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	* 214,191	136,589		2		125	125	14.64	915
BUNKER HILL	460,958	625,540		21		702	702	33.57	1,122
CAMBRIA-JACKSON	234,000	289,622		1		100	100	3.45	345
CLIFFS SHAFT	551,310	911,668		24		3,859	3,859	26.33	4,233
LLOYD	125,810	188,395		2		117	117	10.62	621
MAAS	376,774	491,600		8		452	452	16.27	919
MATHER MINE, "A" SHAFT	1,045,409	1,030,395	2	21	12,000	727	12,727	22.32	12,352
MATHER MINE, "B" SHAFT	1,233,222	967,696	1	23	6,000	564	6,564	24.80	6,783
SPIES-VIRGIL	79,361	88,366						0.00	0
TOTALS	4,321,035	4,729,871	3	102	18,000	6,646	24,646	22.20	5,211
CANISTEO	1,015,337	277,771		4		154	154	14.40	554
HAWKINS	** 971,843	284,891						0.00	0
HILL-TRUMBULL	648,110	270,724		2		41	41	7.39	151
HOLMAN CLIFFS	1,105,062	256,467		4		213	213	15.60	831
HUMBOLDT	214,532	177,841		3		60	60	16.87	337
OHIO	120,277	70,605						0.00	0
REPUBLIC		34,686						0.00	0
SARGENT	*** 74,092	31,860	1	1	6,000	38	6,038	62.77	189,517
TILDEN	119,008	14,079		1		12	12	71.03	852
TOTALS	4,268,261	1,418,924	1	15	6,000	518	6,518	11.28	4,594
ELEC. POWER DIVISION		82,494						0.00	0
GENERAL ROLL		528,081						0.00	0
MISCELLANEOUS		53,248						0.00	0
MISC. - HIBBING		41,398		1		19	19	24.16	459
STHSE. & SHOPS		312,080		3		209	209	9.61	670
TOTALS		1,017,301	0	4	0	228	228	3.93	224
GRAND TOTALS	8,589,296	7,166,096	4	121	24,000	7,392	31,392	17.44	4,381

* AGNEW production includes 45,034 tons from the Alworth.
** HAWKINS production includes 92,065 tons from MacKillican and 56,954 tons from I.H. Co. fine ore pile.
*** SARGENT production includes 3,317 tons of Line Ore (By Contract).

THE CLEVELAND-CLIFFS IRON COMPANY

SAFETY DEPARTMENT, ACCIDENT STATISTICS, JAN. 1ST, 1955 - JAN. 1ST, 1956

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 Injuries Including Fatalities	Days Lost, All Injuries & Fatalities	Frequency	Severity	Avg. Days Lost Per Injury	
CAMBRIA-JACKSON	1	289,622		1	4	100	14	5	114	17.26	394	23	Underground
LLOYD	2	188,395		2	3	117	6	5	123	26.54	653	25	
AGNEW	3	136,589		2	1	125	2	3	127	21.96	930	42	
MAAS	4	491,600		8	3	452	7	11	459	22.38	934	42	
BUNKER HILL	5	625,540		21	8	702	24	29	726	46.36	1,161	25	
CLIFFS SHAFT	6	911,668		24	13	3,859	36	37	3,895	40.58	4,272	105	
MATHER MINE, "B" SHAFT	7	967,696	1	24	19	6,564	46	43	6,610	44.44	6,831	154	
MATHER MINE, "A" SHAFT	8	1,030,395	2	23	18	12,727	42	41	12,769	39.79	12,392	311	
SPIES-VIRGIL	-	88,366			1		3	1	3	11.32	34	3	
TOTALS		4,729,871	3	105	70	24,646	180	175	24,826	37.00	5,249	142	
OHIO	1	70,605								0.00	000	0	Open-Pit
REPUBLIC	2	34,686								0.00	000	0	
HAWKINS	3	284,891			2		5	2	5	7.02	18	2	
HILL-TRUMBULL	4	270,724		2		41		2	41	7.39	151	20	
HUMBOLDT	5	177,841		3	2	60	7	5	67	28.11	377	13	
CANISTEO	6	277,771		4	2	154	5	6	159	21.60	572	26	
HOLMAN CLIFFS	7	256,467		4		213		4	213	15.60	831	53	
TILDEN	8	14,079		1		12		1	12	71.03	852	12	
SARGENT	9	31,860	1	2	2	6,038	7	4	6,045	125.55	189,736	1,511	
TOTALS		1,418,924	1	16	8	6,518	24	24	6,542	16.91	4,611	273	
GENERAL ROLL	1	528,081								0.00	000	0	Independent Unit
ELEC. POWER DIVISION	2	82,494								0.00	000	0	
MISCELLANEOUS	3	53,248			1		3	1	3	18.78	56	3	
MISCELLANEOUS-HIBBING	4	41,398		1		19		1	19	24.16	459	19	
STHSE. & SHOPS	5	312,080		3	2	209	11	5	220	16.02	705	44	
TOTALS		1,017,301		4	3	228	14	7	242	6.88	238	35	
GRAND TOTALS		7,166,096	4	125	81	31,392	218	206	31,610	28.75	4,411	153	

FREQUENCY - $\frac{\text{NO. OF LOST TIME ACC. X 1,000,000}}{\text{MAN HOURS WORKED}}$

SEVERITY - $\frac{\text{NO. OF DAYS LOST X 1,000,000}}{\text{MAN HOURS WORKED}}$

THE CLEVELAND-CLIFFS IRON COMPANY

SAFETY DEPARTMENT, ACCIDENT STATISTICS, JAN. 1ST, 1955 - JAN. 1ST, 1956

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 Injuries Including Fatalities	Days Lost, All Injuries & Fatalities	Frequency	Severity	Avg. Days Lost Per Injury
MARQUETTE RANGE:												
GENERAL ROLL	1	528,081								0.00	000	0
ELEC. POWER DIVISION	2	82,494								0.00	000	0
OHIO	3	70,605								0.00	000	0
REPUBLIC	4	34,686								0.00	000	0
MISCELLANEOUS	5	53,248			1		3	1	3	18.78	56	3
HUMBOLDT	6	177,841		3	2	60	7	5	67	28.11	377	13
CAMBRIA-JACKSON	7	289,622		1	4	100	14	5	114	17.26	394	23
LLOYD	8	188,395		2	3	117	6	5	123	26.54	653	25
STHSE. & SHOPS	9	312,080		3	2	209	11	5	220	16.02	705	44
TILDEN	10	14,079		1		12		1	12	71.03	852	12
MAAS	11	491,600		8	3	452	7	11	459	22.38	934	42
BUNKER HILL	12	625,540		21	8	702	24	29	726	46.36	1,161	25
CLIFFS SHAFT	13	911,668		24	13	3,859	36	37	3,895	40.58	4,272	105
MATHER MINE, "B" SHAFT	14	967,696	1	24	19	6,564	46	43	6,610	44.44	6,831	154
MATHER MINE, "A" SHAFT	15	1,030,395	2	23	18	12,727	42	41	12,769	39.79	12,392	311
TOTALS		5,778,030	3	110	73	24,802	196	183	24,998	31.67	4,326	137
MENOMINEE RANGE:												
SPIES-VIRGIL		88,366			1		3	1	3	11.32	34	3
GRAND TOTALS (MICH.)		5,866,396	3	110	74	24,802	199	184	25,001	31.36	4,262	136

FREQUENCY - $\frac{\text{NO. OF LOST TIME ACC. X 1,000,000}}{\text{MAN HOURS WORKED}}$

SEVERITY - $\frac{\text{NO. OF DAYS LOST X 1,000,000}}{\text{MAN HOURS WORKED}}$

THE CLEVELAND-CLIFFS IRON COMPANY

SAFETY DEPARTMENT, ACCIDENT STATISTICS, JAN. 1ST, 1955 - JAN. 1ST, 1956

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 Injuries Including Fatalities	Days Lost, All Injuries & Fatalities	Frequency	Severity	Avg. Days Lost Per Injury
HAWKINS	1	284,891			2		5	2	5	7.02	18	2
HILL-TRUMBULL	2	270,724		2		41		2	41	7.39	151	20
MISCELLANEOUS-HIBBING	3	41,398		1		19		1	19	24.16	459	19
CANISTEO	4	277,771		4	2	154	5	6	159	21.60	572	26
HOLMAN CLIFFS	5	256,467		4		213		4	213	15.60	831	53
AGNEW	6	136,589		2	1	125	2	3	127	21.96	930	42
SARGENT (OPEN-PIT)	7	31,860	1	2	2	6,038	7	4	6,045	125.55	189,736	1,511
TOTALS		1,299,700	1	15	7	6,590	19	22	6,609	16.93	5,085	300
MESABA RANGE:		1,299,700	1	15	7	6,590	19	22	6,609	16.93	5,085	300
MENOMINEE RANGE:		88,366			1		3	1	3	11.32	34	3
MARQUETTE RANGE:		5,778,030	3	110	73	24,802	196	183	24,998	31.67	4,326	137
ALL CO. PROPERTIES:		7,166,096	4	125	81	31,392	218	206	31,610	28.75	4,411	153

FREQUENCY - $\frac{\text{NO. OF LOST TIME ACC. X 1,000,000}}{\text{MAN HOURS WORKED}}$

SEVERITY - $\frac{\text{NO. OF DAYS LOST X 1,000,000}}{\text{MAN HOURS WORKED}}$

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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	32	FIRST HALF OF DAY SHIFT
12:00 NOON TO 4:00 P.M.	25	SECOND HALF OF DAY SHIFT
4:00 P.M. TO 8:00 P.M.	25	FIRST HALF OF AFTERNOON SHIFT
8:00 P.M. TO 12:00 MIDNIGHT	22	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.	14	SECOND HALF OF NIGHT SHIFT
TOTALS	125	

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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	49	Welder	1	Maintenance Mech.	1
Timberman	6	Mechanic	0	Truck Driver	3
Scraper Operator	3	Carpenter	1	Stacker Operator	1
Motorman	4	Toolman	1	Repairman Helper	1
Motor Brakeman	3	Tunnelman	1	Repairman	1
Repairman	3	Cement Mixer Opt.	1	Welder - Std.	1
Skiptender	3	Pocketman	1	Auto Mechanic	1
Welder	1	Stope Scraperman	1	Shovel Oiler	1
Shift Boss	3	Drill Sharpener	1	Drill Operator	2
Shaft Miner	3			Retreat Plant Hlpr.	1
Stope Scraperman	13			Wagon Drill Opt.	1
Car Dumper	1			Bit Grinder	1
Dia. Drill Opt.	1			Mine Foreman	1
Underground Laborer	1				
Undg. Repair Foreman	1				
Picking Feeder Attend.	1				
Dispatcher	1				
TOTALS	97		8		16

TABLE XIII-A

GENERAL STOREHOUSE

Plumber - Std.	1
Warehouseman	1
Carpenter - Std.	1
	3

HIBBING OFFICE

Janitor	1
	1

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection

Regular safety inspections of all operating properties are made at least monthly by members of the Safety Department. Usually, these trips are made with a supervisor and a union representative. A written report is made of all suggestions and recommendations. On completion of the safety inspection, all matters are discussed with the Superintendent or his assistant. The union representative, in most cases, submits a report on his findings also and the original is filed in the Safety Department office.

At each of the larger underground mines a foreman is appointed to safety work and his inspections are made each day. The foremen rotate these jobs every four months with the exception of the Cliffs Shaft Mine where the one man is on the job continuously with the exception of testing machines and drills and some time study work.

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Idle Property

All idle property is checked at least twice each year, usually in the spring and fall when the leaves are off the trees. Besides these two inspections, the more hazardous places are checked by the Safety Department, Police Department and the supervisors at the mines.

Many of the old test pits and shafts have been either filled or capped with concrete. Fences have been kept in good repair but we still find places where people have cut our fences and each winter the snow breaks down some of the wires.

The Spies Shaft was capped before closing and steel rails and timber were placed across the shaft at ledge in case of any caving between ledge and surface. The old Virgil Shaft and the air shaft were also capped. The cave which occurred at the Spies last summer is being checked for any additional subsidence and the fencing around the mining area is in good condition.

Plans for the Lloyd Shaft, air shaft and two other raises to surface have been completed and will be taken care of in the near future.

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Fire Patrol Inspections

We have continued our regular fire inspections, both underground and on surface. Underground our rule still stands calling for fire patrol of all workings at the end of any shift preceeding any idle period and at least once every 24 hours afterward. These patrols also check other conditions which are found and they are reported to the Superintendent or Mine Captain.

On surface, the police and watchmen patrol the properties and are continually on the alert for fires and fire hazards.

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

TABLE XIV

1955

Mine Or Plant	Violations Of Standards	Safety Suggestions	Recommendations	Fire Hazard	Total
BUNKER HILL	51	69	44	1	165
CAMBRIA-JACKSON	7	9	12	3	31
CLIFFS SHAFT	13	87	28	12	140
HUMBOLDT	2	31	18	9	60
LLOYD	4	15	8	0	27
MAAS	25	70	25	3	123
MATHER MINE, "A" SHAFT	13	60	29	9	111
MATHER MINE, "B" SHAFT	13	51	33	7	104
OHIO	2	7	6	2	17
REPUBLIC	1	12	6	6	25
SPIES-VIRGIL	0	0	1	0	1
STHSE. & SHOPS	1	11	11	2	25
TILDEN	1	5	4	4	14
TOTALS	133	427	225	58	843

TABLE XV

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

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Blasting Inspections

In order to promote as much safety as possible in all blasting operations we have a rule which requires each shift-boss to check blasting procedures in each of his mining contracts at least six times a year. If the blasting is under the supervision of a leader, such as in rock development and shaft sinking, this is not required. A blank form is filled out by the shift-boss for each inspection and these forms are sent to the Safety Department for checking. These inspections are of real value because the boss usually has a fine opportunity to instruct in the blasting procedure if the men are making mistakes.

At all of our properties we have had the foreman electrician instruct all supervisors in operation of proper electrical blasting and the hazards involved.

Members of the Safety Department are constantly checking electrical blasting installations. The most common unsafe practice is contact of blasting wire with pipes and steel sets.

The next table gives the number of inspections by mines and the number of violations. The common violation is failure to use "stemming".

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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	66	15
CAMBRIA-JACKSON MINE	65	49
CLIFFS SHAFT	117	32
LLOYD MINE	29	15
MAAS MINE	89	16
MATHER MINE, "A" SHAFT	177	1
MATHER MINE, "B" SHAFT	110	4
SPIES-VIRGIL MINE	67	42
TOTALS	720	174

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Safety
Rules & Regulations

A new set of safety rules for underground employees was completed and turned over to the Legal Department for checking and should be in the hands of the printers in the near future. Foremens' safety rules will be made up some time during 1956. The safety rules for open-pits and concentration plants was sent to the printers late in 1954 and distributed as the pits opened in 1955.

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	0	0
CLIFFS SHAFT MINE	0	1	1
CLIFFS SHAFT LABORATORY	0	0	0
ELECTRIC POWER DIVISION	1	0	1
ENGR. & GEOL. DEPTS.	0	0	0
HUMBOLDT MINE	0	0	0
LLOYD MINE	0	0	0
MAAS MINE	0	0	0
MATHER MINE, "A" SHAFT	0	1	1
MATHER MINE, "B" SHAFT	0	1	1
MISCELLANEOUS	0	0	0
OHIO MINE	0	0	0
REPUBLIC MINE	9	0	9
SPIES-VIRGIL MINE	0	0	0
STHSE. & SHOPS	0	0	0
TILDEN MINE	0	0	0
TOTALS	10	3	13

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Inspection Reports From Mines & Plants

The following inspection reports are made by Mine or Department supervisors or employees appointed by the Superintendent and are checked by the Safety Department:

HOISTING ROPES (Daily)
SKIP & CAGE ROADS (Twice a week)
SAFETY CATCHES ON CAGES (Monthly)
LADDER ROADS (Weekly)
SLACK ROPE ALARM (Monthly)
HOISTING ENGINES (Monthly)
FIRE EXTINGUISHERS (Twice a year)
FIRE EQUIPMENT (Four times a year)
FIRE PREVENTION (Once a year)
BLASTING INSPECTION (Six times a year-each contract)
OLD STOPE INSPECTION (Cliffs Shaft Mine)
FIRE PATROL INSPECTION (Idle periods)

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	Spies-Virgil	Athens	Total
HOISTING ROPES	50	245	229	689	440	230	244	229	99		2,455
SKIP & CAGE ROADS	50	37	138	93	22	12	38	51	19	1	461
LADDER ROADS	51	36	12	94	11	12	38	43	19		316
CAGE SAFETY CATCHES	12	10	8	57	22	9	9	12	5	1	145
SLACK ROPE ALARM		2	8	10	11	9	4	11	6		61
HOIST INSPECTION		12	12	40	36	36	24	24	12		196
FIRE EXTINGUISHER	1	2	2	2	2	2	2	2	2		17
FIRE EQUIPMENT	2	2	2			3	1				10
FIRE PREVENTION	2	21	15	14	1	15	12	9			89
LIMIT SWITCH					11						11
C.O. ALARM						12					12
HOIST ENGINEERS' SPECIAL REPORT	242										242
TOTALS	410	367	426	999	556	340	372	381	162	2	4,015

Mine Or Plant	Fire Extinguishers	Fire Prevention	Fire Equipment	Total
CANISTEO	1	14	2	17
DIAMOND DRILLS	2	-		2
ELEC. POWER DIVISION	16	8		24
GENERAL OFFICE	2	-		2
HAWKINS	1	38	2	41
HIBBING OFFICE	-	1		1
HILL-TRUMBULL	1	17	2	20
HOLMAN CLIFFS	1	22	2	25
HUMBOLDT	2	6		8
MATHER INN	2	-		2
OHIO	2	14		16
RENTED BLDGS.	2	-		2
REPUBLIC	2	1		3
RESEARCH LABORATORY	2	1		3
SARGENT (OPEN-PIT)	1	2	2	5
STHSE., SHOPS & GARAGE	2	1		3
TILDEN	2	1		3
WANLESS	-	-	2	2
TOTALS	41	126	12	179

