A. 591-F	103
E. & A. 619	5
E. & A. 623	174
C.C. 521	792

Continued . . . . . .

Account	Analyses	Account	Analyses
M.O.C. Foster Deferred Account	41	Teal Lake	100
Tilden Experiments & Investigation	88	North Lake Section 4	27
Empire Experiments & Investigation	266	North Lake Section 5	27
Teal Lake Experiments & Investigation	16	Michigamme	24
Bellevue Experiments & Investigation	71	Land Offers	2776
Section 11 Hole 23B	38	Outside Explorations	635
" 19 Hole 3	105	Section 4 Hole 45	3
" 19 Hole 4	503	" 6 Hole 90	2
" 19 Hole 5	869	" 11 Hole 20C	18
" 19 Hole 6	185		

Metallurgical Reports and Memoranda:

The following lists the Metallurgical Reports and Memoranda issued by the Research Laboratory in 1954. By comparison, 21 Reports and 59 Memoranda were issued in 1952; 21 Reports and 104 Memoranda were issued in 1953, and 35 Reports and 71 Memoranda were issued in 1954. By necessity, however, many of the projects investigated in 1954 were reported in letter form to management.

METALLURGICAL REPORTS - YEAR 1954

Report No.	Subject
105	Vibrating Ball Mill
106	Magnetic Oxide Conversion of R-57
107	Demonstrations of Agglomerating Pellets on Traveling Grates using Updraft & Downdraft Principles
108	Empire Area Progress Report - D.D.H's 3 & 4
109	Ohio Mine Concentrating Plant Operation, 1953 Season
110	Effect of Athens or Mather "A" Ore added as Slime Additives on the Green & Fired Strengths of Pellets made of Humboldt Concentrate H-88
111	Magnetic Oxide Conversion of Saginaw Surface Samples
112	Magnetic Oxide Conversion of Cedar Lake Composites CL-64A thru CL-64I
113	Magnetic Oxide Conversion - Fitch Area
114	Desulfurizing High Sulfur Mather "B" Ore by Sintering
115	Magnetic Oxide Conversion of Composites from the Mather Area - North Jackson Location
116	Progress Report - Empire Area, D.D.H. No's 5, 6, 7, &8 Section 19, 47-26
117	Mine Ore Structure Study, 1953
118	Mather "B" Special Ore - Elimination of Sulfur by H. M. Separation
119	Magnetic Oxide Conversion of Composites from Old Richmond Pit
120	Agglomeration using Updraft Grate Firing Principles
121	Magnetic Oxide Conversion of Composites from Cascade District, Isabella Area
122	Magnetic Oxide Conversion of Composites from the South Jackson Pit Area
123	Magnetic Oxide Conversion of Composites from Ishpeming-Negaunee District - Bellevue Area
124	Magnetic Oxide Conversion - Ogden Pit
125	Magnetic Oxide Conversion - Moore Pit
126	Empire Area - D.D.H's 9, 10, & 11, Section 19, 47-26
127	Magnetic Oxide Conversion - Teal Lake
128	Magnetic Oxide Conversion - Foster Area
129	Moisture Segregation & Concentrate Shipment
130 & Geology Report No. 1	Investigation of Mineral & Petrology and its Relation to the Ore Treatment of the Magnetic Ore in the Empire Area
131	Lloyd Mine Sampling Study - Surface Versus Underground

Continued . . . . . .

Report No.	Subject
132	Summary Report - Magnetic Oxide Conversion
133	Richmond D.D.H. 32, Section 27, 47-26
134	Outside Exploration 1130 - Laboratory Examination of two Pyrite Samples
135	Empire Area - D.D.H's 12 & 13, Section 19, 47-26
136 & Geology Report No. 2	Laboratory Examination of an Ilmenite-Magnetite Ore, St. Antoine, Lake St. John, Canada
137 & Geology Report No. 3	Laboratory Examination of Ollala Creek Manganese Ores, Similkamen District, B.C.
138	Investigation of Humboldt Phosphorous Depression
139	Ohio Mine Concentrating Plant Operation, 1954 Season

METALLURGICAL MEMORANDA - YEAR 1954

Memo No.	Subject
211	Land Offer 3119
212	Land Offer 3110, Canada, - Sample MxC-602
213	Humboldt Mine - Surface Samples
213A	Humboldt Mine - Surface Samples
214	Ohio Mine
215	Outside Exploration 1094
216	Ohio Mine - Heavy Liquid Tests
217	Canadian Samples
218	Outside Exploration 1068
219	Spectrographic Analyses - Humboldt Drill Core
220	Flotation Study
221	Ohio Mine Concentrate Structure - 1953 Season
222	Humboldt Mine - Face & Stockpile Samples
223	Land Offer 3127 - Samples MxC-155, -156, -157, -162
224	Humboldt Mine - Face Sample
225	Microscopic Study - Sample of Oolitic Iron Formation Phil-Cl 470-480'
226	Flotation of Republic Pelletizing Screen Returns
227	Land Offer 3119
228	Microscopic Examination - Humboldt Mine Stockpile Samples
229	Republic & Humboldt Screen Analyses
230	Land Offer 3134
231	Microscopic Examination - Cobber Magnetic Concentrates
232	Humboldt Flotation Tailings & Plant Tailings
233	Screen Analyses
234	Microscopic Study - Albanel Claim Group
235	Ohio Mine Sampling - 1953 Season
236	Sample Nos. MxC-663, -664, & -665
236 (Supplement)	Ditto - 5/12/54
237	Progress Report - April 26 - May 8, 1954, Underground Sampling
238	Testing of Bentonite Samples
239	Progress Report - May 10-15, 1954 Underground Sampling
240	Progress Report - May 17-22, 1954 Underground Sampling
241	Land Offer 3139 - British Columbia Manganese
242	Progress Report - May 24 - June 4, 1954 Underground Sampling
243	Progress Report - June 7-12, 1954 - Underground Sampling
244	Cliffs Shaft Mine - Lump Sizes
245	Land Offer 3141 - Steep Rock Area
246	Land Offer 3162
247	Progress Report, June 14-19, 1954 Underground Sampling
248	Laboratory Examination of a Crystalline Hematite Ore from Benson Mine, New York
249	Outside Exploration 1154 - Payne Bay, Quebec
250	Progress Report - June 21-26, 1954 Underground Sampling
251	Progress Report - June 28 - July 3, 1954 Underground Sampling

Continued . . .