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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 MINE	1	2		2	1		9					15
BUNKER HILL MINE	7	8		21	1	8	23	7				75
CAMBRIA-JACKSON MINE	10	2		10	2		10					34
CANISTEO MINE	4			42		7	6					59
CLIFFS SHAFT MINE	16	4	1	35	2		15					73
DIAMOND DRILLS		3		7			7	6				23
GEN. STHSE. & SHOPS	22	16	1	65			8	3				115
HAWKINS MINE	8	4		34	6	2	16	1				71
HILL-TRUMBULL MINE	7			31	2	18	20					78
HOLMAN CLIFFS MINE	6	6		55	1	6	24	2				100
HUMBOLDT MINE	2	10		12			29					53
LLOYD MINE	7	2	1	18	4	4	5					41
MAAS MINE	6	1	1	30	3		7					48
MATHER INN	14			3			1	2				20
MATHER MINE, "A" SHAFT	9	12		42			69					132
MATHER MINE, "B" SHAFT	26	7		43		1	47	1				125
OHIO MINE	6	2		24			12	2				46
REPUBLIC MINE	2	1					13					16
SARGENT (OPEN-PIT) MINE		1		4	2	1	3				1	12
SPIES-VIRGIL MINE	3	4		1	3	1	3					15
TILDEN MINE		5		29	1	3	3					41
WANLESS MINE	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 " " "				2	1		1			1		5
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	4			15		1		2				22
RESEARCH LABORATORY	4			5			10					19
TOTALS	176	92	10	567	40	52	355	26	5	16	3	1,342

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

TABLE XX

CAUSES AND NUMBER OF DISCIPLINARY ACTIONS

Mine Or Plant	Reporting To Work Under The Influence of Liquor	Violation Of Safety Rule	Sleeping On The Job	Losing Too Much Time	Insubordination	Smoking Underground	Walking Off The Job	Careless Driving	Stealing In Dryhouse	Carelessness In Performing Gen. Work	Loitering-Forbidden Area (Pumphouse)	Stealing Explosives	Violent Use Of Temper	Failed To Close Shaft Gate(No Cage-Flat)	Careless Use Of Winze Cage	Preventing Fellow Empl. From Working	Felonious Assault With An Axe	Horseplay	Failing To Guard Blast	Carrying Powder On Motor	Taking Company Property	Leaving Hoist While In Operation	Handling Out Explosives (No Bag)	Transporting Explosives On Person	Reading Magazine With Hoists In Opt.	Totals
AGNEW				3																						3
BUNKER HILL	1	2		1	1				1	2																8
CAMBRIA-JACKSON					1																					1
CANISTEO				1																						1
CLIFFS SHAFT	1			1	9	1	2	4		1	10	2	1													32
GEN. STHSE. & SHOPS																										0
HAWKINS	1			4																						5
HILL-TRUMBULL				1			1		1																	2
HOLMAN CLIFFS				1				1																		2
HUMBOLDT	1			1																						2
LLOYD																										0
MAAS		1		2									1	1	1	1										7
MATHER MINE, "A" SHAFT			2	2	1		1										1	1	1							10
MATHER MINE, "B" SHAFT	2	11	7	4	2	3	1		4											1	1	2				36
OHIO		2																								2
REPUBLIC																										0
SARGENT (OPEN-PIT)																										0
SPIES-VIRGIL				2	2																	1				5
TILDEN																										0
TOTALS	8	14	10	31	7	6	7	1	7	10	2	1	1	1	1	1	1	1	1	1	1	2	1			118

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Central Safety Committee

The committee met on an average of once a month for our regular meetings and also, a few extra times to work out details of the underground safety rule books.

The committee is composed of Superintendents, Heads of Departments and top management and its purpose is to study all accidents and hazards and to try to prevent recurrence of the same. They also discuss various new jobs, hazards and methods.

Reports of all meetings are submitted to all members and management.

Supervisors Safety Committee

These meetings are similar to the Central Safety Committee meetings except their findings must be passed on by the Central Safety Committee as far as classification of injuries are concerned. These meetings are of real value to all concerned because these men, from all of the various properties, are right on top of the detailed work and have a good chance to exchange ideas and work out problems.

Lake Superior Mines Safety Exchange

Purpose of this organization is to keep in close touch with other mining companies of the district. Nearly all of this work is done by mail and is in the form of a questionnaire which is sent to all eleven members and they, in turn, answer such questions, if possible. We also exchange accident statistics on a monthly basis.

Lake Superior Mines Safety Council

All members, of which there are about 27, all from the Lake Superior District, make up one of the best safety organizations in the mining field. Monthly meetings are held during the year on the various mining ranges in the district and the annual meeting is held each year at Duluth, Minnesota. Programs for the range meetings are handled by the local safety men and attendance is from 100 to 140. The program for the annual meeting is taken care of by an executive committee with usually at least one safety representative from each of the larger iron and copper mining companies. Attendance at the annual meeting is generally from 750 to 850 mining people, but includes many from outside the district and some foreign countries.

Safety Department

Annual Report

Year 1955

11. ACCIDENTS AND PERSONAL INJURY

c. Safety Inspection (Continued)

Safety Banner Flags

Awarded the company's "Banner Flag" this year for the best safety record based on Severity rates are the following:

UNDERGROUND	-	Cambria-Jackson Mine	Severity - 42
OPEN-PIT	-	Ohio Mine	Severity - 0
INDEPENDENT UNIT	-	Electric Power Division	Severity - 0

Safety Department

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Year 1955

11. ACCIDENTS AND PERSONAL INJURY

d. Ventilation

Considerable time was spent on ventilation work during the year. Because of the large size of some of our mines it requires almost constant checking of ventilation courses and volumes. Changing conditions underground usually require changes in the ventilation.

In the Mather Mine, "B" Shaft, Mather Mine, "A" Shaft and Cambria-Jackson Mine ventilation system, four main mine fans are in use plus many small fans.

The Cliffs Shaft Mine still requires only one large main mine fan and one small booster fan.

At the Bunker Hill Mine the ventilation system has been changed with the Bunker Hill Shaft down-draft and the Athens Shaft upcast. Also, the Bunker Hill Shaft is used to furnish air for the Maas Mine with a fan on the old 14th Level, Negaunee forcing air to the Maas Mine.

Present volumes used in the underground mines are as follows (approximate):

Cambria-Jackson Mine	-	55,000 C.F.M.
Mather Mine, "A" & "B" Shafts	-	130,000 " " "
Maas Mine	-	30,000 " " "
Bunker Hill Mine	-	85,000 " " "
Cliffs Shaft Mine	-	130,000 " " "
* Lloyd Mine	-	18,000 " " "
* Spies Mine	-	30,000 " " "

* Operations suspended in 1955.

With the exception of the Cliffs Shaft Mine, all volumes can be increased through fan adjustment.

Dust Sampling & Analysis

Because of a lack of personnel in the Safety Department, only 195 dust samples were taken and analyzed. There were also a number of test samples taken which are not recorded because they would not give a true picture of conditions but were used mainly to learn conditions so the proper equipment could be installed.

Underground samples were generally good but problems are coming up with ore crushing underground. Studies of these conditions are underway.

At our new concentrating plants we will have more new problems of allaying dust but, no doubt, they will be properly taken care of.

Safety Department

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Year 1955

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	1955 MISC.	1955 IN ORE	1955 IN ROCK	1955 TOTAL	1933 - 1955 TOTAL
ATHENS *	0	0	0	0	843
BUNKER HILL	0	0	11	11	25
CAMBRIA-JACKSON	0	8	0	8	384
CLIFFS SHAFT	0	10	0	10	1,952
HUMBOLDT	18	0	0	18	48
LLOYD	0	4	3	7	775
MAAS	1	8	7	16	873
MATHER MINE, "A"	0	0	4	4	896
MATHER MINE, "B"	84	8	17	109	539
NEGAUNEE **	0	0	0	0	830
PRINCETON ***	0	0	0	0	85
RESEARCH LAB.	0	0	0	0	39
SPIES-VIRGIL ***	0	0	0	0	203
TILDEN	0	4	0	4	95
Test Samples - MISCELLANEOUS	0	8	0	8	170
MESABA RANGE	0	0	0	0	20
TOTALS	93	50	52	195	7,777

* Now a part of the Bunker Hill Mine.
** " " " " " " " "
*** No longer in operation.

Safety Department

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Year 1955

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	TILDEN	TOTAL
DRILLING	2	5	4		5	6	4	11		37
SCRAPING	2	3	5		2	9		9		30
LOADING CARS (LOADER)	4							3		7
CHARGING HOLES	2					1				3
CRUSHING ORE				18				69	2	89
LAYING TRACK								2		2
SURFACE CONVEYOR GALLERY								7		7
TIMBERING	1									1
BARRING BACK			1							1
GENERAL MINE AIR								8		8
LOADING AT POCKETS									2	2
TEST SAMPLES			8							8
TOTALS	11	8	18	18	7	16	4	109	4	195

Safety Department

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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	1947
ATHENS	9.89	7.28	25.80	4.90	8.33	6.64	4.17	7.39
CAMBRIA-JACKSON				12.10	6.21	17.05	11.99	9.30
CLIFFS SHAFT	7.77	8.18	7.55	5.99	6.23	8.18	6.34	8.64
LLOYD	11.73	8.05	6.95	5.01	14.45	6.49	9.38	11.17
MAAS	8.71	17.29	8.46	12.48	8.78	8.17	9.29	6.08
MATHER MINE, "A" SHAFT		2.42	5.58	6.64	7.57	8.39	7.72	10.88
MATHER MINE, "B" SHAFT								2.23
NEGAUNEE	10.79	14.02	17.02	4.65	11.81	11.92	6.67	7.05
PRINCETON				10.59	6.32	8.48		
SPIES-VIRGIL	8.40	6.97			5.59	14.22	3.59	11.65
TILDEN		49.60				24.18	66.92	33.65
GARDINER MACKINAW *								
MISCELLANEOUS			3.00					

* No Longer In Operation

(Table Continued - Next Page)

Safety Department

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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	1948	1949	1950	1951	1952	1953	1954	1955
ATHENS *	7.49	7.07	4.71	4.15	2.71	2.37		
BUNKER HILL							1.19	2.33
CAMBRIA-JACKSON	13.81	6.86	9.50	8.32	4.54	6.80	1.38	4.56
CLIFFS SHAFT	5.12	6.26	3.46	4.90	2.76	4.45	2.79	2.31
HUMBOLDT						1.59	27.57	6.34
LLOYD	12.97	11.72	11.32	6.28	4.72	5.17	4.58	5.09
MAAS	21.08	10.55	4.45	4.84	4.93	7.06	5.25	4.14
MATHER MINE, "A" SHAFT	9.50	8.40	7.01	8.75	5.86	5.15	3.77	1.38
MATHER MINE, "B" SHAFT	4.16	2.46	6.68	5.04	5.40	5.56	6.41	4.81
MESABA RANGE **							20.28	
NEGAUNEE *	5.48			2.27	1.70	2.60		
PRINCETON ***								
RESEARCH LAB. **				5.81	5.57	7.14		
SPIES-VIRGIL **	5.24	10.12	18.78	6.05	5.29	4.75	4.14	
TILDEN	2.93	4.38	3.74	6.34		3.05		2.36
GARDNER MACKINAW ***								

* Now a part of the Bunker Hill Mine

** No samples taken during Year 1955.

*** No longer in operation.

Safety Department

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Year 1955

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		2.33	2.33
CAMBRIA-JACKSON		4.40	4.56
CLIFFS SHAFT			2.31
LLOYD		5.09	5.09
MAAS		2.26	4.14
MATHER MINE, "A" SHAFT		1.38	1.38
MATHER MINE, "B" SHAFT	1.27	1.83	4.81

* Includes Miscellaneous and General Air Samples.

Safety Department

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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	-	2.33	2.33
CAMBRIA-JACKSON	4.56	-	4.56
CLIFFS SHAFT	2.31	-	2.31
LLOYD	2.24	7.95	5.09
MAAS	6.53	2.04	4.14
MATHER MINE, "A" SHAFT	-	1.38	1.38
MATHER MINE, "B" SHAFT	8.05	1.77	4.81

* Includes Miscellaneous and General Air Samples.

Safety Department

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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
MAIN LEVELS:							
Drilling In Rock (Wet)	1.65			7.95	1.84	1.32	1.44
Loading Rock	3.39						2.52
Charging Holes	1.39				1.18		
Scraping Rock (Steel Scraper Slide)					2.97		
Drilling In Ore (Wet)				1.46			
Timbering	2.12						
Laying Track							1.60
SCRAPING TRANSFER DRIFTS: *							
Drilling In Ore (Wet)		2.35					1.16
Scraping Ore		4.81		3.80	7.80		9.04
Scraping Rock	1.93						
Drilling In Ore (Auger)		5.48					
Drilling In Rock (Wet)					4.00	1.43	
Scraping Ore And Breaking Chunks					5.27		
RAISES:							
Drilling In Rock (Wet)							1.27
STOPES:							
Drilling In Ore (Wet)			1.59				
Scraping Ore			2.91				
Barring Back			2.20				
AVERAGE COUNTS FOR:							
MAIN LEVELS	2.45			5.35	2.04	1.32	1.83
SUB-LEVEL DRIFTS		4.40		3.80			
SCRAPING TRANSFER DRIFTS	1.99	4.81			6.53	1.43	1.27
RAISES							1.27
STOPES			2.31				
GENERAL AVERAGES:	2.33	4.56	2.31	5.09	4.14	1.38	4.81

* 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

Mine Rescue Training

Mine rescue training was conducted for 190 employees, including most of the underground supervisory force. This training was conducted by members of the Safety Department who are Certified Instructors by the U.S. Bureau of Mines.

Each man who has had previous training is given eight (8) additional hours and new men are given twenty-four (24) hours of training.

11. ACCIDENTS AND PERSONAL INJURY

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

TABLE XXVII

MINE RESCUE TRAINING - MICHIGAN MINES

SEPTEMBER 6-30, 1955

Mine	No. Of Men
BUNKER HILL	33
CAMBRIA-JACKSON	8
CLIFFS SHAFT	26
ENGINEERING DEPARTMENT	8
GEOLOGICAL DEPARTMENT	1
LLOYD	5
MAAS	12
MATHER MINE, "A" SHAFT	53
MATHER MINE, "B" SHAFT	44
SPIES-VIRGIL	0
TOTAL	190

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)	81,440
Merthiolate Applicators	2,500
Knuckle-Bandages	1,760
Plain Gauze Pads (3" x 3")	425
Picric Acid Gauze Pads (For Burns)	224
1" Roller Bandages	140
Oz. of Tincture of Merthiolate	133
Rolls of Adhesive Tape (½-inch)	126
Oz. of Aromatic Spirits Of Ammonia	108
2" Compress Bandages	108
3" Roller Bandages	102
Leather Finger Cots	101
2" Roller Bandages	73
3" Compress Bandages	60
Tubes of Surfacaine (For Burns & Abrasions)	40
5/8 Oz. Tubes Of Foille (For Burns)	38
1 Oz. Medicine Bottles	25
Triangular Bandages	15
Oz. of Absorbent Cotton	10
Pairs of Scissors	4
2 Oz. Medicine Bottles	2
Pairs of Tweezers	2
TOTAL	87,436

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

f. Miscellaneous

Took photographs of the Mine Rescue Station and wrote a brief article for the "Cliffs News" as requested by Mr. Kirkwood, Editor.

Showed motion pictures on safe and unsafe methods of handling heavy duty earth moving equipment to approximately 116 employees and supervisors.

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

Met with safety personnel of other mining companies of the range to discuss the possibility of broadcasting safety messages over the local radio station.

Took part in Negaunee Business and Professional Mens' Association.

During the year, accident statistics were prepared for the U.S. Bureau of Mines, County Mine Inspectors, Lake Superior Mines Safety Council and the National Safety Council.

Assisted in preparations to honor employees with forty or more years of accident-free service and took part in the program.

Tested stench warning devices at the Mather Mine, "A" and "B" Shafts.

As a representative of the National Safety Council, presented "Certificate Of Honor" to the Munising Paper Co. of Munising, Michigan.

Checked all stench injection devices at all underground mines and made recommendations for changes where necessary.

Made three trips to the Cliffs Shaft Mine with oxygen breathing apparatus when fires were reported. However, these fires were extinguished without difficulty and the oxygen breathing apparatus was not needed.

Safety Department

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11. ACCIDENTS AND PERSONAL INJURY

f. Miscellaneous (Continued)

Comparison Of Available Accident Statistics

Because accident statistics for the Year 1955 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 1954 rating to compare with our records.

This table remains the same as in previous years with the exception of the 1954 National Rating for All Mining, Including Coal and the 1954 National Rating for Metal Mining (Underground). To date, we have not received these statistics and therefore are unable to include them in our annual report.

TABLE XXIX, giving a comparison of frequency and severity ratings, follows:

f. Miscellaneous (Continued)

TABLE XXIX

COMPARISON OF FREQUENCY, SEVERITY RATINGS

(Taken From Available Statistics)

	FREQUENCY	SEVERITY	1954 LAKE SUPERIOR DISTRICT FREQUENCY	1954 LAKE SUPERIOR DISTRICT SEVERITY
1954 National Rating, All Mining, Including Coal	*	*		
1954 " " , Coal Mining	25.81	4.79		
1954 " " , Other Mining (Not Including Coal)	22.95	3.14		
1954 " " , Metal Mining (Underground)	*	*		
1954 Lake Superior District Mines (26 Companies Reporting)	13.32	2.52		
1955 The Cleveland-Cliffs Iron Co., Compensable Injuries	17.44	4.38		
1955 " " " " " , All Injuries	28.75	4.41	13.32	2.52
1955 " " " " " , Open-Cut Mining	18.89	6.75	7.47	1.68
1955 " " " " " , Concentrating Plants	12.87	0.24	10.47	6.50
1955 " " " " " , Top Slicing	21.96	0.93	22.82	0.65
1955 " " " " " , Sub-Level Caving	20.48	0.73	18.85	1.86
1955 " " " " " , Stoping	36.18	3.38	24.65	6.96
1955 " " " " " , Block Caving	43.07	7.66	34.95	1.14
1955 " " " " " , Shaft Sinking & Develop.	-	-	13.28	0.66
1955 " " " " " , General Shops	16.02	0.71	6.32	1.26
1955 " " " " " , Elec. Power Division	0.00	0.00		
1955 " " " " " , General Roll	0.00	0.00		
1955 " " " " " , Miscellaneous	2.84	0.03	0.73	0.07

* Statistics Not Available.

ANNUAL REPORT OF THE MINING ENGINEERING DEPARTMENT FOR THE YEAR ENDING DECEMBER 31, 1955

Since the discontinuance of the publication of the five bound volumes which contain maps showing the yearly mining activities, that is, the advancement of the underground development and mining, the photographs of construction progress, the open pit cross-sections and the logs of diamond drill holes, the only manner in which we can record these mining activities is to print additional copies of the large scale, 50' to the inch mine working tracings and file them for future reference. In addition to the above, we must also substitute or replace these more convenient sized annual report maps with the large scale drawing to fulfill the map report requirements as called for in the majority of our mining lease agreements which stipulate map reports showing the operating status of these properties as of December 31st.

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 Cambria-Jackson Lloyd Maas Ohio Republic Spies-Virgil Tilden	Athens Humboldt Mather
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

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 1955 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. V. E. Kral, Acting 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 discontinuing 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 1955.

SPIES-VIRGIL MINE

The fee-owners of the Virgil Mine Property received a copy of the Spies-Virgil 6th Level map, showing the location of underground exploratory diamond drill holes #82, #84 and #87, and copies of the logs which detailed the type of material encountered in these holes.

C. MINING LEASES

The following mining leases and options for leases were executed and placed on file during 1955:

Lease No. 133

Option for fifty-year mining lease from Sylvester Wiitala and wife to The Cleveland-Cliffs Iron Company, dated December 27, 1954, expires December 15, 1957 but with privilege of one year extension, covering the $SE\frac{1}{4}$ of $NE\frac{1}{4}$, Section 4, 42-23, Delta County (Rock Area).

Lease No. 134

Option for fifty-year mining lease from Isaac Ranta to The Cleveland-Cliffs Iron Company, dated December 28, 1954, expires December 15, 1957 but with privilege of one year extension, covering the $NE\frac{1}{4}$ of $NW\frac{1}{4}$, Section 9, 42-23, Delta County (Rock Area).

Lease No. 135

Option for fifty-year mining lease from Clarence Cayer and wife to The Cleveland-Cliffs Iron Company, dated December 28, 1954, expires December 15, 1957 but with privilege of one year extension, covering the $W\frac{1}{2}$ of $NE\frac{1}{4}$ of $SE\frac{1}{4}$, $NW\frac{1}{4}$ of $SE\frac{1}{4}$, $E\frac{1}{2}$ of $SW\frac{1}{4}$ of $SE\frac{1}{4}$, $W\frac{1}{2}$ of $W\frac{1}{2}$ of $SE\frac{1}{4}$ of $SE\frac{1}{4}$, all in Section 14, 43-22, Delta County (Osier Area).

Lease No. 136

Option for fifty-year mining lease from Elmer J. Lepisto and wife to The Cleveland-Cliffs Iron Company, dated January 6, 1955, expires December 15, 1957 but with privilege of one year extension, covering the NE¼ of NE¼ and the NW¼ of NE¼, Section 4, 42-23, Delta County (Rock Area).

Lease No. 137

Option for fifty-year mining lease from John W. Seppanen and wife to The Cleveland-Cliffs Iron Company, dated January 6, 1955, expires December 15, 1957 but with privilege of one year extension, covering the SW¼ of NW¼ and the NW¼ of SW¼, Section 36, 43-23, Delta County (Rock Area).

Lease No. 138

Option for fifty-year mining lease from Henry W. Jokela and wife to The Cleveland-Cliffs Iron Company, dated January 14, 1955, expires December 15, 1957 but with privilege of one year extension, covering the E-3/4 of SW¼ of NW¼ and the SE¼ of NW¼, Section 2, 42-23, Delta County (Rock Area).

Lease No. 139

Option for fifty-year mining lease from Florian DeCremer and wife and Joseph DeCremer and wife to The Cleveland-Cliffs Iron Company, dated January 17, 1955, expires December 15, 1957 but with privilege of one year extension, covering the E½ of SE¼, Section 19; SE¼ of SW¼, Section 20; NE¼ of NW¼, Section 29; and the N½ of NE¼, Section 30, all in 42-22, Delta County (Perkins Area).

Lease No. 140

Option for fifty-year mining lease from G. Harold Earle and wife and Stewart E. Earle and wife to The Cleveland-Cliffs Iron Company, dated January 24, 1955, expires December 15, 1957 but with privilege of one year extension, covering the:

NE¼ of NW¼, NW¼ of NW¼, SW¼ of NW¼, Section 19, 43-21;
NE¼ of SW¼, NW¼ of SW¼, SW¼ of SW¼, SW¼ of SE¼, Section 13, 43-22;
NE¼ of NE¼, SE¼ of NE¼, NE¼ of SE¼, Section 23, 43-22;
NE¼ of NE¼, NW¼ of NE¼, SW¼ of NE¼, SE¼ of NE¼, NE¼ of NW¼, SW¼ of NW¼, SE¼ of NW¼, NE¼ of SW¼, NE¼ of SE¼, and the NW¼ of SE¼, all in Section 27, 43-22;
SE¼ of NE¼, NE¼ of SW¼, Section 28, 43-22;
NE¼ of SE¼, NW¼ of SE¼, Section 31, 43-22;
NE¼ of NW¼, NW¼ of NW¼, Section 36, 43-22, Delta County (Osier Area).

Lease No. 141

Option for fifty-year mining lease from Clarence J. Larson et al. to The Cleveland-Cliffs Iron Company, dated January 15, 1955, expires December 15, 1957 but with privilege of one year extension, covering Lots 31, 62, 63, 67, 68, 69, 80 and portion of Lot 81, all in Plat of Rock. The SW¼ of NW¼, SE¼ of NW¼, NE¼ of SW¼, SW¼ of SW¼, and SE¼ of SW¼, Section 3, 42-23; the SW¼ of SW¼, SE¼ of SW¼, NE¼ of SW¼, and the ores and minerals under the SW¼ of NE¼ and SE¼ of NE¼, Section 31, 43-22, Delta County (Rock Area).

Lease No. 142

Option for fifty-year mining lease from George Mattila to The Cleveland-Cliffs Iron Company, dated February 1, 1955, expires December 15, 1957 but with privilege of one year extension, covering the NW¼ of SW¼, NE¼ of NW¼, NW¼ of NW¼ except that part East of the C. & N. W. right of way, the SE¼ of NW¼, SW¼ of NW¼, all in Section 24, 42-23, Delta County (Perkins Area) except an undivided 1/2 interest in the minerals.

Lease No. 143

Option for fifty-year mining lease from Albert C. Norden and wife to The Cleveland-Cliffs Iron Company, dated February 1, 1955, expires December 15, 1957 but with privilege of one year extension, covering the NE¼ of NE¼ and SE¼ of NE¼, Section 24, 42-23, Delta County (Perkins Area).

Lease No. 144

Option for fifty-year mining lease from Fred LeClaire and wife to The Cleveland-Cliffs Iron Company, dated February 3, 1955, expires December 15, 1957 but with privilege of one year extension, covering the W½ of SW¼ of NW¼ and N½ of NW¼ of SW¼, Section 2, 42-23, Delta County (Rock Area).

Lease No. 145

Option for fifty-year mining lease from John DeCremer and wife to The Cleveland-Cliffs Iron Company, dated February 3, 1955, expires December 15, 1957 but with privilege of one year extension, covering the SE¼ of SE¼, Section 20, 42-22, Delta County (Perkins Area).

Lease No. 146

Option for fifty-year mining lease from Onni A. Johnson and wife to The Cleveland-Cliffs Iron Company, dated February 3, 1955, expires December 15, 1957 but with privilege of one year extension, covering the SW¼ of SE¼, Section 19, 42-22 and the surface and 1/2 of the minerals in that part of the NW¼ of NW¼, Section 24, 42-23 lying East of the C. & N. W. right of way, Delta County (Perkins Area).

Lease No. 147

Option for fifty-year mining lease from Frank W. Hill to The Cleveland-Cliffs Iron Company, dated January 28, 1955, expires December 15, 1957 but with privilege of one year extension, covering the NW¼ of NW¼ and SW¼ of NW¼, Section 31, 43-22, Delta County (Rock Area).

Lease No. 148

Option for fifty-year mining lease from Wilbert Demeuse and wife and Louis Demeuse to The Cleveland-Cliffs Iron Company, dated February 23, 1955, expires December 15, 1957 but with privilege of one year extension, covering the NW¼ of NE¼, NE¼ of NE¼ and N-1/8 of SE¼ of NE¼, Section 29, 42-22, Delta County (Perkins Area).

Lease No. 149

Option for fifty-year mining lease from Frank V. Freeman to The Cleveland-Cliffs Iron Company, dated March 4, 1955, expires December 15, 1957 but with privilege of one year extension, covering the NW¼ of NE¼, Section 24, 42-23, Delta County (Perkins Area).

Lease No. 150

Option for fifty-year mining lease from Kimberly-Clark of Michigan, Inc., to The Cleveland-Cliffs Iron Company, dated March 3, 1955, expires December 15, 1957 but with privilege of one year extension, covering the NE¼ of NW¼, Section 19, 42-22, Delta County (Perkins Area).

Lease No. 151

Option for seventy-five year mining lease from The Cleveland-Cliffs Iron Company to the United States Steel Corporation, dated March 8, 1955, expires March 8, 1980, covering the NE¼ of SE¼, Section 19, 47-27; N½ of SW¼,

$S\frac{1}{2}$ of $NW\frac{1}{4}$, Section 20, 47-27; $N\frac{1}{2}$ of $NW\frac{1}{4}$, $E\frac{1}{2}$ of $NE\frac{1}{4}$, Section 21, 47-27; $NW\frac{1}{4}$ of $SW\frac{1}{4}$, Section 17, 47-28; $E\frac{1}{2}$ of $SE\frac{1}{4}$, Section 18, 47-28, Marquette County, Michigan (these lands involved in the Eagle Mills Pelletizing Plant exchange).

Lease No. 152

Option for fifty-year mining lease from Federal Land Bank of Saint Paul to The Cleveland-Cliffs Iron Company, dated March 11, 1955, expires December 15, 1957 but with privilege of one year extension, covering a 1/2 interest in the minerals in the $SW\frac{1}{4}$ of Section 12 and the $NW\frac{1}{4}$ and $NW\frac{1}{4}$ of $SW\frac{1}{4}$, Section 24, all in 42-23, Delta County (Perkins Area).

Lease No. 153

Option for fifty-year mining lease from Joseph B. Perron et al. to The Cleveland-Cliffs Iron Company, dated April 12, 1955, expires April 11, 1958, covering the $N\frac{1}{2}$ of Section 24, 43-22, Delta County (Osier Area).

Lease No. 154

Fifty-year exploratory and mining lease from the Department of Conservation of the State of Michigan to The Cleveland-Cliffs Iron Company, dated May 5, 1955, covering the $W\frac{1}{2}$ of $SW\frac{1}{4}$, Section 17 and the $SW\frac{1}{4}$ of $NE\frac{1}{4}$ and $NW\frac{1}{4}$, Section 20 and the minerals in the $W\frac{1}{2}$ of $NE\frac{1}{4}$, $NW\frac{1}{4}$, $SW\frac{1}{4}$ and $SE\frac{1}{4}$, Section 18, the $SE\frac{1}{4}$ of $NE\frac{1}{4}$, Section 19, and the $NE\frac{1}{4}$ of $SW\frac{1}{4}$, Section 20, all in 42-22, Delta County (Perkins Area).

Lease No. 155

Fifty-year exploratory and mining lease from the Department of Conservation of the State of Michigan to The Cleveland-Cliffs Iron Company, dated May 5, 1955, covering the mineral rights in the $NW\frac{1}{4}$ of $NW\frac{1}{4}$ and $S\frac{1}{2}$ of $NW\frac{1}{4}$, Section 9, the $NE\frac{1}{4}$, $NE\frac{1}{4}$ of $NW\frac{1}{4}$ and $E\frac{1}{2}$ of $SE\frac{1}{4}$, Section 13, and the $SW\frac{1}{4}$ of $NE\frac{1}{4}$, Section 24, all in 42-23, Delta County (Rock and Perkins Areas).

Lease No. 156

Fifty-year exploratory and mining lease from the Department of Conservation of the State of Michigan to The Cleveland-Cliffs Iron Company, dated May 5, 1955, covering the $N\frac{1}{2}$ of $NE\frac{1}{4}$, $SE\frac{1}{4}$ of $NE\frac{1}{4}$ and $SE\frac{1}{4}$ of $NW\frac{1}{4}$, Section 19 and the mineral rights in the $S\frac{1}{2}$ of $SE\frac{1}{4}$, Section 18, all in 43-21, Delta County, (Osier Area).

Lease No. 157

Fifty-year exploratory and mining lease from the Department of Conservation of the State of Michigan to The Cleveland-Cliffs Iron Company, dated May 5, 1955, covering the:

$S\frac{1}{2}$ of $SE\frac{1}{4}$, Section 23;
$NE\frac{1}{4}$ of $SE\frac{1}{4}$, Section 25;
$N\frac{1}{2}$ of $NW\frac{1}{4}$ and $SW\frac{1}{4}$ of $NW\frac{1}{4}$, Section 26;
$SE\frac{1}{4}$ of $SW\frac{1}{4}$ and $SE\frac{1}{4}$ of $SE\frac{1}{4}$, Section 27;
$S\frac{1}{2}$ of $SE\frac{1}{4}$, Section 31;
$S\frac{1}{2}$ of $NE\frac{1}{4}$, $S\frac{1}{2}$ of $NW\frac{1}{4}$, $E\frac{1}{2}$ of $SW\frac{1}{4}$ and $SE\frac{1}{4}$, Section 32;
$S\frac{1}{2}$ of $NE\frac{1}{4}$, $S\frac{1}{2}$ of $NW\frac{1}{4}$, $SW\frac{1}{4}$ and $SE\frac{1}{4}$, Section 33;
$S\frac{1}{2}$ of $NE\frac{1}{4}$, $S\frac{1}{2}$ of $NW\frac{1}{4}$ and $SW\frac{1}{4}$, Section 34;
$N\frac{1}{2}$ of $NW\frac{1}{4}$, Section 35;
and the minerals in:
$SW\frac{1}{4}$, Section 24;
$NE\frac{1}{4}$ of $NE\frac{1}{4}$ and $NW\frac{1}{4}$ of $NW\frac{1}{4}$, Section 25;
$SW\frac{1}{4}$ of $SE\frac{1}{4}$, Section 27;
$N\frac{1}{2}$ of $NE\frac{1}{4}$ and $N\frac{1}{2}$ of $NW\frac{1}{4}$, Section 34;
all in 43-22, Delta County (Rock and Osier Areas)

Lease No. 158

Fifty-year exploratory and mining lease from the Department of Conservation of the State of Michigan to The Cleveland-Cliffs Iron Company, dated May 5, 1955, covering the minerals in the S½ of NE¼, E½ of SW¼ and W½ of SE¼, Section 36, 43-23, Delta County (Rock Area).

Lease No. 159

Agreement dated April 29, 1955 between The Cleveland-Cliffs Iron Company and the Chicago & Northwestern Railway Company, covering exploration requirements and royalties payable on the mineral rights in 4041.59 acres in the Gwinn District purchased by Cliffs from Northwestern.

Lease No. 160

Option for fifty-year mining lease from Madeline G. Katz et al. to The Cleveland-Cliffs Iron Company, dated June 24, 1955, expires June 30, 1958 but with privilege of one year extension, covering the SW¼ of SW¼, Section 13, 42-22, Delta County (Perkins Area).

Lease No. 161

This mining lease number has been assigned for convenience to our file of Operating Agreements, etc., relating to the Athens Mine.

Lease No. 162

Option for fifty-year mining lease from Eugene L. Munn to The Cleveland-Cliffs Iron Company, dated August 26, 1955, expires June 30, 1958 but with privilege of one year extension, covering the W½ of W½ and NE¼ of NW¼, Section 24, 42-22, Delta County (Perkins Area).

Lease No. 163

Fifty-year exploratory and mining lease from Elsbeth M. Glocke et al. to The Cleveland-Cliffs Iron Company, dated December 1, 1955, covering the NE¼ of NW¼, NW¼ of NW¼ and SW¼ of NW¼, Section 17, 44-35, Iron County.

1. Override royalty agreement between The Cleveland-Cliffs Iron Company and A. D. McPherson, dated December 1, 1955 and providing for payment by Cliffs to McPherson of 2¢ per ton of ore shipped under Mining Lease 163.

The following mining leases and options were terminated or allowed to expire during 1955:

Lease No. 14-C

City of Negaunee to The Cleveland-Cliffs Iron Company, dated November 20, 1901, covering the Baldwin Kiln Road Strip in the Maas Mine. Notice served October 28, 1955, termination effective December 30, 1955.

Lease No. 51

The following leases to The Cleveland-Cliffs Iron Company covering various fractional interests in the SW¼ of NW¼, Section 24, 43-35, Iron County (Virgil Mine). Noticed served July 21, 1955, termination effective September 30, 1955.

Lessor	Interest	Date of Lease
Wallace R. Cook & Marion L. Cook Marion C. Frink & H. Lee Frink Mabel C. Duncan & Robert F. Duncan	1/3	May 12, 1920
Katherine Eliasen & Edwin A. Eliasen	1/10	July 1, 1936
Minnie Macdonald	1/10	July 1, 1936
Alexander J. Macdonald & Belle W. Macdonald	4/15	July 1, 1936
Christina Knable & Frederick Knable	1/10	July 1, 1936
Ronald Macdonald & Olive Macdonald	1/10	July 1, 1936

Lease No. 74

Sub-lease from The Cleveland-Cliffs Iron Company to The Hanna Iron Ore Company, dated April 1, 1947, covering the $SW\frac{1}{4}$, Section 19, 43-34, Iron County. Notice served December 1, 1954, termination effective March 30, 1955.