Memo No.	Subject
252	Outside Exploration 1153
253	Progress Report - July 5-17, 1954 Underground Sampling
254	Progress Report - July 19 - August 7, 1954 Underground Sampling
255	Progress Report - August 9-14, 1954 Underground Sampling
256	Ohio Mine - Shipping Analyses
257	Land Offer 3146
258	Land Offer 3145
259	Empire Area, Section 20, 47-26
260	Progress Report - August 16 - September 3, 1954 Underground Sampling
261	Land Offer 3144
262	Sample Mx-1709
263	Land Offer 2798
264	Humboldt Phosphorous Study
265	Land Offer 3135
266	Cambria-Jackson Mine Underground Sampling
267	Progress Report - September 20, 1954 Underground Sampling
268	Outside Exploration 1131
269	Land Offer 3135
270	Microscopic Examination - Drill Hole Specimens from D.D. Hole No. 32, Cascade District
271	Land Offer 2798
272	Progress Report, October 4-29, 1954 Underground Sampling
273	Humboldt Phosphorous Control Study
274	Land Offer 3145
275	Land Offer 3147
276	Land Offer 3120
277	Land Offer 3121
278	Land Offer 3102
279	Microscopic Examination of some Magnetic Rocks from Vermilion Range, Minnesota

PART II

PYROLYSIS & AGGLOMERATION

This section of the Annual Report covers the following subjects:

1. Laboratory Grate Firing Investigations.
2. Continuous Demonstrations of Traveling Grates used for Firing Pellets of Flotation Concentrates.
3. Design of 2000 TPD Agglomeration Plant.
4. Standardized Laboratory Tests for Green, Dry and Fired Pellets.
5. Balling Disc Studies.
6. Magnetic Oxide Conversion - Concentration.
7. Service Projects.

LABORATORY GRATE FIRING INVESTIGATIONS:

Laboratory grate firing investigations were continued through 1954 and were conducted in a laboratory section of a grate for firing pellets by induced draft. These tests provided data for investigating numerous variables which influence operation. The most economical procedure of operation was set forth for the design specifications for the 2000 TPD Plant and other tests were conducted for the determination of performance in pilot plant traveling grates.

Research Laboratory's Metallurgical Report No. 120 is a summary of 281 individual grate firing tests conducted through the period June 10th, 1953 through April 16th, 1954.

CONTINUOUS DEMONSTRATIONS OF TRAVELING GRATE USED FOR FIRING PELLETS OF FLOTATION CONCENTRATE:

Tests were conducted in 1953 to determine the feasibility of the down-draft method for pelletizing specular hematite concentrates, but these earlier tests were of such a nature that results were inconclusive. Therefore, an additional test was conducted at the Allis-Chalmers-McKee Pilot Plant at Carrollsville, Wisconsin on May 13, 1954. The test was performed by the Allis-Chalmers-McKee staff and data were obtained and reported by The Cleveland-Cliffs Iron Company's staff. A report on this test was issued by the Allis-Chalmers Company to The Cleveland-Cliffs Iron Company on June 2nd, 1954.

DESIGN OF 2000 TPD AGGLOMERATION PLANT:

The outcome of the Laboratory tests on agglomeration with a traveling grate by updraft and continuous demonstrations of both methods of agglomeration was the design of a 2000 TPD Agglomeration Plant for Republic using a traveling grate for firing pellets by updraft.

The preliminary design and engineering of the 2000 TPD Plant was awarded to the Swindell-Dressler Corporation in 1953 and completed in early 1954.

Competitive bids were submitted by various organizations on the construction of the 2000 TPD Agglomeration Plant in Eagle Mills and construction contracts were let to the McDowell Company of Cleveland, Ohio.

STANDARDIZED LABORATORY TESTS FOR GREEN, DRY AND FIRED PELLETS:

Laboratory tests were continued to determine the merit of specific additives for green pellets by testing according to standardized procedures. The effect of limestone, bentonite, and soft ore slimes have been evaluated and reported in Research Laboratory's Metallurgical Report No. 110.

BALLING DISC STUDIES:

During the past year, the Research Laboratory has undertaken the study of the inclined rotary disc, commonly referred to as the balling disc, to determine its utility for balling iron ore concentrates and specifically as applied to flotation concentrates.

This phase has been the subject of intermittent research since February, 1954. A considerable number of tests have been conducted on the 3' x 1/2' and the 4-1/2' x 3/4' balling discs.

MAGNETIC OXIDE CONVERSION - CONCENTRATION:

Most of the important areas of the Marquette Range, where outcropping of the iron formations occur, have been sampled and standard magnetic tube tests and flotation tests have been conducted on these samples. A considerable number of the areas did not respond favorably to concentration by either of the aforementioned processes.

During 1953, samples from Cedar Lake, Saginaw, North Jackson, South Jackson, Fitch, and Foster Areas were subjected to standard magnetic oxide conversion-concentration tests to determine their concentratability by this method. During 1954, samples from Old Richmond, Moore, Isabella, Ogden Pit, Teal Lake, Bellevue, and Republic Areas were subjected to magnetic oxide conversion to determine their concentratability. The results of these tests have all been reported in Laboratory reports.

SERVICE PROJECTS:

Sinter Studies:

Surveys were conducted on the sintering characteristics of the Marquette Range ores with particular emphasis on the Cliffs Group Ores.

Laboratory sinter equipment was fabricated and investigations undertaken on determining the sintering characteristics of admixtures of Humboldt concentrates and Cliffs Group Ores with varying amounts of sinter returns, fuel additives, and additives such as bentonite and limestone.

Laboratory sinter equipment was also utilized in investigating the sintering operation as a means of desulfurizing the "Special Grade" ore from the Mather Mine "B" Shaft. The tests concluded that by simulating continuous conditions, the "Special Grade" ore can be sintered with approximately 95% of the sulfur eliminated when using sinter feed crushed to minus 1/4". Detailed results are included in Research Laboratory's Metallurgical Report No. 114.

INHIBITING DUST FORMATION OF CONCENTRATES ON HUMBOLDT STOCKPILE:

A brief study was conducted on ways and means by which the dusting of Humboldt concentrates on stockpile could be inhibited. Laboratory and field tests were conducted using inhibitors such as bentonite, detergents, and oils.