Basic lease from Arthur W. Johnson et al. to The Cleveland-Cliffs Iron Company, dated May 1, 1943, covering the $SW\frac{1}{4}$, Section 19, 43-34, Iron County. Notice served May 3, 1955, termination effective July 15, 1955.

Lease No. 109

McDermott Estate et al. to The Cleveland-Cliffs Iron Company, dated April 1, 1953, covering the $W\frac{1}{2}$ of $E\frac{1}{2}$, Section 25, 43-35, Iron County. Notice served November 26, 1954, termination effective April 1, 1955.

Lease No. 111

Option for mining lease from Ford Motor Company to The Cleveland-Cliffs Iron Company, dated September 1, 1953, covering Lots 1 and 3, the $S\frac{1}{2}$ of $S\frac{1}{2}$ of $SE\frac{1}{4}$ of $NE\frac{1}{4}$ and the minerals in the $N\frac{1}{2}$ of $S\frac{1}{2}$ of $SE\frac{1}{4}$ of $NE\frac{1}{4}$ and the $N\frac{1}{2}$ of $SE\frac{1}{4}$ of $NE\frac{1}{4}$, all in Section 21, 48-31, Baraga County. Notice that option would not be exercised served November 21, 1955.

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). Notice that option would not be exercised served December 13, 1955.

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). Notice that option would not be exercised served December 13, 1955.

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). Notice that option would not be exercised served December 13, 1955.

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 SE¼ of NE¼, Section 27, 42-22, Delta County (Perkins Area). Notice that option would not be exercised served December 13, 1955.

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 NE¼ of SE¼, Section 21, 42-22, Delta County (Perkins Area). Notice that option would not be exercised served December 13, 1955.

Lease No. 117-A

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 N½ of N½, Section 26, 42-22, Delta County (Perkins Area). Notice that option would not be exercised served December 13, 1955.

Lease No. 117-B

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 N½ of N½, Section 26, 42-22, Delta County (Perkins Area). Notice that option would not be exercised served December 13, 1955.

Lease No. 117-C

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 N½ of N½, Section 26, 42-22, Delta County (Perkins Area). Notice that option would not be exercised served December 13, 1955.

Lease No. 117-D

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 N½ of N½, Section 26, 42-22, Delta County (Perkins Area). Notice that option would not be exercised served December 13, 1955.

Lease No. 117-E

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 N½ of N½, Section 26, 42-22, Delta County (Perkins Area). Notice that option would not be exercised served December 13, 1955.

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 E½ of SW¼ and SW¼ of SE¼, Section 23, 42-22, Delta County (Perkins Area). Notice that option would not be exercised served December 13, 1955.

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 W½ of NE¼ and SE¼ of NE¼, Section 28, 42-22, Delta County (Perkins Area). Notice that option would not be exercised served December 13, 1955.

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 NW¼ of SW¼, Section 22, 42-22, Delta County (Perkins Area). Notice that option would not be exercised served December 13, 1955.

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 N½ of NW¼, SW¼ of NW¼ and NW¼ of SW¼, Section 25 and the SE¼ of SE¼, Section 26, 42-22, Delta County (Perkins Area). Notice that option would not be exercised served December 13, 1955.

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 SW¼ of SW¼, Section 22, 42-22, Delta County (Perkins Area). Notice that option would not be exercised served December 13, 1955.

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). Notice that option would not be exercised served December 13, 1955.

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). Notice that option would not be exercised served December 13, 1955.

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). Notice that option would not be exercised served December 13, 1955.

The following mining leases were amended in 1955:

Lease No. 98

The Department of Conservation of the State of Michigan to The Cleveland-Cliffs Iron Company, dated July 2, 1951, covering the N½ of SW¼, Section 22, 48-31, Baraga County. Letter amendment, dated May 18, 1955, clarifies minimum royalty requirements.

Lease No. 125

The Department of Conservation of the State of Michigan to The Cleve-

land-Cliffs Iron Company, dated October 5, 1954, covering the:
$E\frac{1}{2}$ of $SW\frac{1}{4}$, $N\frac{1}{2}$ of $SE\frac{1}{4}$ and $S\frac{1}{2}$ of $SE\frac{1}{4}$, Section 22;
$NW\frac{1}{4}$ of $SW\frac{1}{4}$ and $SW\frac{1}{4}$ of $SW\frac{1}{4}$, Section 23;
$SE\frac{1}{4}$ of $NW\frac{1}{4}$ and $NE\frac{1}{4}$ of $SW\frac{1}{4}$, Section 25;
$NE\frac{1}{4}$ of $NE\frac{1}{4}$, $NE\frac{1}{4}$ of $NW\frac{1}{4}$ and $NW\frac{1}{4}$ of $SE\frac{1}{4}$, Section 27, all in 42-22, Delta County (Perkins Area). Letter amendment, dated May 18, 1955, clarifies minimum royalty requirements.

D. THE FORCE

The Mining Engineering Department Staff has been reduced an additional 15% during 1955 as a result of combining the Lloyd Mine engineering duties along with the Mather Mine, "A" Shaft, the Cambria-Jackson Mine with the Mather Mine, "B" Shaft and the termination of the Spies Mine Operation. The following men's employment was terminated in this general overall reduction of the Mining Engineering Department Staff:

Name	Classification
Robert B. Davis	Mining Engineer
John F. Magnuson	Mining Engineer
Herbert S. Kelly	Surveyor
Arnold E. Townsend	Surveyor
John P. Clark	Helper
Henry C. Coron	Helper
Raymond S. Windsand	Helper

In addition to the above, the following men terminated their employment with The Cleveland-Cliffs Iron Company's Mining Engineering Department to accept employment elsewhere:

1. Leamon G. McGee, Mining Engineer, terminated his employment on March 31st to accept a similar position with the Davison Chemical Corporation in Bartow, Florida.

2. V. E. Swan, Engineer assigned to the Republic Townsite Project, terminated his employment on April 15th to accept the City Engineer--Superintendent of Public Works position for the City of Marquette.

3. Keith R. Busby, Technical Foreman assigned to the Maas Mine, terminated his employment on December 1st to accept a position with the Inland Steel Company.

4. Lionel N. Larson, Mining Engineer assigned to the Bunker Hill--Maas Operation, resigned on December 31st to accept a position with the Saginaw Metal Products Company, Saginaw, Michigan.

Charles W. Cornish returned from his two years of service with the Armed Forces on March 1st to rejoin the Engineering Department as Surveyor.

Henry C. Coron reentered the Mining Engineering Department on May 15th to serve in a Chauffeur--Helper capacity.

Richard L. Swanson was hired on August 15th as a Surveyor Helper and was assigned to the Bunker Hill--Maas Operation.

George M. Olson, Geological Department Technician, was transferred to the Mining Engineering Department rolls as of August 16th and assigned to the Bunker Hill--Maas Operation as a Surveyor Helper.

Donald G. Johnson was hired on December 1st as a Surveyor Helper and was assigned to the Bunker Hill--Maas Operation.

On October 1st, Joseph D. Crites was transferred to the Republic Mine as Pit Foreman.

The employment of George M. Olson, Surveyor Helper assigned to the Bunker Hill--Maas Operation, was terminated on December 31st.

The following men were employed on a temporary basis during the summer months to expedite the projects as noted:

1. John P. Clark, Donald G. Johnson and William M. Leaf were hired on July 18th as temporary Surveyor Helpers to assist in the L.S.&I.--C.&N.W.--D.S.S.&A. Railroad Relocation Project proposed in the Negaunee--Ishpeming Area. This project was completed on August 31st.

2. Lowell P. Marjama was hired on July 18th and Ralph K. Oja on August 1st, as a temporary Surveyor Helper and Surveyor respectively, to assist in the survey control work in the Perkins Area.

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

Name	Position	Entered	Left	1955 Employment
Grant T. Hollett	Chief Mining Engineer			12 Months
Eric G. Beinlich, Jr.	Engineer			12 Months
Keith R. Busby	Technical Foreman		December 1st	12 Months
Joseph D. Crites	Pit Foreman		October 1st	9 Months
Robert B. Davis	Engineer		January 31st	1 Month
Robert M. DeGabriele	Construction Engineer			12 Months
Robert J. Flynn	Engineer			12 Months
Robert G. Fountain	Recorder			12 Months
Oiva W. Hakala	Engineer			12 Months
Allen H. Heikkinen	Engineer			12 Months
Albert Henry	Engineer			12 Months
LeRoy Hosking	Engineer			12 Months
R. Charles Kincaid	Engineer			12 Months
Eino A. Koski	Development Engineer			12 Months
Lionel N. Larson	Engineer		December 31st	12 Months
Leamon G. McGee	Engineer		March 31st	3 Months
John F. Magnuson	Engineer		March 31st	3 Months
Bernhardt H. Petersen	Technical Foreman			12 Months
Victor E. Swan	Engineer		April 15th	3½ Months
Kenelm C. Winslow	Engineer			12 Months

Name	Position	Entered	Left	1955 Employment
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			12 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
Charles W. Cornish	Surveyor	March 1st		10 Months
Herbert S. Kelly	Surveyor		March 1st	2 Months
Alfred B. Nault	Surveyor			12 Months
Ernest A. Oja	Surveyor			12 Months
Ralph K. Oja	Surveyor	August 1st	September 23rd	7 Weeks
Joseph J. Scoleri	Surveyor			12 Months
John R. Sleeman	Surveyor			12 Months
Martin D. Tasson	Surveyor			12 Months
Arnold E. Townsend	Surveyor		May 31st	5 Months
Allan E. Wakkuri	Surveyor			12 Months
Clyde C. Anderson	Helper			12 Months
John P. Clark	Helper		March 1st	
		July 18th	August 19th	3 Months
Henry C. Coron, Jr.	Helper	May 15th	March 1st	9½ Months
Arthur W. Hemmila	Helper			12 Months
Donald G. Johnson	Helper	July 18th	August 31st	
		December 1st		2 Months
Donald E. Lampi	Helper			12 Months
William M. Leaf	Helper	July 18th	August 19th	1 Month
William R. Lehmann	Helper			12 Months
Lowell P. Marjama	Helper	August 1st	September 16th	1½ Months
George B. Olson	Helper	August 16th	December 31st	4½ Months
Arnold A. Sundell	Helper			12 Months
Richard L. Swanson	Helper	August 16th		4½ Months
Wilburt H. Thomas	Helper			12 Months
Raymond S. Windsand	Helper		March 1st	2 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
Grant T. Hollett	August, 1940	15 Years, 4½ Months
Eric G. Beinlich, Jr.	July, 1952	3 Years, 6 Months
Robert M. DeGabriele	December, 1945	10 Years, 1 Month
Robert J. Flynn	April, 1953	2 Years, 8 Months
Robert G. Fountain	August, 1951	4 Years, 4 Months
Oiva W. Hakala	July, 1951	4 Years, 6 Months

Name	Date Entered	Length of Service
Allen H. Heikkinen	August, 1952	3 Years, 5 Months
Albert Henry	June, 1953	2 Years, 6 Months
LeRoy Hosking	March, 1954	1 Year, 10 Months
R. Charles Kincaid	July, 1951	4 Years, 6 Months
Eino A. Koski	March, 1952	3 Years, 9½ Months
Lionel N. Larson	October, 1951	4 Years, 2½ Months
Bernhardt H. Petersen	November, 1950	5 Years, 1½ Months
Kenelm C. Winslow	August, 1953	2 Years, 5 Months
P. Daniel Isaacson	November, 1940	10 Years, 4½ Months
C. Arthur Koski	June, 1941	11 Years, 1 Month
F. Alfred Koski	January, 1936	15 Years, 9 Months
W. Harlow Stannard	November, 1940	15 Years, 2 Months
Lembit L. Liivoja	January, 1952	3 Years, 11½ Months
Anselm H. Mantyla	July, 1948	7 Years, 5½ Months
George B. Manzoline	December, 1947	5 Years, 9½ Months
Louis R. Miller, Jr.	August, 1945	10 Years, 3½ Months
Jean C. Jensen	July, 1951	4 Years, 5½ Months
Clifford H. Amel	May, 1944	11 Years, 7½ Months
Robert E. Anderson	July, 1948	7 Years, 6 Months
Clarence P. Ayotte, Jr.	April, 1948	7 Years, 8½ Months
Allan L. Bjork	April, 1952	3 Years, 9 Months
Charles W. Cornish	January, 1951	3 Years, ½ Month
Alfred B. Nault	September, 1946	9 Years, 3½ Months
Ernest A. Oja	March, 1943	12 Years, 10 Months
Joseph J. Scoleri	May, 1951	4 Years, 7½ Months
John R. Sleeman	February, 1947	8 Years, 10½ Months
Martin D. Tasson	August, 1948	5 Years, 5 Months
Allan E. Wakkuri	January, 1951	4 Years, 11½ Months
Clyde C. Anderson	December, 1950	5 Years, 1 Month
Henry C. Coron, Jr.	April, 1953	2 Years, 6 Months
Arthur W. Hemmila	June, 1953	2 Years, 7 Months
Donald G. Johnson	June, 1953	1 Year, 4 Months
Donald E. Lampi	April, 1951	4 Years, 9 Months
William R. Lehmann	February, 1952	3 Years, 10 Months
Arnold A. Sundell	February, 1951	4 Years, 11 Months
Richard L. Swanson	June, 1952	1 Year
Wilburt H. Thomas	January, 1951	5 Years

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	227		9	19
Eric G. Beinlich, Jr.	246½	10½	1	18
Keith R. Busby	228			6
Joseph D. Crites	183			9
Robert B. Davis	15			

Name	Days Worked	Overtime	Sick	Absent
Robert M. DeGabriele	255			
Robert J. Flynn	245			10
Robert G. Fountain	245			10
Oiva W. Hakala	236	1½	8	12½
Allen H. Heikkinen	249¼	11¼		17
Albert Henry	248	6	1	12
LeRoy Hosking	245			10
R. Charles Kincaid	248	2		9
Eino A. Koski	245		1	9
Lionel N. Larson	193	11½	51	22½
Leamon G. McGee	52	1		13
John F. Magnuson	62			2
Bernhardt H. Petersen	246	1		10
Victor E. Swan	71		4	
Kenelm C. Winslow	236	2		21
P. Daniel Isaacson	240½	10		24½
C. Arthur Koski	245	1		11
F. Alfred Koski	246	12		21
W. Harlow Stannard	240			15
Lembit L. Liivoja	244½		½	10
Anselm H. Mantyla	243			12
George B. Manzoline	243½		1½	10
Louis R. Miller, Jr.	239		2	14
Jean C. Jensen	245			10
Clifford H. Amel	244¼	3/4		11½
Robert E. Anderson	247	3	1	10
Clarence P. Ayotte, Jr.	246½	3	1	10½
Allan L. Bjork	244			11
Charles W. Cornish	204			10
Herbert S. Kelly	29		3	9
Alfred B. Nault	248	3		10
Ernest A. Oja	244½		½	10
Ralph K. Oja	39			
Joseph J. Scoleri	246	3	1	11
John R. Sleeman	259	4		
Martin D. Tasson	245-3/4	1-3/4		11
Arnold E. Townsend	95			11
Allan E. Wakkuri	246	3	2	10
Clyde C. Anderson	253	4	4	2
John P. Clark	57			9
Henry C. Coron, Jr.	182		8	11
Arthur W. Hemmila	241	1	10	5
Donald G. Johnson	54			
Donald E. Lampi	242			13
William M. Leaf	25			
William R. Lehmann	245	2	1	11
Lowell P. Marjama	39		5	
George M. Olson	84½		1½	10
Arnold A. Sundell	242½	2	1½	13
Richard L. Swanson	96		1	
Wilburt H. Thomas	231		14	10
Raymond S. Windsand	32			9

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		48	179	227
Eric G. Beinlich, Jr.	136¼	½	109-3/4	246½
Keith R. Busby	49½		178½	228
Joseph D. Crites		169	14	183
Robert B. Davis	½	¼	14¼	15
Robert M. DeGabriele	Distribution not reported.			255
Robert J. Flynn		208	37	245
Robert G. Fountain		10	235	245
Oiva W. Hakala	34	6	196	236
Allen H. Heikkinen		222¼	27	249¼
Albert Henry		146¼	101-3/4	248
LeRoy Hosking		154-3/4	90¼	245
R. Charles Kincaid	62½	7	178½	248
Eino A. Koski	47		198	245
Lionel N. Larson	49½	2½	141	193
Leamon G. McGee	28¼	2	21-3/4	52
John F. Magnuson	14	9	39	62
Bernhardt H. Peterson	Distribution not reported.			246
Victor E. Swan		16	55	71
Kenelm C. Winslow		56	180	236
P. Daniel Isaacson	92	4	144½	240½
C. Arthur Koski	162	22	61	245
F. Alfred Koski	1	186	59	246
W. Harlow Stannard			240	240
Lembit L. Liivoja			244½	244½
Anselm H. Mantyla			243	243
George B. Manzoline			243½	243½
Louis R. Miller, Jr.			239	239
Jean C. Jensen			245	245
Clifford H. Amel		180-3/4	63½	244¼
Robert E. Anderson	151½	5	90½	247
Clarence P. Ayotte, Jr.	133-3/4	3½	109¼	246½
Allan L. Bjork	106½	22	115½	244
Charles W. Cornish	37½	132	34½	204
Herbert S. Kelly	9½		19½	29
Alfred B. Nault	122-3/4	1½	123-3/4	248
Ernest A. Oja		202	42½	244½
Ralph K. Oja		34½	4½	39
Joseph J. Scoleri	132	3½	110½	246
John R. Sleeman	177	16½	65½	259
Martin D. Tasson		198¼	47½	245-3/4
Arnold E. Townsend	40	14	41	95
Allan E. Wakkuri	128½	3½	114	246
Clyde C. Anderson	156	8½	88½	253
John P. Clark		39½	17½	57
Henry C. Coron, Jr.		109½	72½	182
Arthur W. Hemmila	124-3/4	3½	112-3/4	241
Donald G. Johnson	13½	17	23½	54
Donald E. Lampi		198½	43½	242
William M. Leaf		25		25

Name	Underground	Field	Office	Total
William R. Lehmann	133-3/4	1	110¼	245
Lowell P. Marjama		37	2	39
George M. Olson	25	3	56½	84½
Arnold A. Sundell	129-3/4	1½	111¼	242½
Richard L. Swanson	67	½	28½	96
Wilburt H. Thomas	102	3½	125½	231
Raymond S. Windsand	12	3	17	32

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

MINING ENGINEERING DEPARTMENT PERSONNEL - 1955

	BUNKER HILL	CAMBRIA-JACKSON	CLIFFS-SHAFT	HUMBOLDT	LLOYD	MAAS
MINE ENGINEER	L. N. Larson	Combined		A. Henry	Combined	Combined
ASS'T MINE ENGINEER		with	C. A. Koski		with	with
SURVEYOR	R. E. Anderson	Mather Mine,	A. L. Bjork	C. H. Amel	Mather Mine,	Bunker Hill
HELPER	C. C. Anderson R. L. Swanson G. M. Olson D. G. Johnson (Dec. 1955)	"B" Shaft			"A" Shaft	
TECHNICAL FOREMAN	K. R. Busby B. H. Peterson E. G. Beinlich (UG Foreman) J. R. Sleeman (Conveyor Belt Installation)		R. M. DeGabriele (Construction Engineer)			

	MATHER "A"	MATHER "B"	OHIO	REPUBLIC	SPIES	TILDEN
MINE ENGINEER	O. W. Hakala	R. C. Kincaid		R. J. Flynn		
ASS'T MINE ENGINEER	P. D. Isaacson					
SURVEYOR	C. P. Ayotte J. J. Scoleri	A. B. Nault A. E. Wakkuri	C. H. Amel	C. W. Cornish	A. E. Townsend	C. H. Amel
HELPER	W. R. Lehmann W. H. Thomas	A. W. Hemmila A. A. Sundell			Operation ceased	
TECHNICAL FOREMAN		E. A. Koski (Development Engineer)	A. H. Heikkinen (Pit Foreman)	J. D. Crites (Pit Foreman)	June, 1955	A. H. Heikkinen (Pit Foreman)

	NEGAUNEE & REPUBLIC TOWNSITES	MARQUETTE RANGE GENERAL SURVEY CONTROL
MINE ENGINEER	L. Hosking	
ASS'T MINE ENGINEER		F. A. Koski
SURVEYOR	E. A. Oja	M. D. Tasson
HELPER	D. E. Lampi	H. C. Coron (part time)

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

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	%
Mining Engineering General	1,501.25	14.238
Bunker Hill Mine	728.25	6.907
Cambria-Jackson Mine	181.75	1.723
Cliffs-Shaft Mine	792.00	7.511
Humboldt Mine	471.25	4.469
Lloyd Mine	115.50	1.095
Maas Mine	481.25	4.564
Mather Mine		
"A" Shaft	1,244.75	11.806
"B" Shaft	1,181.75	11.208
"B" Shaft--House Moving	1.50	.014
E&A NM-90 (Conveyor Belt and Crusher)	.50	.005
E&A NM-90 ba (9th Level Conveyor Belt)	4.50	.042
E&A NM-90 bb (9th Level Crusher)	2.00	.018
E&A NM-90 bc (9th Level Discharge End and Excavation)	39.00	.369
E&A NM-90 bd (9th Level Load End Excavation)	17.75	.168
E&A NM-90 be (9th Level Conveyor Drift Excavation)	12.00	.113
E&A NM-101 (Main Level Development - 8th and 9th Levels)	.50	.005
E&A NM-101-8-a (Drifting - 8th Level)	39.75	.377
E&A NM-101-9-a (Drifting - 9th Level)	54.75	.519
E&A NM-102 (Installation of Sub-Level Conveyor Belts - 8th and 9th Levels)	6.00	.056
E&A NM-103-2-j (Exploration - 2nd Level)	3.00	.028
E&A NM-103-5-d (Drifting - 5th Level)	4.00	.037
E&A NM-103-6-d (Drifting - 6th Level)	5.00	.047
E&A NM-103-6-j (Exploration - 6th Level)	2.00	.018
E&A NM-103-7-d (Drifting - 7th Level)	3.50	.043
E&A NM-103-8-d (Drifting - 8th Level)	20.25	.192
E&A NM-103-8-j (Exploration - 8th Level)	1.00	.009
E&A NM-103-8-v (Ventilation - 8th Level)	10.50	.099
E&A NM-103-9-b (Pockets, Trenches and Equipment - 9th Level)	18.25	.173
E&A NM-103-9-d (Drifting - 9th Level)	36.75	.348
E&A NM-103-10-d (Drifting - 10th Level)	54.75	.519
E&A NM-103-10-k (Raise above Level - 10th Level)	1.00	.009
E&A NM-111-7-d (Installation of Conveyors and Crushers on 7th Level - Drifting)	10.25	.097
E&A NM-112 (House Moving Project - Cliffs Fourth Addition)	16.50	.156
E&A NM-44-0-a (Crusher, Pan Feeder and Grizzly - 5th Level)	6.50	.061
E&A NM-44-0-c (Steel Supports for Belt Crusher and Feeder - 5th Level)	4.00	.037
E&A NM-44-0-d (200' of Belt Drift - 5th Level)	8.25	.078

Property	Total	%
E&A NM-44-O-B-c (Steel Supports for Belt, Crusher and Feeder - 8th Level)	31.25	.296
E&A NM-44-O-B-d (450' of Belt Drift - 8th Level)	24.00	.227
E&A NM-44-O-B-e (Trench and Loading End Excavation - 8th Level)	5.00	.047
E&A NM-44-O-B-f (Discharge End Excavation - 8th Level)	3.00	.028
E&A HM-44-O-B-h (Ore Pass - 7th Level)	2.00	.018
Ohio Mine	271.75	2.577
Spies Mine	159.25	1.510
Tilden Mine	61.25	.580
Morris Mine	3.25	.040
Minnesota Mines General	3.50	.043
Deferred Accounts:		
Balling Disk Study	11.00	.104
Canadian Cliffs Limited	.50	.005
Cliffs Fourth Addition	18.75	.177
Coal Department	6.50	.061
Lakeview	35.50	.336
Railroad Relocation	85.00	.806
Rifle Range	9.50	.090
Teal Lake Lands	12.50	.118
Land Offer 3110	1.00	.009
Land Offer 3163	4.00	.037
Outside Exploration 1131	3.00	.028
Outside Exploration 1155	2.00	.018
Outside Exploration 1158	24.00	.227
Outside Exploration 1159	13.00	.123
Outside Exploration 1164	12.50	.118
E&A CC-345 (Negaunee Shaft)	2.00	.018
E&A CC-491-A-a-2 (Republic Mine)	648.75	6.153
E&A CC-491-J-b (House Moving Project - Republic)	333.50	3.163
E&A CC-522 (Empire)	37.25	.353
E&A CC-593 (Allen Forty)	.25	.002
E&A CC-600 (Titan)	.25	.002
E&A CC-619 (Bunker Hill--Athens Drifting)	472.50	4.481
E&A CC-623 (Bunker Hill Underground Drilling)	12.50	.118
E&A CC-654-A-1-a (Eagle Mills Pelletizing Plant)	242.75	2.302
E&A CC-659 (Belleview Exploration)	31.00	.294
E&A CC-662 (Maas--Bunker Hill Connecting Drift)	450.50	4.272
E&A CC-666 (Drying Plant)	3.00	.028
E&A CC-668 (Cascade East End)	59.25	.561
E&A CC-669 (Perkins)	213.75	2.027
E&A CC-684 (Bunker Hill Heating Plant)	20.25	.192
E&A CC-685 (Bunker Hill Shop Addition)	8.25	.078
E&A CC-699 (Rock-Osier)	77.50	.735
E&A CC-701 (Cliffs Third Addition)	26.50	.251
E&A CC-702 (Fitch)	12.50	.118
E&A CC-739 (Drilling, Section 10, 47-27)	3.50	.043
E&A CC-745 (Drilling, McColeman Lands)	3.00	.028
	10,543.25	100.000%

F. COSTS

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

	1953	1954	1955
Salaries	$287,600.45	$275,507.92	$232,704.00
Travel & Entertainment	4,480.99	1,497.21	772.00
Dues & Subscriptions	185.65	100.00	146.00
Telephone & Telegraph	570.33	530.25	575.00
Printing, Stationery & Special Supplies	10,252.94	10,929.32	6,554.00
Heat, Light, Power & Water	1,085.34	985.03	224.00
Furniture & Fixtures	2,479.72	2,222.86	65.00
Unemployment Insurance	2,177.52	2,299.38	12.00
Auto Expense	7,581.21	9,220.88	7,049.00
Old Age Benefits Tax	3,047.05	4,050.08	84.00
Donations	375.80	49.47	
Group Annuity Premiums	2,707.35	6,201.90	8,015.00
Repairs & Maintenance	1,091.93	830.69	56.00
Insurance	688.31	921.19	837.00
Postage & Express	129.04	233.62	201.00
State Franchise, Property & Miscellaneous Taxes	50.63	50.63	20.00
Depreciation - Buildings & Equipment	3,034.00	2,956.00	3,279.00
Cleaning & Janitor Supplies	36.40	254.44	
Personal Injury Expense			12.00
Field & Specialized Equipment including Maintenance	15,080.07	3,335.44	1,418.00
Building Alterations			331.00
Rentals	55.00	13.33	
Miscellaneous	6,954.37	2,749.06	1,647.00
Totals	$349,664.10	$324,938.70	$264,001.00

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) and the Chevrolet Handyman (1953 model) by the surface survey crews. The Chevrolet Carryall (1949 model), which was assigned to the Negaunee and Republic Townsites crews, was operated until May 21st when it was replaced with a 1955 model Chevrolet Carryall. The Chevrolet Carryall (1950 model), which was assigned to the Humboldt Mine engineering crew, was operated until November 30th when it was replaced with a 1956 model Ford Ranch Wagon.

The following table shows the mileage covered in 1955, the total mileage to the end of the year and the date the cars were received in the Department:

Car	Miles 1955	Miles Total	Date Received	Date Disposed of
Ford Ranch Wagon (1952 model), #29	15,700	50,990	6/20/52	
Ford Ranch Wagon (1953 model), #48	15,730	39,800	7/30/53	
Ford Ranch Wagon (1956 model), #77	850	850	11/30/55	
Chevrolet Carryall (1949 model), #21	3,565	61,267	6/13/49	5/21/55
Chevrolet Carryall (1950 model), #22	9,990	59,440	6/1/50	11/30/55
Chevrolet Carryall (1955 model), #69	9,777	9,777	5/21/55	
Chevrolet Handyman (1953 model), #49	12,841	35,941	8/14/53	

I. MINES

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

BUNKER HILL MINE - Lionel N. Larson, Mining Engineer

(1) The extension of the shops and engine house, plus the construction of a heating plant, required lines and elevations.

(2) Considerable time was spent in the engine house to establish center lines for the new skip hoist installation. Center lines and anchor bolts were set and concrete poured for the M.G. installation in the engine house addition.

(3) Considerable time was spent plumbing and taping the Bunker Hill Shaft prior to the Maas-Bunker Hill connection on the 2nd Level. A four-crew check survey was also run from the Maas 6th Level to the old Negaunee Mine 14th Level, with good results.

(4) In December, the Maas and Bunker Hill were connected by a 1000' rock drift from the Maas 7th Level to the Bunker Hill 4th Level. The connection was perfect as to line and grade.

(5) The shaft was gauged in October and the necessary corrections were made to the sets and runners in preparation for the hanging of the new twelve-ton skips.

(6) The installation of the 14th Level conveyor was started in July and progressed satisfactorily until November 15th, at which time its progress was halted to allow further rock development at the crusher station.

The discharge end of the conveyor and approximately 2300' of steel supports and idlers have been completed.

(7) Two ore and rock transfer raises were put up from the 14th Level to the 12th Level and on up to the 10th Level. These raises required much of the Surveyors' time.

(8) Two raises from the 6th Level trench to the 2nd Level were also put up. These raises will transfer the ore and rock from the Maas 7th to the Bunker Hill 6th.

(9) Drawings and surveying were required for the relocation of the 10th Level fan.

(10) Stockpiles at the Bunker Hill were surveyed and calculated in May. This survey showed an overrun of 8.13%.

(11) In June, the shaft was taped from 6th to 14th Level to establish elevations for the conveyor installation. A six-angle check survey was also carried in on the 14th Level.

(12) Most of the Engineer's time was consumed by mine planning, report writing, supervision of the survey crews, ore and production estimates and capital expenditure forecasts.

(13) A precise survey control, both horizontal and vertical was established between the Bunker Hill and Maas surfaces. Some difficulty was encountered with measuring due to heavy snow and extreme temperatures. The entire survey was taped four times, the resulting closure for the last two tapings was 0.06 ft. Numerous attempts were made to project the meridian underground at the Maas Shaft, the average results were not too encouraging.

(14) The West stocking area was contoured at the Bunker Hill Mine and subsidence surveys were also made.

CAMBRIA-JACKSON MINE - R. Charles Kincaid, Mining Engineer

(1) Throughout the year, lines and grades were surveyed by one, two-man crew in the various development areas.

(2) The Engineer's presence was required in the planning of a percussion-type exploration drilling program during the year.

(3) A considerable amount of survey work was necessary in the construction and installation of the North stocking trestle.

(4) Throughout the latter part of 1955, the Mining Engineer was responsible for the writing of the monthly reports, laying out of mining plans and assisting in the 1956 production and cost estimates.

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

(1) During the construction of the foundations and installation of hoisting equipment and other headframe equipment, the Mining Engineer and his survey crew were called upon for "lines and grades" work, design, layout and leveling.

(2) The alteration of the surface plant, specifically, the new tunnel, the motor-generator set room and foundations, railroad car loading pocket facilities, the new surface foremen's office, the new boiler house, the new sollar on the stocking grounds, the conveyor gallery from the headframe to the railroad loading pocket, the building containing the rock pocket and screens, etc., and the renovation of parts of the dry house, called for survey control work, layout and inspection during their construction.

(3) Engineering personnel assigned to the property gauged "A" and "B" Shafts twice during the year. The runners in the "C" Shaft skip compartment were

gauged prior to the operation of the skips and the runners in the cage compartment were gauged four ways prior to the installation of the Koepe cage.

(4) The stockpiles at the mine were surveyed many times during the first half of the year in an attempt to establish a new skip factor.

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

(6) During the year a mixing agreement was entered into by The Cleveland-Cliffs Iron Company and the Oliver Iron Mining Division. Following the institution of this agreement, it became necessary for the engineering personnel to maintain accurate production analyses records under the terms of the agreement.

(7) During the shaft sinking operation, "C" Shaft was plumbed several times and the alignment and elevations of the steel sets were checked. Upon completion of the shaft, it was plumbed from top to bottom and found to vary a maximum of 3/8" throughout.

(8) The rock excavation pertinent to the ore pass raises, skip loading pockets, skip pit, crushing station room, travelling raises and cut-outs for dumping stations at ore pass raises made it necessary to perform continuous survey control work.

(9) During the construction of foundations, steel frame work, pockets, skip pit loading facilities and dumping station facilities and the installation of crusher station equipment, the Mining Engineer and his survey crew were called upon for "lines and grades" work, layout, leveling and inspection during construction.

(10) A study of mine water problems was instituted and conducted with the result being a decision to construct a new pumping station and install an automatic pumping set-up. Engineering personnel conducted this study.

(11) The new pumping installation required design and layout work. The rock excavation pertinent to this installation and the new sump made it necessary to perform continual survey work.

(12) Plans for starting several shrinkage stopes were instituted during the year and the Mining Engineer and survey crew were called upon for layout, "lines and grades", and continual survey work.

(13) The survey crew assisted the Mine Geologist in some time study work, the preparation of several estimates of some small second class orebodies and some work on the Deep Soft Ore Study.

(14) The annual estimate of proven ore reserves and the attending report were prepared and submitted. Several other reports of other than routine nature were also prepared and submitted.

(15) 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.

(16) The Mining Engineer and survey crew also assisted in various pillar recovery projects throughout the year.

(17) The following tabulation summarizes some of the events of the commencement of operations in "C" Shaft:

a. The first skip was installed on August 12, 1955.

b. The first rock was hoisted through "C" Shaft with the Koepe equipment on September 1, 1955.

c. The second skip was installed on September 20, 1955.

d. The first ore was hoisted through "C" Shaft with the Koepe equipment on November 8, 1955.

e. The "C" Shaft was exclusively used for production from December 5, 1955 to date.

f. The cage, skip and ropes were removed from "A" Shaft on December 12, 1955 and the hoist dismantled.

g. The "C" Shaft cage was installed on December 12, 1955 with motive power being supplied by the temporary sinking hoist.

h. A record production of 2,816 tons was hoisted through the "C" Shaft plant on December 15, 1955.

i. The use of the "B" Shaft hoist, skip and cage was discontinued on December 19, 1955, and "C" Shaft became the only operating shaft at the Cliffs-Shaft Mine.

HUMBOLDT MINE - Albert Henry, Mining Engineer

(1) The jet pierced blast holes were located, sampled and loaded. All possible data was recorded that might improve efficiency.

(2) The monthly pit progress was surveyed. This was entered on the maps along with geological and exploration diamond drilling data. Crude ore and stripping estimates were prepared as mining progressed. The daily pit-mill results were entered by blasts on the bench maps. Complete jet operating data and oxygen loss was recorded. The Joy rotary drill was tested in various sections of the pit.