PART III

RESEARCH & DEVELOPMENT WORK AND FLOTATION PROJECTS

Empire Area Projects:

The Empire Area testing program was continued throughout the Year 1954. Drill core material from Diamond Drill Holes 1 and 2, located in the S.W. 1/4, Section 19, T47N-R26W, was completed in 1953. Testing of drill core from Diamond Drill Holes 3 through 17, Section 19, T47N-R26W was completed in 1954. Research Laboratory's Progress Report Nos. 108, 116, 126, 135, and 140 detail the results of metallurgical testing on drill core from Diamond Drill Holes 3 through 17.

The drill core material received was composited at suitable intervals and subjected to grinding followed by magnetic separation with the Laboratory tube tester. Flotation was eliminated as a means of concentration on the basis of previous work.

On the basis of the results of the drill holes tested through 1954, the Geological and Metallurgical Departments have classified the drill core material into classes of metallurgical ore. Class I material is that which predominantly produces weight recoveries of over 40%; Class II represents that material which predominantly produces weight recoveries from 30%-40%, and Class III represents that material which predominantly produces weight recoveries of less than 30%.

A brief summary of test results is presented as follows:

Summary of Test Results
Empire Area

D.D.H. Nos.	Total Footage	% Minus 400 M.	Head % Fe	Magnetic Concentrate % Wt.	Magnetic Concentrate % Fe	Magnetic Concentrate % SiO_2	Magnetic Concentrate % Fe Rec.	Tails % Fe
			Class I					
1,2,4,8,9,11, 14,15,17	4265	92.3	34.65	42.46	64.14	9.43	78.60	12.90
			Class II					
5,6,7,10,16	2007	89.0	33.78	37.97	63.62	9.30	71.51	15.51
			Class I & II					
1,2,4,5,6,7, 8,9,10,11, 14,15,16,17	6272	91.3	34.37	41.02	63.98	9.39	76.36	13.78
			Class III					
3,12,13	917	92.7	34.37	21.66	63.70	9.64	40.14	26.26
			Total for All Holes					
	7189	91.4	34.37	38.55	63.96	9.41	71.74	15.80

Presented below is a summary of test results for each drill hole.

Summary of Metallurgical Test Results
of Empire Diamond Drill Holes

D.D.H. No.	Footage Included	Total of Footage Included	% Minus 400 M.	Head % Fe	Magnetic Concentrate % Wt.	% Fe	% SiO_2	% Fe Rec.	% Mag. Fe	Tails % Fe
				Predominantly Class I Material						
1	3-596	593	92.6	33.80	44.35	65.30	8.28	85.68	28.96	8.70
2	8-600	592	90.9	35.50	46.00	64.50	9.78	83.58	29.67	10.80
4	16-640	624	89.1	35.40	44.40	63.70	10.36	79.90	28.28	12.80
8*	6-240	234	93.9	34.51	41.99	63.99	9.17	77.87	26.87	13.17
9*	20-515	495	94.4	34.90	41.99	64.10	9.01	77.12	26.92	13.76
11	30-581	551	91.0	35.20	39.44	63.30	8.74	70.93	24.97	16.90
14	0-673	673	96.8	33.30	42.70	64.30	10.04	82.45	27.46	10.20
15	14-150	136	88.2	34.60	39.30	64.10	9.34	72.81	25.19	15.50
17*	18-385	367	91.4	34.77	36.54	63.22	9.77	66.44	23.10	18.39
				Predominantly Class II Material						
5*	16- 95	79	96.6	33.27	31.82	64.62	8.42	61.80	20.56	18.64
6	27-500	473	82.5	34.40	37.33	61.60	10.14	66.85	23.00	18.20
7*	50-450	400	87.3	34.48	34.03	63.22	9.53	62.39	21.51	19.66
10	14-563	549	92.5	33.60	41.39	64.90	8.68	79.95	26.86	11.50
16*	19-525	506	91.3	32.91	38.92	64.12	9.21	75.83	24.96	13.02
				Predominantly Class III Material						
3	68-345	277	90.4	31.70	33.05	63.50	10.76	66.21	20.99	16.00
12*	18-479	461	-	35.11	15.95	63.86	8.69	29.01	10.18	29.66
13	14-193	179	96.2	36.60	18.75	63.90	8.68	32.73	11.98	30.30

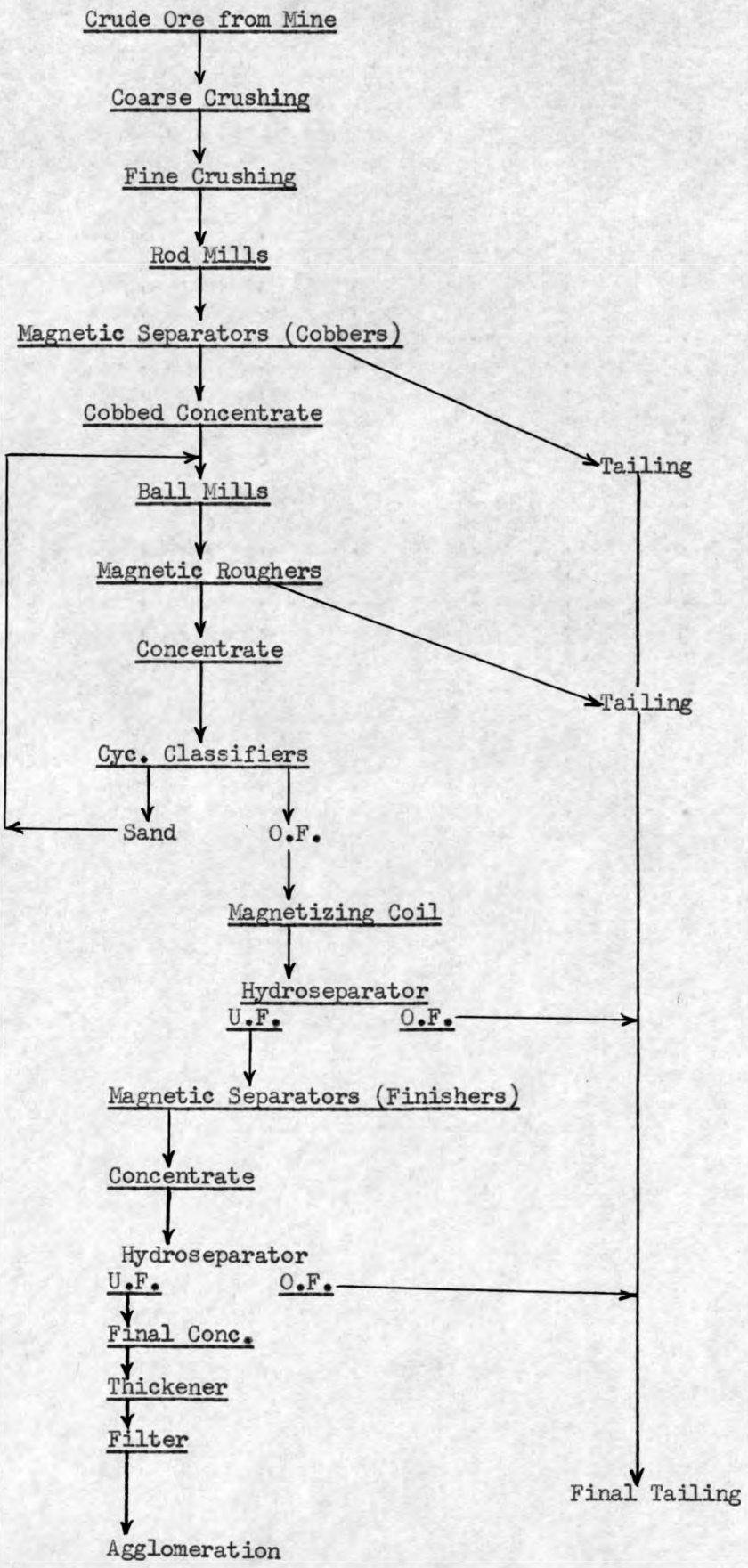
* Calculated Results.