(3) Miscellaneous field work included shovel and wagon drilling grades, tailings pond study, monthly water samples, township baseball diamond, mill construction, culverts, power pole locations and locating old mine shafts in the area.

LLOYD MINE - Oiva W. Hakala, Mining Engineer

(1) A proposed mining plan was prepared for the possible development of the orebody which lies above the #3 cross-cut on the Lloyd Mine's 10th Level. Two diamond drill holes, U.H. #191 and U.H. #192, were drilled from the 10th Level. U.H. #191 was drilled to the Southeast at +15° from the #3 East cross-cut and U.H. #192 was drilled North at -45° from the #3 cross-cut. Both holes were very discouraging and prompted the decision to close the property.

(2) Ore reserves at the end of 1955 totalled 33,581 tons with 5,701 tons being Non-Bessemer Lloyddale and 27,880 tons being sulphurous ore. Mining of this small tonnage was uneconomical because it was not possible to maintain grade and production.

(3) On December 12th, mining operations were terminated and all employees, except a small salvage crew, were transferred. Salvage operations continued for the remainder of the year and should be completed in January, 1956. The mine will be allowed to fill with water and the Lloyd and Section 6 Shafts capped. Dams on the 4th and 7th Level Lloyd-Morris connecting levels will be constructed by the Inland Steel Company.

(4) In addition to the routine survey work and mapping at the Lloyd Mine, the tax estimate was completed and the North and Northeast stockpiles were surveyed and estimates of ore in stock calculated.

MAAS MINE - Lionel N. Larson, Mining Engineer

(1) Plumbings in the Maas Shaft were completed in March, with five being made from surface to 2nd Level, two from 2nd to 6th Level and two from 6th to 7th Level.

(2) A six-angle check survey was made from the shaft to the winze on the 6th Level and from the winze to the heading in the extension drift on the 7th Level.

(3) Elevations were carried from the Bunker Hill to the Maas on surface. The Maas Shaft was then taped, consolidating the elevations in the two mines.

(4) The surface survey crew ran a contour on the West stockpile sollar in July.

(5) The Maas 7th and the Bunker Hill 2nd holing-through took place during the first half of December. Elevations were run to establish a uniform track grade throughout.

(6) The Negaunee-Maas cave outline was run in the spring. Very little change was noted.

(7) Most of the Engineer's time was consumed by report writing, mine planning, supervision of the survey crews and ore and production estimates.

MATHER MINE

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

(1) The development activity on the 9th and 9½ Levels and the conveyor belt drift required the careful planning of the Mining Engineer and survey control by the survey crews.

(2) The development of the 8th and 9th Levels haulage drifts and crosscuts and the rock excavation for the 9½ to 9th Level storage raise required continual survey control.

(3) The engineering personnel assisted in a ventilation survey in cooperation with the Safety Department.

(4) A stockpile quantity survey was performed, the results plotted and calculated. This procedure of confirming the cubic foot per ton stockpile factor is necessary every year or so due to the varying structure, moisture and stocking methods.

(5) Another main level drift holing-through job between "A" and "B" Shafts occurred during the year. This 5th Level connection was perfect for both grade and alignment, thus proving for the fourth time that the engineering services at this property are worthy of repeated praise.

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

(1) Throughout the year the Engineering Department personnel assigned to this property took care of the day to day surveying of mining and development contracts, compilation of stope analysis data, posting of analysis maps and taking water elevations in the Jackson Pit Area.

(2) This year the Engineer was responsible for the writing of the weekly, monthly and annual reports, figuring contract miners' incentive earnings, determining the quarterly steel requirements and calculating the Michigan State Tax and Federal Tax Estimates.

(3) With the installation of the 100,000 c.f.m. Joy Fan on the 8th Level, a number of ventilation surveys were required by both the Engineer and the Safety Department.

(4) Application of exploration drilling with a small percussion-type drill was started during the year. The results are very accurate and a much lower cost than the standard diamond drilling method.

(5) The Mining Engineer assisted in the North Jackson Drainage Project, which required the locating of a number of wells and recording pumping data.

(6) The quarterly E&A cash forecast was also handled by the Engineer along with a subsidence report on U.H. #170 which was drilled from the 4th Level.

OHIO MINE - Allen H. Heikkinen, Mining Engineer

(1) Drill holes were surveyed in the Titan Lease.

(2) Pit blasts were calculated and supervised.

(3) Ore reserve estimates and future mining plans were computed.

(4) Alignment and grade staking of the new haul road from the West Pit were prepared.

(5) The new pole line to the South side of the West Pit was surveyed.

REPUBLIC MINE - Robert J. Flynn, Mining Engineer

(1) Lines and elevations were placed for the various contractors, as

well as lines, grades and inspection of the concreting of the No. 1 conveyor tunnel. Grades were set on all the building piers and conveyor pedestals in the concentrating plant. Grades were also set and inspection made of the floor slabs in the shops and mill.

(2) Surveys were run and drawings made for bidding of the 20" fresh water line to the Michigamme River; the 20" reuse water line to Milwaukee Lake and the 6" steam and 3" condensate line from the shop building to the fine crushing building. These projects were also followed up with the necessary field work to completion.

(3) The dike work for the year consisted of lines, grades and slope staking of the greater portion of the dike, running of new lines to secure a better route, placing of two overflows and numerous surveys to determine the drainage action of various areas after the dikes are completed. Some of the borrow pits were cross-sectioned and the yardage calculated.

(4) The grading projects which were handled by the engineering force in conjunction with C. C. I. personnel are as follows: North pit road, South pit road, access road, road from shops to primary crusher, drainage system at plant site, road from mill to stockpile area and the stockpile area.

(5) The rod and ball mills, hydroscillators and thickeners were leveled. All conveyors were aligned.

(6) The pit was cross-sectioned at 50' intervals to determine stripping yardage and also the ore above the 1600' bench.

(7) Monthly maps were also posted showing the progress of these various projects.

(8) A survey was run for the construction of 7200 lineal feet of fencing around a portion of the mine. Drawings were made and the project was inspected until completion.

(9) Pajula and Maki constructed a pump house on the Michigamme River, and is now building a first aid room in the shops, a pump house on Milwaukee Lake and a concrete slab for the Linde Driox storage tank. Lines and levels were placed for these projects.

(10) Surveys were made and stakes set for a system of power lines to serve the plant and pit.

(11) Calculations were made of the floor grating and the corrugated sheeting placed by the contractors.

SPIES MINE

(1) Discovery of high grade ore along the boundary between The Cleveland-Cliffs Iron Company's Spies Operation and the Inland Steel Company's so-called MacDonald Lease made it necessary to establish accurate and precise sixteenth corners in the SW¼, Section 24, 43-35. Joint C.C.I.--Inland surveys were run so that common coordinate values could be determined.

(2) On June 2nd, mining operations were terminated.

(3) An inspection was made of the new Spies cave (approximately 300' in diameter), which is located 300' North of the junction of highway US-2 and the Bates Mine road. Protective fences were placed around the mined areas and "Danger--Caving Ground" signs were posted.

TILDEN MINE - Allen H. Heikkinen, Mining Engineer

(1) Layout was planned and cut and fill supervised for the new stocking area and the L. S. & I. track relocation.

(2) Ore reserve estimates were computed and plans prepared for the lease of parts of the East and West Pit Ore Reserves to the M. A. Hanna Company.

(3) Pit blasts were calculated and supervised.

(4) Ore reserve estimates and future mining plans were computed.

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 8/31/54	As of 8/31/55
Athens	1,518,244	680,566
Bunker Hill	3,263,759	2,731,043
Cambria-Jackson	477,588	458,767
Cliffs-Shaft	1,600,472	1,316,679
Lloyd	214,607	76,953
Maas	3,851,937	3,291,952
Mather		
"A" Shaft	4,987,166	8,802,460
"B" Shaft	19,607,265	17,340,277
Spies	193,038	0
Total Developed Ore	35,714,076	34,698,697
Undeveloped Reserves		
Section 3, 47-27	302,378	302,378
Grand Total All Ores	36,016,454	35,001,075

STOCKPILES

Estimates of the ore in stock were made by the Engineering Department at the Lloyd and Spies Mines.

The following table shows the comparison of ore in stock on November 1, 1954 and November 1, 1955:

Mine	Nov. 1, 1954	Nov. 1, 1955
Bunker Hill		
Athens Shaft	127,476	83,690
Bunker Hill Shaft	167,763	21,056
Cambria-Jackson	106,350	0
Cliffs-Shaft	181,896	39,054
Humboldt	15,618	86,412
Lloyd	222,611	148,064
Maas	273,199	91,263
Mather		
"A" Shaft	644,317	14,648
"B" Shaft	170,411	32,247
Ohio	18,903	0
Spies	132,701	25,140
Tilden	18,874	62,572
Totals	2,080,119	604,146

COAL PILES

At the request of the Reiss Coal Company, the coal piles at the Green Bay docks were cross-sectioned during the first week of July, the quantities calculated and supplied to their management.

SHAFT GAUGING

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

Mine	Date
Bunker Hill	October 29th
Cliffs-Shaft	January 13th July 1st
Mather Mine, "A" Shaft	May 14th

REPUBLIC TOWNSITE - LeRoy Hosking, Engineer

(1) In February, the plans of the plat design, the grading of streets and alleys and the sewer and water systems of the proposed Republic Townsite were forwarded to the Marquette County Road Commission, the Marquette County Plat Board and the Republic Township Board for consideration, appraisal and approval by these groups.

(2) Plans of the water distribution and sanitary sewer systems, the design of the 8" water supply main from the Republic Mine to the Townsite and

the sewage disposal plant were forwarded to the Michigan Department of Health in May for their approval and construction permits. Typical of all State agencies, we did not receive this approval until the latter part of August which delayed actual construction into the fall and early winter.

(3) The final plat maps of the Republic Townsite were received from the printers in June and were sent to the various local, county and state officials for their signatures. In October, the Michigan State Highway Department demanded a bond covering the completion assurance of two doubtful highway approaches and a "line of sight" feature before they would approve the plat and send it to the Auditor General's Department. This office in turn did not approve the plat because, in the Attorney General's opinion, a mineral reservation could not be included within the dedication portion. In other words, "the interested parties" could not dedicate the use of the highways to the public and still reserve unto themselves the minerals beneath the streets and alleys. The dedication was revised and these maps were re-lithographed, omitting the reservation clause, and again sent out for approval. As of the end of the year, the signed plat maps had not been received at this office.

(4) A total of eight houses were moved from the critical blasting area to the new Townsite by Charles W. Moore, house moving contractor, during September, October and November.

(5) The field engineering crew assigned to this project performed the following surveying duties in connection with the Republic Plat:

a. prepared plans for the 8" water supply line to the plat and sanitary sewer facilities within the plat.

b. ran location lines and prepared profiles for the water and sewer installations.

c. grade staked the entire Townsite area for the site grading contractor.

d. placed lot and block corner monuments.

e. supervised the actual house moving and basement construction.

CLIFFS THIRD ADDITION - LeRoy Hosking, Engineer

(1) In April, the Lakeview Plat was submitted to the City of Negaunee's Council, who in turn approved of our design and tentative construction of this plat, the Third Addition to the City of Negaunee.

(2) The final plat maps of the Cliffs Third Addition to the City of Negaunee were received from the lithographers in June and were sent to the various local, county and state officials for their signatures. Because, in the Attorney General's opinion, a mineral reservation could not be included within the dedication portion, the plat maps were returned to this office for revision. These maps were re-lithographed, omitting the reservation clause, and were again sent on for approvals. As of the end of the year, the signed plat maps had not been received at this office.

CLIFFS FOURTH ADDITION - LeRoy Hosking, Engineer

(1) Sewer data was compiled and contour maps and tentative lot design prepared for the Cliffs Fourth Addition to the City of Negaunee. This addition will occupy the present Maas Mine stocking area. It is intended that this area will be used for the houses which must be removed from the Gas House Location, South of the Cambria-Jackson Mine, and those houses on Maas--Pioneer & Arctic Lands. Work in this area in 1955 included development of six lots only. Further development of the area will await the perfection of title and the permission of the mineral owner, namely, the Muck Interests, in establishing an authorized plat.

(2) One house, the Johnson house, was moved from the Gas House Location to this newly developed housing area after the necessary temporary water and sewer installations were completed.

EAGLE MILLS PELLETIZING PLANT - LeRoy Hosking, Engineer

(1) Base lines and elevations were established, cross-sections prepared and earth quantities calculated for the grading phase of the plant construction.

(2) In Sections 34, 35 and 36, 48-26 and Sections 1 and 2, 47-26, control points for both horizontal and vertical control were surveyed for use in the aerial mapping of this area.

(3) Base lines and profiles were run for use in the seismic surveys.

(4) Final cross-sections were run and quantity estimates prepared for the settlement between The Cleveland-Cliffs Iron Company and the L. S. & I.

(5) Location, profile and construction staking was done for the process water line and power line to the new pump house on the Carp River, South of the plant site.

(6) Potable water wells and pipe lines to the plant were located.

(7) A survey was made for relocating the 30 KV transmission line in the plant area and for location of the new U. P. Power Company's line around the boundaries of Sections 34, 35 and 36.

(8) Preliminary work, clearing and grading stakes were set for the stocking area West of the plant and for the railroad facilities in this area.

(9) Topographic maps were prepared for the entire area; Sections 34, 35 and 36, 48-26

(10) A wind and weather map was made for the discussion as to the advisability of locating this pelletizing plant in the vicinity of the Morgan Heights Sanatorium.

(11) The Engineering Department was called upon to assist in the "around the clock" inspection work during the construction of the concrete bin sections which were poured by the use of slip forms.

SURVEY CONTROL - MARQUETTE RANGE - F. A. Koski, Engineer

ISHPEMING DISTRICT

(1) Considerable time was spent on the establishment of survey control in Section 24, 47-28 (Fitch Mine Area). Drill holes were laid out and surveyed and profiles prepared for the electromagnetic geophysical work.

NEGAUNEE DISTRICT

(1) In anticipation of the exploration of the Belleview Farm Area, section and quarter corners were established and control surveys performed in Sections 17 and 18, 47-26.

(2) In cooperation with the Jones & Laughlin Steel Corporation, control surveys were established and drill holes located and surveyed in the Teal Lake Lands Area.

CASCADE DISTRICT-CASCADE EAST END

(1) Considerable field work was required in Section 27, 47-26 for the extension of survey control, the planning of routes and the roads for present and future drilling.

SURVEY CONTROL - MENOMINEE RANGE - F. A. Koski, Engineer

PERKINS DISTRICT

(1) The Perkins--Rock--Osier Areas required considerable time for survey control work for geophysical prospecting and drilling programs.

SPIES DISTRICT

(1) Tentative and final drill hole surveys were established in the Gibbs City Area.

FRANCIS A. BELL MEMORIAL HOSPITAL

The work of landscaping and the grading of the driveway, parking lot and grounds was completed at the Francis A. Bell Memorial Hospital under the guidance of the Engineering Department.

RESEARCH LABORATORY

The installation of a fuel storage tank for the Research Laboratory required engineering assistance.

UPPER PENINSULA POWER COMPANY

One three-man field engineering crew was loaned to the Upper Peninsula Power Company for transmission line relocation work in the Gwinn--Sands Airport Area and the Eagle Mills Pelletizing Plant Area.

HOLIDAYS

The following holidays were granted during the year:

January 1st	-	New Year's Day
May 30th	-	Memorial Day
July 4th	-	Independence Day
September 5th	-	Labor Day
November 24th	-	Thanksgiving Day
December 26th	-	Christmas

Respectfully submitted,

Grant T. Hollett
Chief Mining Engineer

GTH:jcj

3-16-55

RESEARCH LABORATORY

ANNUAL REPORT - YEAR 1955

The Annual Report for 1955 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 highlight the various programs undertaken during the year. No attempt is made in this report to present special test data, conclusions or recommendations reached by completing any investigation. Many projects which can be considered minor in nature, however not mentioned in this report, are referred to only in monthly reports.

PART I

GENERAL TESTING PROGRAM

MAJOR PROJECTS:

Pilot Mill Tests:

Empire Area:

During the year several tests were conducted in the pilot mill employing the flowsheet as proposed for the Empire Mill. The program covered the complete study of the flowsheet, which involves rod mill grinding, dry magnetic cobbing, ball mill grinding of the rougher magnetic concentrate, classification at 400 mesh in the cyclone and final cleaning in the magnetic cleaning stage. Various tests were conducted to determine what effect varying the field strengths of the magnetic separators would have on the grade of the final concentrate.

During the fall roughly 150 tons of low grade ore from the Empire Area were crushed and trucked to the Laboratory. An additional 90 tons were hauled from the blasted site to the Laboratory for use in the Aerofall Mill and Cascade Mill grinding tests.

Aerofall Mill:

At the end of the year tests were started employing the Aerofall Mill grinding Empire crude ore. These tests are being conducted to investigate the Aerofall Mill grinding unit and to determine whether or not the resultant metallurgy of the ore so ground is improved as compared to the material ground in a conventional mill.

Land Offers & Outside Explorations:

During the year numerous priority samples submitted under Land Offers and Outside Exploration numbers were submitted to the Research Laboratory for test work. The bulk of these samples that were submitted were analyzed and no testing was conducted.

Plant Control Work - Humboldt - Ohio:

The plant control work conducted at the Research Laboratory for the operating plants involves such routine work as structures, bouyoucos determinations, heavy media loss determinations, and grindability tests.

Property X:

Testing was continued on drill core employing the standard magnetic oxide conversion-concentration tests. The bulk of the work during the year under this classification was the Cascade drill cores.

Some preliminary test and design work was completed in preparation for the installation of a one-ton-per-hour Dorr Oliver reactor unit. This pilot plant would be installed in the old pelletizing pilot plant building at the rear of the Laboratory. The MOC pilot plant is scheduled to start operations in June, 1956.

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.

Specular Hematite Flowsheet Development:

During the first part of the year pilot mill tests were conducted on Humboldt crude ore to determine the feasibility of concentrating a portion of the crude material by gravity methods. The test work indicated that it is possible by utilizing spirals to concentrate a portion of the crude material at a coarser size than is required for the flotation process. Any economic advantages of utilizing this pre-concentration scheme has not been fully evaluated.