Estimates on reserve tonnages of magnetite concentrates from the Empire Project were made in July, 1954. That estimate was made as a result of drilling and metallurgical test work of that date.

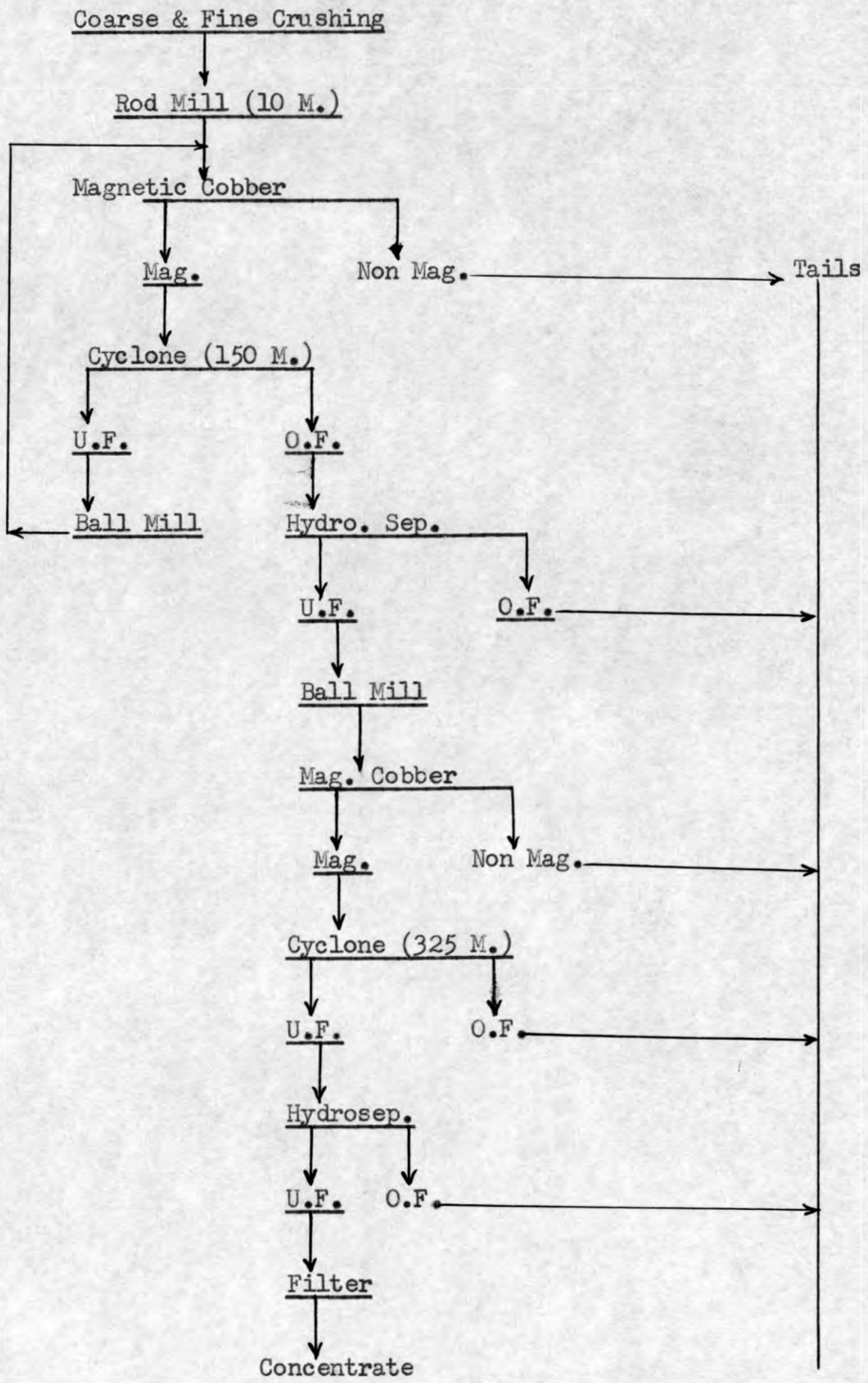
The estimate indicated a reserve of 55,000,000 tons of concentrate available from the Empire Area. Subsequent drilling from July, 1954 to December, 1954 further substantiated this reserve tonnage.

The following are typical flowsheets which could be utilized in the concentration of Empire material.

Preliminary Flowsheet for Empire Ore
(Similar to existing Installations on Magnetic Taconites)



Flowsheet Currently Being Considered for
Empire Magnetic Concentration



Phosphorous Depression Tests, Humboldt Mill:

A method of depressing phosphorous while floating hematite was tested at the Humboldt Mill. The process depends upon the addition of sodium fluoride before reagentizing with fatty acid and subsequently maintaining a pH of 4.5-6.0 at all stages of flotation. The following table summarizes the data from 8 hour tests performed at the Humboldt Mill.

		Concentrate						Reagent Cost/ton	
Test	F.F. % Fe	% Wt.*	% Fe	% P.	% Fe Rec.*	% P. Rec.*	Tail % Fe	Crude	Conc.**
		Group A - Average of Tests 1 to 11, Omitting No. 3							
Phos. D.	35.56	47.74	62.86	.0470	84.09	49.26	10.62	$ .3325	$ .7624
Control	35.63	48.70	61.75	.0853	84.34	80.20	10.72	.1576	.3529
Difference				Minus	0.25 (Iron Units)			Plus	$ .4095
		Group B - Average of Tests 1 to 11, Omitting 3,4,8							
Phos. D.	35.18	46.31	63.21	.0424	83.13	45.31	10.99	$ .3368	$ .7682
Control	34.98	47.07	61.93	.0820	83.47	79.07	10.87	.1491	.3441
Difference				Minus	0.34 (Iron Units)			Plus	$ .4241
		Group C - Average of Tests 2,6,7,10,11							
Phos. D.	35.87	45.87	63.85	.0346	81.45	37.12	12.13	$ .3339	$ .7912
Control	35.62	46.57	62.48	.0808	81.98	77.27	11.83	.1404	.3289
Difference				Minus	0.53 (Iron Units)			Plus	$ .4623

* Calculated from flotation feed.
** Figures corrected for 7½% Slime Loss

Since it is only desired to reduce the phosphorous to .045%, the differential cost can be lowered to below 30¢ per ton of concentrates by blending in selected regular production with concentrates produced by the above method. Further reductions in cost might be made by prudent selection of the ores to be proceeded by this method.

On the basis of some incomplete test work it appears possible to reduce cost still further by setting up a split flotation circuit, and only processing a certain fraction for phosphorous depression.

Flotation Study Project:

Fatty Acids:

The study of fatty acid reagents, especially as applied to Republic and Humboldt, was continued in 1954. Of the reagents tested, Armour's Neo fats received considerable attention because of the low titer. Various blends of the Neo fats and red oils containing almost none of the saturated fatty acids were tested to determine the best combination of reagents for the process.

Phosphorous Depression:

Laboratory flotation studies were conducted for the specific purpose of determining the disposition and nature of the phosphorous mineral and ways and means by which the phosphorous content of the concentrates could be reduced. The studies dealt with phosphorous depression by using as reagents the various fatty acids, sodium fluoride, fuel oil, sulfuric acid and various frothers.

Service Projects:

Grindability Tests:

During the course of the year, grindability tests were conducted on various samples and data was obtained. This data gives an indication of the relative ease with which certain ores grind as compared to others. This data is presently being accumulated and tabulated to project into power figures for the various ores.

Humboldt Control Tests:

Samples have intermittently been submitted by the Humboldt Mill for controlled testing. The samples have been obtained from various sections of the pit or from the mill circuit. Control tests were conducted as requested with results submitted to the Humboldt Mill.

Sub-sieve size analyses have also been made at intervals by the Bouyoucos method. These determinations are submitted to the Humboldt Mill as completed.

Settling Tests:

During the year, an investigation was conducted to determine how the settling rates of tailings and slime pulps were affected by the addition of various flocculating agents. Simple comparison tests were conducted in an effort to discover which reagent or reagents were most efficient and economical. Testing of new flocculating agents is being continued and a progress report on the first phase of the program will be issued when all results have been tabulated.

PART IV

MICROSCOPY SECTION

This section of the Annual Report covers the work completed in the Microscopy Section of the Research Laboratory during the Year 1954. The work involved all phases of preparation, study, and fact recording of drill cores, samples, and rock specimens from The Cleveland-Cliffs Iron Company's exploration areas.

This section of the Report covers only that work which was conducted for the Metallurgical Department. As the microscopist's time is divided with the Metallurgical and Geological Departments, the remainder of the work conducted in the Microscopy Section will be included in the Geological Department's Annual Report.

MARQUETTE RANGE PROJECTS:

Humboldt Project:

Samples are submitted intermittently by the Humboldt Mine for mineralogic examination and mineral texture studies. The samples may vary from pit samples to mill products and the primary objective of each study is to determine the mineralogy and texture and its effect on the concentratability of the particular sample. In addition, a special study was conducted on the phosphorous occurrence in the crude and milled ore. The study revealed that the apatite, a phosphorous mineral, is associated with the ore minerals rather than the chert and the apatite generally concentrates in minus 200 mesh sizes milled products.

Development Projects:

An intensive microscopic study was accomplished on drill core specimens from the Empire, Cascade, Tilden and Foster Areas. The study involved the mineralogy, mineral relation, and ore size liberation. A special study was also conducted on Empire drill core material in regard to the mineralogy and petrology and its relation to ore treatment. The investigation revealed that the mineralogic composition, mineral texture, and lithological characteristics governed the liberation of the magnetite.

LAND OFFERS AND OUTSIDE EXPLORATIONS:

Microscopic examinations were conducted on samples received under Land Offers 3060, 3120, 3121, 3130, 3137, 3135, and Outside Exploration 1131. The examinations were primarily conducted to determine the mineralogical characteristics and its effect on concentration of these samples.

MISCELLANEOUS:

Microscopic examinations were also conducted on samples of magnetite concentrates from the Mesabi Range and the crystalline hematite from Benson Mine, New York. A brief study was also conducted on the tailings produced by the Ohio Mine to determine microscopically the ferrosilicon loss.

PART V

CHECK SAMPLING PROGRAM

Moisture tests were conducted at the Cliffs Shaft Mine sample preparation building in May, 1954. The tests were conducted in an effort to standardize the drying time at controlled temperatures of some of the grades of soft ores being used in Cliffs Group Ore.

A visit was made to the Monessen Works of the Pittsburgh Steel Company at the request of the Ore Sales Department. The nature of the visit was in response to a complaint regarding the low iron and high silica analyses obtained from a sample collected from 17 R.R. cars of Cliffs Shaft lump ore.

A few inspections were made at the L.S.&I. Marquette Yard for the purpose of culling out wet ore loads during the 1954 Season at the request of the Shipping Department.

A change in sampling procedures was introduced at the Tilden Pit Mine as a result of short-term sampling study in August, 1954. The reason for the changes was an effort to affect a closer correlation between mine analyses and moisture determinations with those of the Lower Lakes Chemists.

A number of ore cargoes consigned to the Steelton Works of the Bethlehem Steel Corporation were inspected at the L.S.&I. Marquette Dock for debris and large lumps.

A short-term sampling study was conducted at the Cambria-Jackson Mine in September, 1954. The study was conducted primarily to establish a better correlation between the chute samples and general level composite samples.