Sample Shipments:

During the year various samples of crude material and concentrates were shipped to various companies and research laboratories for testing and development work.

SERVICE PROJECTS AND RESEARCH & DEVELOPMENT:

Drill Core:

The practice of processing drill core sections of lean iron formation representing underground drill holes and material encountered below practical open pit limits in exploration drill holes was continued. These core samples are crushed to roughly 1/4" and a head sample riffled out for analysis. These samples are not usually tested because they do not represent an area under active consideration or one which has possibilities of being developed in the near future. A portion of these drill core samples are saved for reference. These core samples are costly to obtain and it only seems logical that a portion of the samples should be saved. These reference samples may prove to be a useful tool by which a more complete evaluation of the concentrating characteristics of the Marquette Range ores may be obtained.

Time Charges for 1955:

Listed below is a tabulation for the last five years showing the Laboratory staff and total hours as reported on the cost sheets. By glancing at the figures one can easily see that 1953 had the greatest number of total hours worked. This is primarily due to two reasons; (1) 26 men comprised the staff for the entire year while in 1955 the staff was made up of 24 men with the addition of one metallurgist on July 1st, another metallurgist on August 1st and another metallurgist on

November 1st, and (2) because in 1953 several priority projects were being undertaken and a considerable amount of overtime was granted. The number of engineers has grown from 6 to 10 since 1951. With the starting up of the concentrating plants and the need for a plant metallurgist at each mill, the number of metallurgists working from the Metallurgical Department will have to be increased periodically.

Year	Staff		Total Hours
	Engineers	Technicians	
1955	10*	17	55,275
1954	8	15	50,982
1953	8	18	66,005
1952	6	13	47,958
1951	6	11	31,369

* One metallurgist hired 7/1/55
" " " 8/1/55
" " " 11/1/55

TIME DISTRIBUTION - YEAR 1955

Account	Hours	Account	Hours
Flotation Study	1376	Cascade - CC-368 - Hole 33	164
Agglomeration Research	3883	34	171
Research & Study	2573	36	357
Magnetic Oxide Conversion	786	37	392
Microscopy Section	418	38	235
Specular Flowsheet Development	253	39	278
Troy Mine	29	40	208
Cliffs Shaft Mine	1274	Rock - CC-699 - Hole 1, Section 31	280
Cambria-Jackson	1003	Osier- CC-699 - Hole 1, Section 18	176
Mather Mine "A" Shaft	3952	Republic - CC-491-A-r	743
Mather Mine "B" Shaft	2702	Allen - CC-740	1
Maas	936	Aerofall Mill - CC-726	464
Bunker-Hill	1993	North Lake - CC-521	46
Ohio	964	Fitch - CC-702 - Hole 1	45
Humboldt	5116	2	429
Spies	23	MOC Pilot Plant - CC-744	372
Lloyd	542	Perkins - CC-669 - Hole 1	239
Tilden	147	Titan - CC-600 - Hole 1	3
Empire - CC-661	4128	Humboldt Phosphorous Depression	594
Empire - CC-522 - Hole 5	2	Balling Disc Study	14500
10	20	Land Offers	2372
11	12	Outside Explorations	358
12	10	Accounts Receivable	107
14	7		
15	8		
16	13		
17	11		
18	191		
19	369		

Note: Total hours for 1955 = 55,275

Chemical Charges:

The following is the distribution of the chemical charges made by the Chemical Laboratory during 1955. The number of analyses completed during 1955 totaled 18,846 for a reduction of roughly 9,200 compared to 1954 and somewhat over 15,000 less than the determinations made in 1953. The reason for this great reduction is twofold; (1) because the projects worked on during the year were investigations which did not as a rule require many chemical determinations such as the balling disc study, etc., and (2) because an effort was made during 1955 to minimize the number of determinations reported for each series of samples.

The distribution of the chemical analyses along with the time distribution presents a good overall picture of the projects and studies which consumed the major portion of the time and which, by the same token, were the most important.

TOTAL NUMBER OF DETERMINATIONS ANALYZED IN 1955 FROM RESEARCH LABORATORY SAMPLES

Account	Analyses
Maas Mine	303
Bunker Hill Mine	305
Cliffs Shaft Mine	259
Lloyd Mine	186
Tilden Mine	120
Cambria-Jackson Mine	174
Mather Mine "A" Shaft	1212
Mather Mine "B" Shaft	1150
Spies Mine	72
Ohio Mine	389
Athens Mitchell Lease	8
Humboldt Mine	2984
Humboldt Phos. Study	355
Humboldt Phos. Depression	153
Humboldt Special Study	1208
Humboldt Special Test	39
Flotation Study	127
Magnetic Oxide Conversion	93
Foster Magnetic Oxide Conversion	30
Research & Study	412
Agglomeration Research Plant Design	18
Agglomeration Res. Sintering Study	10
Cliffs Group Ore Research	16
Cliffs Group Study	1580
Cliffs Group 1955 Structural Study	1085
Land Offer 3037C	9
3090	16
3092	15
3110C	20
3120	161
3121	120
3135	14
3154C	9
3163	847
3163C	36
3168	11
3169	7
3176C	271
3179	43
3182C	18
3521	9
3548	166
3553	18
3575	21
3576	3
3580	9
3584	18
3586	27
3600	25
3601	37
Outside Exploration 991	24
1031	4
1127C	82
1158	51
1171	9
1173	36
E. & A. CC-522	253
" CC-591F	30
" CC-593	23
" CC-600	7
" CC-623	8
" CC-659	82
" CC-661	1699
" CC-668	1425
" CC-669	219
" CC-699	173
" CC-702	385
" CC-726	113
" CC-739	5

Metallurgical Reports and Memoranda:

Listed below are the metallurgical reports and memoranda issued by the Research Laboratory during 1955. The number of reports or memoranda issued in any year is not a true index of the amount of work completed or carried out at the Laboratory. Some of the reports as such may represent months of development work while other reports may represent only a week or two of study. During 1955, twenty-five reports were issued and seventy-four memoranda were issued. Some of the projects carried out, especially those which are more or less service projects, are reported in letter form to management and therefore do not appear as a memorandum or a report.

METALLURGICAL REPORTS - YEAR 1955

Report No.	Subject
140	Empire Area - D.D.H's 14, 15, 16, & 17, Section 19, 47-26
141 & Geology Report No. 4	Laboratory Investigation of Beach Sands from the Seven Devils Mine, Oregon
142	Mine Ore Structure, 1954
143	Ishpeming-Negaunee District, Belleview Area
144 (Supplements)	Albanel Area
145	Cliffs Group Study - Preliminary Report on Screenability
146 (Supplements)	Sandspit Claim Group
147	Empire Area - D. Holes 18 & 19, Section 19, 47-26
148 & Geology Report No. 5	The Occurrence of Phosphorous in the Iron Formation of the Humboldt Area
149	Specular Hematite Flowsheet Development
150	Marquette Range Underground Ore Characteristics
151	Magnetic Oxide Conversion-Concentration Tests of Samples from D.D.H. 33, Section 27, 47-26, Cascade Area
152 (Supplements)	Land Offer 3163 - Bruce Lake, Iron Bay Mines, Ltd.
153	Evaluation of Different Flocculants
154	Flotation Investigation - High Lime Flotation Process
155	Cliffs Group Study II - Screenability & Flowability Tests on Cliffs Group Ores & Mixes
156	Magnetic Oxide Conversion-Concentration Tests from D.D.H's 34 & 36, Section 27, 47-26, Cascade District
157	Magnetic Oxide Conversion-Concentration Tests from Diamond Drill Hole 1, Section 24, 47-28 - Fitch Area
158 & Geology Report No. 10	Microscopic Examination of Core Specimens from Drill Hole 36, Cascade
159 (Supplements)	Check Sampling Program - Marquette Range Ores
160	Cliffs Group Study III - Natural Aggregation and Stability of Natural Aggregates
161	Magnetic Oxide Conversion-Concentration Tests on Composites from D.D.H. 37, Section 27, 47-26 - Cascade District
162	Magnetic Oxide Conversion Tests on North Lake Drill Holes
163	Magnetic Oxide Conversion-Concentration Tests on Composites from D.D.H. 2, Section 24, 47-28, Fitch Area
164	Check Sampling Study - Mather Mine "A" Shaft

METALLURGICAL MEMORANDA - YEAR 1955

Memo No.	Subject
280	Rock Picking - Cliffs Shaft Mine - Underground Sampling
281	Mather Mine "A" Shaft Underground Sampling
282	Sampling Lloyd Mine Silica Ore Stockpiles - Undg. Sampling
283	Land Offer 3548 - Sample No. Mx-379
284	Outside Exploration 991 - Sample No. MxC-714
285	Miscellaneous Exploration - Drill Hole Nos. 148 & 149
286	Land Offer 3548, Arizona Manganese & Iron Deposits
287	1954 General Sampling Correlation Study - Undg. Sampling
288	Correlation of Bond Grindability Tests to the Humboldt Operation
289 (Supplement)	Land Offer 3168 - Sample No. MxC-715
290	Land Offer 3169 - Sample No. MxC-716
291	Rock Specimens from Northeastern Itasca County, Minnesota - Microscopy Section
292	Undg. Sampling - Check Sampling a Champion Mine Lump Ore Shipment
293	Microscopic Examination of Core Specimens from Humboldt
294 (Supplement)	Land Offer 3548
295	Underground Sampling - Cliffs Shaft Mine
296	Ore Sampling Progress Report - May, 1955 - Undg. Sampling
297	Microscopic Examination - Ore #577 Troy Mine, Minnesota
298	McLouth Steel - Sampling
299	Microscopic Examination of a Lead-Zinc Ore from Lake Mistasinni, Quebec, Canada
300	Microscopic Examination of a Pyrite Ore from Mistasinni Post, Province of Quebec, Canada
301	Structure Study - Mather Mine "A" Shaft
302	Land Offer 3176C - Sample No. MxC-717
303	Land Offer 3548 - Samples Mx-1734 and Mx-1735
304	A Limonitic Ore from Steeprock, Canada - Sample Mx-393
305	Check Sampling Pittsburgh Steel Car Tops at Monessen, Pennsylvania - Check Sampling Cliffs Group Ore
306	Ore Sampling Progress Report - July 19, 1955 - Undg. Sampling
307	Land Offers 3135C & 3135
308	Land Offer 3179
309	Cliffs Shaft Mine Underground Check Sampling - Undg. Sampling
310	Check Sampling Lump Ore Shipments - Cliffs Shaft Mine - Underground Sampling
311	Outside Exploration 1171
312	Standard MOC Tests - Wabush Lake Samples, Labrador and Republic Crude Ore
313	Reporting of Standard Magnetic Oxide Conversion Test Results
314	Land Offer 3584 - Sample Mx-398
315	Land Offer 3584 - Samples Mx-399 & Mx-1736
316 (Supplement)	Land Offer 3182C
317	Ore Sampling Progress Report - September 6, 1955 - Check Sampling
318	Microscopic Examination of Iron Formation Rocks from Westward Extension of Vermilion Range
319	Davis Magnetic Tube Tests
320	Petrographic Examination of a Rock Specimen from the Republic Mine
321	Land Offer 3090C
322	Land Offer 3110C
323	Land Offer 3037C
324	Outside Exploration 1127C
325	Land Offer 3110C
326	Land Offer 3584
327	Land Offer 3594
328	Outside Exploration 1127C
329	Land Offer 3600

Continued . . . . . .

Memo No.	Subject
330	Land Offer 3586
331	Metallurgical Tests - Specimen No. 16492, from Superior, Arizona - Sample No. Mx-412
332	Metallurgical Tests - Specimen No. 16525, from Utah Cache Company, Eklund Property
333	Land Offer 3575
334	Land Offer 3580
335	Land Offer 3154C
336	Land Offer 3601
337	L.O. Olson Exploration - Sample Mx-416
338 & Geology Report No. 9	Microscopic Examination of Drill Core Specimens from Perkins
339	High Tension Separator Tests on Low Grade Specular Hematite
340	Microscopic Examination of the Empire Rejected Products
341	Heavy Media Tests - Mather Mine "A" and "B" Shafts Ore Samples
342	American Cyanamid Company's Fatty Acid Reagents
343	Fatty Acid Reagents - Humboldt Mine
344	Outside Exploration 1175 - Microscopic Examination of Samples from Clam Lake, Wisconsin
346	Progress Report - Underground Sampling
347	Two Diagonal Lines Versus Three Parallel Lines Sampling Study
348	Land Offer 3548
350	Land Offer 3553
351	Mather Mine "B" Shaft Special Ore Sample
352 & Geology Report No. 11	Laboratory Examination of the Chromite Deposits near Sheridan, Montana
353	Outside Exploration 1173 - Rtential Market for Thorium Minerals
354	Land Offer 3179

PART II

PYROLYSIS & AGGLOMERATION

LABORATORY GRATE FIRING INVESTIGATIONS:

Laboratory grate firing investigations were continued during the latter part of 1955 on the 11" x 11" laboratory pot grate using the updraft principle. The object of these tests was to investigate variables that may improve the operation and product of the updraft process. The variables studied were as follows:

1. Replace the usual size pellets (-1/2" +3/8") with smaller sized pellets (-3/8" +3 M.) in the first feed stage to aid induration and increase the discharge recovery.

2. Increase the fuel in the top layer of pellets (fourth feed stage) to promote induration and produce a fused product suitable for the open hearth. The variables investigated were as follows:

(a) Anthracite Coal:

1. Size
2. Amount
3. External (Surface of Pellets)
4. Internal

(b) Coke:

1. Size
2. Amount
3. External (Surface of Pellets)
4. Internal

Further investigations of the material claimed in the updraft pelletizing patent application by Mr. Erck, Mr. Ban and Mr. Violetta were conducted during 1955. The claims investigated were as follows:

1. The size of the green pellets fed to the grate was varied for each of the four feed stages. The smallest pellets were placed in the first layer and the size was increased for each succeeding layer.

2. The amount of powdered fuel on the green pellets was varied for each of the four layers. The largest amount of fuel was coated on the pellets in the first layer and decreased in each of the succeeding layers.

In November of 1955, three railroad cars of Humboldt concentrate were shipped to The McDowell Company for updraft pelletizing tests on the traveling grate. A

representative sample was obtained from each of these cars for updraft pelletizing tests in the laboratory grate. The tests were standardized laboratory firing tests and the results were submitted to The McDowell Company.

CONSTRUCTION OF 2000 TPD AGGLOMERATION PLANT:

Construction of the agglomeration plant at Eagle Mills was started during 1955 with The McDowell Company of Cleveland, Ohio as the general contractor. Several important changes in the flowsheet were the result of laboratory investigations conducted during 1955. These changes are as follows:

1. A regrind circuit was added to the flowsheet to increase the amount of fines in the concentrate and thus aid balling.

2. The balling and reroll drums were replaced by the balling disc. It was concluded that the disc produced a more uniform and constant feed to the grate than the balling drum. Also, considerable auxiliary equipment was eliminated from the balling circuit with the installation of the discs.

3. Laboratory tests revealed that the use of recuperative air in the firing zone aided induration. A recuperative system is to be installed at Eagle Mills.

STANDARD LABORATORY TESTS FOR GREEN & DRIED PELLETS:

Samples of bentonite submitted to the Research Laboratory during 1955 by the various companies interested in supplying bentonite for the pelletizing operation at Eagle Mills were subjected to standardized test procedures. The object of these tests was to determine the value of the bentonites as possible binding agents in green pellets of specular hematite concentrate.

The companies that submitted the samples to be tested are as follows:

1. American Colloid Company - Miller & Company
2. Eastern Clay Products
3. Federal Foundry and Supply Company
4. Magnet Cove Barium Corporation
5. Baroid Sales - Interstate Supply & Equipment Company

The samples submitted by these companies were the sodium base, high swelling type bentonite and as such the qualatative results were all comparable. The results of these tests may be found in the General Memorandum, "Final Report on the Use of Various Types of Industrial Bentonites as Possible Binding Agents for Green Pellets of Iron Ore."

BALLING DISC STUDIES:

Balling investigations employing the balling disc were continued during 1955 at the Research Laboratory and the Humboldt Mine. Investigations at the Research Laboratory were conducted on the 4.5' x 0.75' disc and included the following:

1. The balling of specular hematite concentrate as received from the concentration plant.

2. The effect regrinding of the concentrate has on the operation of the disc concerning the quality of the green pellet and the capacity of the disc.

3. Insertion of a conical insert to aid balling conditions.

4. Installation of a reroll ring on the disc to add either powdered fuel or concentrate on the surface of the green pellets.

The balling tests at Humboldt were conducted on a 14' 10" diameter disc fabricated by The Wellmen Engineering Division of The McDowell Company. A totally enclosed circuit was constructed to utilize the filter discharge from the mill as balling disc feed and the existing conveyor belt to transport the disc product to the mill loading pocket. The tests at Humboldt included the following investigations:

1. Attempt to ball Humboldt concentrate in the balling disc as received from McDowell with the telescopic brim at the maximum height.

2. Attempt to ball Humboldt concentrate with the telescopic brim lowered to the minimum height and an 8" conical insert between the brim and the bottom of the pan.

3. Cut 11" from the stationary brim and lowered the telescopic brim to the minimum height of 18". Attempted to ball Humboldt concentrate.

4. Inserted a 5" step on a conical insert to form a 13' disc with a 16" annular ring, each balling chamber containing a 9" step. Best balling action on the large disc obtained with this insert.

5. Inserted hoofs on the oscillating trimmer bar to eliminate the plus 3/4" slugged masses of concentrate being produced by the bar.

6. Conducted balling tests with the disc at various slopes and speeds.

7. Changed the position of the stationary scraper bar from 0° to 95° on the disc. This further diminished the plus 3/4" slugged masses of concentrate.

8. Operated at capacities of 25 LT/Hr with this contour of the disc.

9. Inserted three 9" steps on a conical section in an attempt to increase the capacity of the disc.

10. Operated at capacities of 33 LT/Hr with this contour of the disc.

11. Collected representative samples of the disc production, coated the pellets with powdered fuel in the 3' diameter disc, and fired the pellets in the laboratory apparatus.