A Lloyd Mine Sampling Study was begun in July, 1953 and terminated in April, 1954 to determine the correlation between the underground versus surface sampling. The study was presented in two parts.

In December, 1954 a series of samples were collected from the three Lloyd Mine Silica Ore Stockpiles for the purpose of structure tests.

Ore samples from pocket and stockpile shipments were collected during the 1954 Season for structure tests.

A number of ore samples were collected for the Research Laboratory personnel for special tests during the year.

Six - 3/11/55

ELECTRIC POWER DEPARTMENT
ANNUAL REPORT
YEAR 1954

The Cliffs Power & Light Company disposed of its transmission and distribution facilities and ceased to serve all of its customers except those affiliated with and operated by The Cleveland-Cliffs Iron Company on December 16, 1953. The purchaser of these facilities was the Upper Peninsula Power Company of Houghton, Michigan. Having been relieved of the obligation to furnish electric power and energy to anyone other than The Cleveland-Cliffs Iron Company, The Cliffs Power & Light Company was dissolved on January 29, 1954, and the generating and other facilities for power production which had formerly constituted The Cliffs Power & Light Company became the Electric Power Department of The Cleveland-Cliffs Iron Company. Throughout the year, however, the system which had formerly constituted The Cliffs Power & Light Company continued to operate as an integrated unit and all of the energy which was used by that system was furnished from the plants of The Cleveland-Cliffs Iron Company and from the purchase power sources which had formerly been available to The Cliffs Power & Light Company. Because of this situation, the power and energy producing facilities for the entire system will, in this report, be discussed as a unit and compared directly with the previous year's performance.

Total energy generated and purchased during the year 1954 amounted to 174,829,275 Kwh, which was 1.72% greater than that generated and purchased during the year 1953. Of this amount, 90,923,875 Kwh were generated by the hydro plants, 58,131,000 Kwh by the Steam Plant, 15,842,400 Kwh by the Diesel Plant, and 9,932,000 Kwh were purchased. Precipitation during the year amounted to 33.77", which is approximately normal, and the hydro production of almost 91,000,000 Kwh was higher than would be normally anticipated with the precipitation which occurred. In addition to the amount which was generated from this precipitation, the water in storage at the end of the year 1954 amounted to approximately 24,000,000 Kwh, which was 5,000,000 Kwh more than was in the reservoirs at the beginning of the year. This brings the total hydro production which will ultimately be realized from the precipitation during the calendar year up to approximately 96,000,000 Kwh. Kilowatt hour uses from the system during the year 1954 amounted to 158,155,664 Kwh, which was an increase of 2% above the corresponding figure last year. Of this amount, The Cleveland-Cliffs Iron Company distributed to its users 77,684,159 Kwh or 49%, the remainder going to the Upper Peninsula Power Company for distribution to its customers. The increase in kilowatt hours used was held to the small amount shown due to the fact that The Cleveland-Cliffs Iron Company reduced its production schedule of mining operations in the early part of the summer and this reduction was reflected in the energy uses of the mines.

Construction has gone forward on the Upper Peninsula Generating Company's new Presque Isle Station at Marquette. The original estimates for this station anticipated that it would be completed and placed in commercial operation by January 1, 1956. However, progress of the work and delivery of materials have been such that this completion has been pushed forward until at the present time it seems that the plant will be placed in commercial operation some time during the month of September, 1955. At the end of the year the construction of the building had progressed far enough to completely house all of the indoor construction, erection of some of the auxiliary apparatus had taken place, and delivery of the boiler and turbine was scheduled for the middle of January. The major portion of the work will be conducted inside of the building during the winter months and the availability of this building will mean that construction work can progress with anticipated rapidity, and it is believed that it will be easy to comply with present construction schedules.

Difficulty had been experienced in the Ishpeming Diesel Plant for some time with cracking which occurred in the engine blocks and frames. This cracking had progressed so far on #8 engine that when inspected in January by representatives of the General Motors Corporation, it was decided that it would be necessary for that engine to be repaired before it could be operated extensively. Accordingly, in February a welding specialist and metallurgist were sent to us from the Cleveland plant of the General Motors Corporation. These men worked on the #8 engine and while they were in town also inspected and worked upon several other engines in the plant which were showing difficulties due to cracking. While here also, the metallurgist assisted in the redesign of the foundations and, after they left, our employees proceeded to reinforce the present bedplates upon which the engines were setting and to regrout all of the engines on the west side of the plant. It is felt that this was a very good preventive measure to assist us in avoiding future difficulties with the engine blocks and frames and that the repairs which were made will, with the foundation revisions, avoid future difficulties of this nature.

In years of previous operation, considerable engine shutdown time was caused by the Harrison radiator type oil coolers in the Diesel Plant. There are very small oil passages in this type of cooler and the tendency of these passages to become clogged was so great that it was necessary to shut down the engines and clean them out at short intervals. To avoid this difficulty, a complete set of ten tube type oil coolers was ordered for the Diesel Plant. Installation of these coolers was started in March and was completed in June. It is anticipated that this type of cooler will be practically trouble-free.

On August 26, there was an oil failure in the #10 engine at the Diesel Plant which resulted in failure of all of the bearings, etc. and practically the destruction of all lubricating surfaces. The engine was torn down and completely rebuilt, including the purchase and installation of a new crankshaft for the engine. This engine was not completely repaired and placed back into operation until early in the month of November.

On September 30, there was a failure of the main bearings in #6 engine at the Diesel Plant which destroyed four bearings and scored the crankshaft of that engine badly. Although it is not known exactly what caused this failure, it was fortunately discovered early enough to prevent complete destruction of the engine as occurred in the #10 engine. The engine was taken out of service immediately, but no attempt was made to dismantle it and make extensive investigations until the #10 engine was placed back in service in November.

All of the Diesel engines are provided with a safety trip which is supposed to shut the engine down in case of low oil pressure or failure in the lubricating oil supply. This apparatus is actuated by the closing of an electrical circuit which trips the necessary relays at various points in the engine operating mechanism. If for any reason such as dirty contacts or wires broken due to vibration, etc. the circuit is unable to close, the machine continues to operate in spite of the incorrect lubrication. To correct this situation we have made plans to change this tripping mechanism so that it will be actuated by the opening of an electrical circuit. In other words, at all times when the engine is operating the circuit will be closed, but if lubrication difficulties arise, the low pressure will open the circuit and the engine will be shut down. This is a much more positive method than the one employed at the present time, and we hope that it will avoid such difficulties as were experienced in the #6 and #10 engines.

Difficulties were experienced in the Ishpeming Steam Station with the temporary wall which was installed on the east side of the station. This wall was constructed of Galbestos material which was purchased from the H. H. Robertson Company, and it was found during the summer that the material was cracking badly. This was called to the attention of the company from which the purchase was made and they sent their workmen to Ishpeming and applied an entirely new coating to the entire east wall of the building during the early part of July. It is anticipated that this application of a new coating will correct the difficulties which have been experienced in the past.

On July 17, the Ishpeming Steam Station was shut down in order to permit boiler inspection by both the insurance company and by a representative of the Riley Stoker Corporation. This boiler was inspected by these people on July 18 and was put back into service on July 19. The representative from the Riley Stoker Corporation stayed in Ishpeming until August 6 for the purpose of making tests on the boiler, varying the fly ash disposal and reinjection cycle. The fly ash disposal system was installed during the summer of 1953 and has been successful in helping to eliminate a good many of the difficulties which had been previously experienced in the boiler furnace. The tests which were conducted by the Riley Stoker Corporation were made to obtain information for their Design Department on this type of an installation.

On August 17, there was a rupture of one superheater tube and two steam generator tubes in the boiler in the Ishpeming Steam Station. This necessitated immediate shutdown of the unit which was out of service until August 28, during which time repairs to it were made. The repairs necessitated the services of Mr. T. H. Pentecost of the Riley Stoker Corporation in Chicago and a certified welder for the Riley Stoker Corporation who came from Paducah, Kentucky. The report on the failure was made to the American Motorists Insurance Company who later informed us that they accepted the failure as being an accident occurring to the boiler and would assume such liability therefor as was called for under their insurance policy with us. No settlement had been made by the end of the year, but it is anticipated that a discussion of this matter will be held early in 1955. At the time that the boiler was shut down, opportunity was taken to reinforce other places in the boiler which would be subject to the same type of failure, and it was also discovered that there had been numerous failures of air preheater tubes which were unnoticed in the former shutdown and inspection. All of these tubes were replaced during the shutdown.

Intrusion-Prepakt began work on the Carp pipeline on June 6 and proceeded as rapidly as possible with the repair of that pipeline in an effort to get all of the leaks stopped and the repairs completed during the summer. This was completed during the month of July and the construction gang that had been doing that work was moved from there to the Hoist Plant to repair deteriorated concrete on the discharge side of the plant near the water line. The crew was then moved to the AuTrain Plant to remove a wall supporting the pipeline under the L.S.& I. bridge and install new supports for that pipeline. All of this work was completed in the early part of September, and it is not anticipated that it will be necessary to use this company in the coming year.

In September, 1953, the necessary switchboard equipment to convert the #2 and #3 hydroelectric generators at the Hoist Plant to automatic operation was ordered from Westinghouse Electric Corporation. This equipment was scheduled to arrive early in the summer of 1954, but delivery was somewhat delayed. However, delivery was made during the fall of 1954 and work was started immediately

to convert the plant from manual operation, as it has been up until the present time, to automatic control. Installation of the equipment was completed in the early part of December and the plant was operated on a trial basis until the first of the year, at which time it was placed on an automatic operating schedule. There were originally at this plant a Chief Operator and four shift operators. One of the shift operators was transferred to the McClure Plant to replace an operator who was brought to the Ishpeming Steam Station and two of the other shift operators were brought into the Ishpeming Steam Station which permitted the reduction of forces in the Hoist Plant by three men. It is anticipated that this operation will be as satisfactory in the future as has that of our other automatic plants and that a similar change to automatic equipment in the McClure Plant can be made, possibly in the year 1956.

At the time the retroactive wage settlement was made in the fall of 1952, there was a grievance filed on the manner in which the Company calculated the amounts of these payments. This grievance was carried to arbitration and a decision was rendered against the Company. The checks covering the re-calculation of this pay were mailed to employees on February 9, the total amount of the payments being approximately $2,000.00.

In May an agreement was signed by the Electric Power Department of The Cleveland-Cliffs Iron Company with the United Steelworkers of America, retroactive to January 29, under which the Company and the Union agreed that all the terms and conditions of the labor agreement and pension and insurance agreement in effect at the time of the dissolution of The Cliffs Power & Light Company would be assumed by the Electric Power Department of the Company. The labor agreement thus adopted expired October 14, 1954, and several meetings were held with the Union to discuss the terms of the new agreement. The final meeting was held on October 14, at which time it was agreed that a new contract would be signed between the Union and the Electric Power Department, and all of the features of this new agreement were agreed upon with the exception that certain sections were dependent upon an agreement which would be reached at a later time between the Mining Department of the Company and the Union. At the end of the year the final agreement on the details of this latter contract had not been reached and for that reason the contract with the Electric Power Department was being held in abeyance. As soon as the contract for the Mining Department is completed, the contract with the Electric Power Department will be signed. The granting of the pay increase equivalent to that which was given by the Mining Department to its employees on July 1, 1954, was contingent on the signing of the satisfactory agreement with the Electric Power Department. Since this agreement had not been signed up to the first of the year, the retroactive pay has been accumulated since July 1 and will be payable whenever the final agreement is executed.

ELECTRIC POWER DEPARTMENT

STATISTICAL DATA - 1954

	McClure	Hoist	Carp	AuTrain	Republic	Escanaba	Total Hydro	Steam	Diesel	Total Generated
Jan.	4,074,000	1,454,000	1,171,000	226,600	137,500	252,000	7,315,100	4,841,000	889,900	13,046,000
Feb.	4 504 000	1 570 000	938 000	312 000	74 800	227 000	7 625 800	4 456 000	447 000	12 528 800
Mar.	4 425 000	1 454 000	800 000	485 800	88 500	260 000	7 513 300	5 113 000	1 296 000	13 922 300
Apr.	3 119 000	960 000	1 867 000	714 700	216 700	648 000	7 525 400	4 245 000	1 020 900	12 791 300
May	3 383 000	1 203 000	1 680 000	809 900	331 600	1 035 000	8 442 500	5 292 000	1 376 800	15 111 300
June	3 092 000	1 104 000	1 496 000	588 600	379 300	652 000	7 311 900	5 396 000	1 009 600	13 717 500
July	3 455 000	1 272 000	906 000	467 400	210 100	517 000	6 827 500	4 776 000	1 598 900	13 202 400
Aug.	4 010 000	1 516 000	1 126 000	259 800	99 000	344 000	7 354 800	4 733 000	1 237 600	13 325 400
Sept.	4 024 000	1 469 000	1 733 000	136 000	72 700	314 000	7 748 700	3 565 000	1 973 900	13 287 600
Oct.	3 574 000	1 348 000	2 084 000	104 800	243 600	750 000	8 104 400	4 975 000	1 870 300	14 949 700
Nov.	3 508 000	1 274 000	1 714 000	337 800	316 300	633 000	7 783 100	5 194 000	1 585 500	14 562 600
Dec.	3 518 000	1 337 875	1 396 000	499 300	209 200	411 000	7 371 375	5 545 000	1 536 000	14 452 375
	44,686,000	15,961,875	16,911,000	4,942,700	2,379,300	6,043,000	90,923,875	58,131,000	15,842,400	164,897,275

ELECTRIC POWER DEPARTMENT

STATISTICAL DATA - 1954

	Total Generated	Purchased	Total Gen. and Purch.	Station Use	Net Energy For Load	Used by C.C.I. and U.P. Power	Losses - Jointly Used System
Jan.	13,046,000	432,000	13,478,000	404,420	13,073,580	11,298,799	1,774,781
Feb.	12 528 800	750 000	13 278 800	379 980	12 898 820	12 494 095	404 725
Mar.	13 922 300	661 000	14 583 300	427 909	14 155 391	13 221 683	933 708
Apr.	12 791 300	643 000	13 434 300	394 500	13 039 800	12 218 769	821 031
May	15 111 300	850 000	15 961 300	413 920	15 547 380	14 650 556	896 824
June	13 717 500	821 000	14 538 500	407 670	14 130 830	13 272 016	858 814
July	13 202 400	802 000	14 004 400	361 297	13 643 103	12 796 430	846 673
Aug.	13 325 400	1 680 000	15 005 400	375 327	14 630 073	13 554 533	1 075 540
Sept.	13 287 600	1 094 000	14 381 600	292 806	14 088 794	13 994 561	94 233
Oct.	14 949 700	824 000	15 773 700	399 345	15 374 355	14 724 928	649 427
Nov.	14 562 600	759 000	15 321 600	396 880	14 924 720	14 376 006	548 714
Dec.	14 452 375	616 000	15 068 375	417 595	14 650 780	14 212 658	438 122
	164,897,275	9,932,000	174,829,275	4,671,649	170,157,626	160,815,034	9,342,592

ELECTRIC POWER DEPARTMENT
ANNUAL REPORT
YEAR 1954

STATISTICAL DATA - 1954

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Precipitation -	1.23	0.89	2.38	4.00	3.73	3.43	1.80	2.34	6.46	4.01	2.50	1.00

Total precipitation at Ishpeming during 1954 - 33.77" (2.814 ft.)
Average " " Marquette - 32.80" (46 year record)

CARP RIVER PLANT:

Drainage area above intake dam	66.66 sq. miles
Cubic feet precipitation in 1954	5,229,465,000
Kilowatt hours generated in 1954	16 911 000
Cubic feet water utilized in 1954 (90 cu. ft. - 1 Kwh)	1 521 990 000
" " " wasted over intake dam in 1954	87 336 000
" " " in Carp storage Dec. 23, 1953	224 160 000
" " " " " " Dec. 20, 1954	389 076 950
" " " added to Carp storage in 1954	164 916 950
Total run-off in 1954 (cubic feet)	1 774 242 950
Run-off per sq. mile of drainage area (cubic feet)	26 616 305
Second-feet run-off	0.843

	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Total Precip.	30.11	26.53	38.40	36.83	25.46	31.05	29.50	27.40	30.38	33.67	21.90	22.95	20.71
Sec.-ft. Run-off	1.03	0.67	0.93	1.29	0.70	0.79	0.83	0.73	0.68	1.06	0.59	0.50	0.25

	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Total Precip.	35.69	29.86	36.06	32.28	23.14	36.70	31.20	32.72	32.87	27.10	30.23	30.10	35.32
Sec.-ft. Run-off	0.85	0.98	1.11	0.67	1.10	0.83	1.13	1.14	1.00	0.79	0.89	0.86	1.33

	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951
Total Precip.	33.58	30.34	32.20	34.26	32.04	32.77	30.81	26.12	32.88	22.87	37.23	30.64	43.50
Sec.-ft. Run-off	1.47	1.05	0.83	0.84	1.17	0.70	0.81	0.56	0.88	0.44	0.77	1.09	1.54

	1952	1953	1954
Total Precip.	24.35	35.42	33.77
Sec.-ft. Run-off	0.69	0.85	0.84

McCLURE PLANT:

Drainage area above intake dam	140.52 sq. miles
Cubic feet precipitation in 1954 (Hoist Plant - 38.13"-3.17')	12,449,728,457
Kilowatt hours generated in 1954	44 686 000
Cubic feet water utilized in 1954 (125 cu. ft. - 1 Kwh)	5 371 625 000
" " " wasted over intake dam in 1954	0
" " " in Hoist storage basin Dec. 23, 1953	1 587 952 000
" " " " " " " Dec. 20, 1954	1 962 348 484
" " " increase in 1954	374 396 484
" " " in Silver Lake Dec. 23, 1953	0
" " " " " " Dec. 20, 1954	0
" " " taken from Silver Lake in 1954	0
Total run-off in 1954 (cubic feet)	5 746 021 484
Run-off per sq. mile of drainage area (cubic feet)	40 891 129
Second-feet run-off	1.297

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Total Precip.	35.10	42.03	26.60	30.49	24.06	43.95	35.51	43.80	38.75	30.81	37.02	32.54	35.07
Sec.-ft. Run-off	1.02	1.54	0.85	0.92	0.52	1.52	1.80	2.22	1.36	1.45	1.10	1.23	1.30

	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946
Total Precip.	35.02	29.96	32.16	38.18	40.93	41.22	36.59	38.15	40.20	35.64	37.62	37.94	31.91
Sec.-ft. Run-off	1.16	0.90	1.05	1.19	1.75	1.69	1.47	1.28	1.15	1.43	1.17	1.36	0.86

	1947	1948	1949	1950	1951	1952	1953	1954
Total Precip.	37.27	28.81	43.28	40.65	50.90	29.27	41.56	38.13
Sec.-ft. Run-off	1.22	0.78	1.24	1.37	2.09	0.97	1.33	1.29

PRECIPITATION BY YEARS