12. Investigated the scheme of firing the pellets by using recuperative air in the firing zone.

13. Investigated the effect regrinding the concentrate has on the operation of the disc. Regrinding increased balling capacity, green pellet strength, and produced a more evenly sized product in every test conducted.

14. Installed three 9" balling steps with reroll ring on a conical section. Formed and coated pellets with powdered coal on the large disc and fired the pellets in the laboratory apparatus.

15. Formed balls in the large disc with the balling operator viewing television. The object was to determine if an operator could operate one or more discs by viewing television rather than directly at the disc.

16. Tested various vibrating feeders as possible green pellet feeders for the sintering machine at Eagle Mills.

17. Dismantled the disc pan and installed a new disc pan fabricated by The McDowell Company which contained an additional 18" reroll section.

18. Removed three inches from the height of the brim in the reroll section to improve balling action in this section.

19. Formed and coated balls with powdered coal at a capacity of 27.7 LT/Hr. Subsequent firing of these pellets was favorable.

MAGNETIC OXIDE CONVERSION - CONCENTRATION:

During 1955, drill core samples from the Fitch Area and Cascade District submitted to the Research Laboratory were composited at suitable intervals and subjected to standardized magnetic oxide conversion-concentration tests. The holes investigated were Diamond Drill Holes 33, 34, 36, and 37 of Section 27, T47N-R26W in the Cascade District and Diamond Drill Holes 1 and 2 of Section 24, T47N-R26W in the Fitch Area. The results of these tests have been reported in metallurgical reports.

Test work has started on Diamond Drill Holes 38 and 39 in the Cascade District. Metallurgical reports will be issued as soon as all the results are received and tabulated.

SERVICE PROJECTS:

Sinter Studies:

Desulfurizing tests on Mather Mine "B" Shaft special grade ore were conducted at The Ford Motor Company's Rouge Plant in Dearborn, Michigan. A mixture of 70 percent Mather "B" ore and 30 percent Humboldt concentrate proved to be a satisfactory sinter burden. The tests revealed that approximately 90 percent of the sulfur present in the grate feed was eliminated on the sintering machine when using sinter feed screened on a 5/8" x 3" slotted screen. The results revealed that the bed pressures were relatively low and the capacities high when compared to other sintering operations.

Laboratory sinter tests were conducted in the pot grate previous to the Ford sinter tests to obtain operating information that could be utilized on large continuous machine. The data obtained from the laboratory tests and the Ford tests compared quite closely except for the moisture content of the grate feed and the capacity of the machines. The laboratory apparatus required a higher moisture feed to produce favorable sintering conditions and produced a lower capacity.

PART III

RESEARCH AND DEVELOPMENT WORK AND FLOTATION PROJECTS

EMPIRE AREA:

The drill core material representing the respective footages of the nineteen holes drilled in the Empire Area, Section 19, T47N-R26W has been designated as either Class I, Class II, or Class III. This classification is based on the weight recoveries obtained in Davis magnetic tube testing in which a concentrate of acceptable grade (less than 10 percent silica) was obtained. Class I denotes crude generally yielding weight recoveries greater than 40 percent. Class II material gives from 30 to 40 percent weight recovery and Class III less than 30 percent. The several progress reports on the Empire Area give detailed results of Davis tube tests on the various footages of the individual drill holes.

Below are presented the calculated combined Davis tube test results for the three classes of material. Along with these calculated combined figures there are presented the results of actual Davis tube tests on composite samples respectively representing Class I, Class II, and Class III material. It is noteworthy that some of the drill holes contain both Class I and Class II material at different footages.

Summary of Davis Tube Test Results

D.D.Hole Nos.	Total Footage	D.T.Feed % -400 M	Head % Fe	Concentrate % Wt.	Concentrate % Fe	Concentrate % SiO_2	% Rec. Fe	% Mag. Fe	Tails % Fe
Class I									
1,2,4,6,8, 9,10,11,14, 15,16,17,18, 19	4510	92.9	34.80	45.04	64.32	9.26	83.25	28.97	10.66
Composite Sample		97.4	34.87	45.86	64.00	9.62	84.17	29.35	10.20
Class II									
1,5,6,7,8,9, 10,11,14,15, 16,17,18,19	2879	90.4	32.71	34.45	63.65	9.31	67.04	21.93	14.25
Composite Sample		94.4	32.90	34.87	63.90	9.54	67.72	22.28	16.30
Total Calculated Class I and Class II									
	7389	91.9	33.99	40.91	64.10	9.28	77.14	26.22	12.21

Continued . . . . . .

D.D.Hole Nos.	Total Footage	D.T.Feed % -400 M	Head % Fe	Concentrate % Wt.	Concentrate % Fe	Concentrate % SiO2	% Rec. Fe	% Mag. Fe	Tails % Fe
				Class III					
3,12,13	917	92.7	34.37	21.66	63.70	9.64	40.14	13.80	26.26
Composite Sample		93.3	34.80	20.38	64.50	9.14	37.79	13.15	27.20

For each class of material the calculated combined results and the results of actual Davis tube tests on the respective composites agree quite well with one another. However, in order to produce a concentrate of similar grade, the composite samples were ground somewhat finer than was indicated by the calculated combined results.

DRY COBBING TESTS:

The possibility of rejecting a hard, lean, interfering fraction by a preliminary magnetic cobbing was considered. Dry cobbing tests were run in conjunction with the Dings Magnetic Separator Company on relatively coarse (minus 1/2 inch) Class I and Class II material. It was established that with both types of crude, dry cobbing could eliminate a hard fraction low in magnetic iron.

PILOT PLANT MILLING OF EMPIRE ORE:

The laboratory pilot plant milling of Empire ore consisted of two phases. In each case the final product simulates the final concentrate that would be produced in a mill treating Empire ore.

In the first phase a previously prepared minus 10 mesh cobber concentrate representing about 68 percent of the original weight and containing 90 percent of the iron units was treated in a ball mill - magnetic separator - cyclone circuit. The overflow from the cyclone was fed to the finishing separator. A 61.2 percent iron concentrate was produced with approximate weight and iron unit recoveries of 38 and 72 percent respectively.

The second phase consisted of treating a crushed, crude ore in the proposed complete mill circuit in which rod milling and magnetic cobbing precede the regrind circuit described above. The elimination of lean material in the cobbing stage may be an important control factor in obtaining a satisfactory mineral separation in the balance of the circuit.

PHOSPHOROUS DEPRESSION TESTS, HUMBOLDT MILL:

In the beginning of the year the phosphorous depression tests at the Humboldt Mill were conducted. It is believed it should be possible to obtain Bessemer grade concentrate on suitable ores if only the secondary cyclone underflow were treated for phosphorous depression. An economy in operation could be achieved if this secondary cyclone underflow conditioned for phosphorous depression were subjected to flotation in a separate circuit.

FLOTATION STUDY:

Fatty Acids:

Several fatty acid reagents were tested as collectors for the specular hematite ores such as Humboldt and Republic. Of chief note was "Acintol No. 2" a product of The Arizona Chemical Company. Acintol No. 2 proved to be an effective, economical collector at the Humboldt Mill and recently a tank car shipment of this reagent was delivered to the mill.

Flotation of Undeslimed Specular Hematite Ore:

The flotation without desliming of specular hematite ore received considerable attention using "acidulated cottonseed oil foots" - a source of crude oleic-linoleic acids as the collector. The results of laboratory tests on ore representing Humboldt Mill feed show that this flotation procedure can produce concentrates of comparable grade but with substantially higher recoveries than those indicated by the monthly average of Humboldt Mill operation.

Upgrading Magnetic Concentrates by Cationic Flotation:

An Empire magnetic concentrate containing 61.0 percent iron was upgraded by cationic flotation to 69.8 percent iron yet maintaining satisfactory recovery in the flotation operation. Rather small quantities of the following reagents were employed: sodium hydroxide, gum 3502 (a starch product), a cationic chemical such as Armac CD, and methyl isobutyl carbinol (a frother). The same procedure was applied to a Cascade MOC concentrate but the separation was not as effective as for the natural magnetite.

High Lime Flotation Process:

Evaluation of the laboratory test results employing the high lime flotation method on North Lake low grade ores indicated that the competing MOC process gave

better metallurgical results. In this process the iron oxides are depressed with a caustic starch-xanthate and the siliceous material is removed as a froth product in a highly alkaline pulp using a liqro soap as the collector.

MISCELLANEOUS:

Alum and several commercial flocculants reputed to increase settling rates of fine materials were tested with respect to their effectiveness on Humboldt Mill plant tailings. In batch tests, alum proved to be the most effective yet economical reagent for increasing settling rates of these tailings. No attempt was made to extend this work to the Humboldt plant.

PART IV

MICROSCOPY SECTION

This report covers the work completed for the Metallurgical Department in the Microscopy Section of the Research Laboratory during the Year 1955.

HUMBOLDT MINE:

Samples have intermittently been submitted by the Humboldt Mine for microscopic examination. The scope of the study involved the concentratability determination of of crude samples, the comparative study of test samples, and the mineralogic study of concentrates and tailings produced from the Humboldt Mill.

1. Concentratability of Crude Samples:

Lean samples usually show low percentages of iron recovery than normal Humboldt specular hematite ore because of the abundance of fine-grained ore particles in the samples.

2. Comparative study of open and close circuit test samples revealed that the open circuit grinding might be favorable for the cherty specular hematite ore in Humboldt; and the batch flotation test samples revealed that the flotability of a particle, other things being equal, is governed by the particles size and the percentage of ore (0-100%) attached to the particle.

3. As the result of the microscopic examination of tailings and concentrates produced from the mills in Humboldt, four size liberation zones may be established: A zone of no liberation (+48 mesh), a zone of partial liberation (48 to 150 mesh), a zone of complete liberation (150 to 400 mesh) and a zone of contamination (minus 400 mesh).

DEVELOPMENT PROJECTS:

A microscopic study was accomplished on drill core specimens from Cascade, Perkins, Osier, Rock, and Empire Areas. The study involved the mineralogy, mineral relation, and ore size liberation. Special study was also made on products from dry magnetic cobbing tests of the Empire ore and that from the magnetic oxide conversion tests of the Cascade chert-martite ore.

LAND OFFERS AND OUTSIDE EXPLORATIONS:

Microscopic examinations were conducted on samples and specimens received under Land Offers 3521, 3553, 3586 and Outside Exploration 1172, 1174, and 1175. The

objectives of the study are to determine the mineralogic characteristics and its effects on concentration, and to evaluate samples and specimens from these land offers and outside explorations.

SPECIAL RESEARCH:

A mineralographic examination of pellets, sinters, briquettes, nodules and extrusions has been conducted. This work was done in conjunction with the paper entitled "Why Not Briquette Fine Iron Ores?" by Mr. L. J. Erck, Chief Metallurgist which has been presented at The International Briquetting Association at Estes Park, Colorado, September, 1955.

A microscopic review of ores from the Marquette District was also accomplished. This work was for Mr. Erck's paper entitled "Utilization of Michigan's Jasper Deposits" which has been presented at the American Chemical Society in Minneapolis on September 12th, 1955.

MISCELLANEOUS:

Microscopic examinations were also conducted on samples of limonitic ore from Steeprock, Canada and magnetic ore from Troy Mine, Minnesota.

PART V

CHECK SAMPLING PROGRAM

Structure tests were conducted on a silica ore sample collected from the west stockpile at the Lloyd Mine.

A visit was made to the McLouth Steel Corporation's plant in Trenton, Michigan to conduct a check sampling program. The object of this program was to obtain samples of the various ores used by McLouth to determine the flue dust potential of the ores.

During April, 1955 a drilling program was begun at the Bunker-Hill Mine west stockpile for the purpose of determining free moisture percentages and also for iron and silica assays. The program was stopped because of the difficult nature of the drilling.

A pocket sampling study was conducted at the Tilden Pit Mine in May, 1955. In order to maintain maximum production, the diagonal method of R.R. car sampling was replaced by the cup method of sampling the ore discharge from the loading bin.

In June, 1955 an underground check sampling program was conducted in the sampling of the No. 2 crushed or intermediate ore at the Cliffs Shaft Mine.

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 to check sample a railroad shipment of Cliffs Group ore consigned to the plant.

A total of 347 R.R. cars of ore from the North Range Mining Company was check sampled at the request of the Ore Grading Department.

A comprehensive check sampling program was conducted on Marquette Range soft ores in conjunction with the Lerch Brothers sampling firm in October, 1955. The purpose of this program was to establish the reliability of the Cleveland-Cliffs check sampling results.

Ore samples were collected from mine pocket and stockpile shipments during the 1955 Season for general sampling correlation data, structure and concentration tests.

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

ELECTRIC POWER DEPARTMENT
ANNUAL REPORT
YEAR 1955

The Electric Power Department continued to operate its generating facilities to supply the energy required by the Eastern Division of the Upper Peninsula Power Company and the mining operations of The Cleveland-Cliffs Iron Company until October 1. During that period there were delivered a total of 117,737,594 kwh, of which 65,578,599 kwh were delivered by the hydroelectric plants, 39,449,305 kwh were delivered by the Ishpeming Steam Electric Station, and 12,709,690 kwh were delivered by the Ishpeming Diesel Electric Station. In addition, during this period 7,932,000 kwh were supplied by the Presque Isle Station of the Upper Peninsula Generating Company, this energy being that which was generated during the period of start-up and trial operation of the new generating station. The total energy required by the combined operations of the two companies in this area amounted to 125,669,594 kwh for the period until October 1. Including the Humboldt Mine, 66,638,009 kwh (53.5%) of this energy were used for our operations and 59,031,585 kwh (46.5%) were used for the operations of Upper Peninsula Power Company. During this period the Upper Peninsula Power Company and The Cleveland-Cliffs Iron Company shared the cost of generating energy from all sources on the basis of a uniform unit production cost obtained by taking the actual cost of production and dividing it by the energy produced in each of the various facilities. In addition to this uniform unit production cost, the Upper Peninsula Power Company paid to our company an earning on the net book value of the various generating facilities in the proportion which the quantity of energy which they took from those facilities bore to the total amount of energy delivered by the individual plants. The unit cost to our company's operations, including wheeling charges, amounted to $.0093069 per kilowatt hour during the first nine months of the year, and during the same period $79,951.22 were obtained from the Upper Peninsula Power Company in the form of earnings on facilities used by them.

Beginning on October 1, the division of operating costs of our company's facilities which were used by the Upper Peninsula Power Company changed from the temporary basis which had been in effect since the beginning of the operating agreement with them on December 15, 1953, to the permanent basis on which these facilities will be operated in the future. This basis provides that our company will operate its facilities primarily for production of energy for its own operations, but if it is necessary for our company to operate its facilities for the use of the Upper Peninsula Power Company, our company will be paid the entire operating expense of the facilities during such a period and will also be paid a proportionate part of the fixed expense and carrying charges plus an earning on the investment which is necessary to keep these facilities available for use. During the period from October 1 to the end of the year, our company delivered 17,693,685 kwh and purchased 5,698,421 kwh from the Presque Isle Station of the Upper Peninsula Generating Company to make a total of 23,392,106 kwh supplied for our company's operations. In addition, 4,032,301 kwh were furnished by the Ishpeming steam and Diesel plants for the use of Upper Peninsula Power Company. Of the amount delivered by our company's plants, 17,675,900 kwh were delivered by the hydroelectric plants, 3,536,096 kwh were delivered by the Ishpeming Steam Electric Station, and 513,990 kwh were delivered by the Ishpeming Diesel Electric Station. Of the 23,392,106 kwh required for our company's operations, including the Humboldt Mining Company, 17,675,900 kwh were obtained from our hydroelectric generating stations, 17,785 kwh were obtained from the Ishpeming Diesel Station, and 5,698,421 kwh were purchased from the Presque Isle Station. During this period after October 1, the cost to our company amounted to $.0087131 per kilowatt hour and the Upper Peninsula Power Company paid us $38,674.98 for return on the investment in our generating facilities utilized by them.

During the year 1955 the mining operations of our company, including the Humboldt Mine, required a total of 90,030,115 kwh, which was a 16% increase over the amount of energy required during the previous year. In 1954 our company, including its Humboldt operation, utilized 48.5% of all of the energy furnished by its power plants and the Upper Peninsula Power Company utilized 51.5% of the energy furnished by our company. In 1955, however, the increase in energy consumed by the mining operations and the purchases during the last three months by the Upper Peninsula Power Company from the Upper Peninsula Generating Company reversed this trend and our company used 57.5% of the total energy furnished by our power plants whereas the Upper Peninsula Power Company used only 42.5% of the energy so supplied. This change in ratio of energy used, of course, reduced the proportionate part of fixed charges and return on the investment which were carried by the Upper Peninsula Power Company.

Energy in the amount of 75,338,826 kwh was produced for mining operations of the Company and delivered to the Company's operations at a cost of $.0091431 per kilowatt hour. Energy produced for the Humboldt Mining Company amounted to 14,691,289 kwh, upon which a revenue of $77,146.30 was realized. The return on the value of generating facilities used for production of energy used by Upper Peninsula Power Company amounted to $118,626.20. Net Profit and Loss for the Department during the year amounted to $166,405.75. This was a decrease from $201,476.37 in 1954, the reduction being caused by the decreased earnings on production facilities resulting from Upper Peninsula Power Company purchasing its energy requirements from the Upper Peninsula Generating Company rather than from our company after October 1, 1955.

Construction of the Upper Peninsula Generating Company's Presque Isle Station progressed in accordance with schedule with the result that the plant was capable of being placed in commercial operation on October 1. As with any new generating station, there were a certain number of operating difficulties encountered at the time that the station was first placed into service, but these difficulties are rapidly being overcome. The continuity of service obtained from this station since it was placed in operation has been good and the economy has been slightly better than was anticipated. Due to load conditions on the system, it has been necessary to operate the plant at slightly below its most economical point of operation, but it is felt that with the load growth which is expected for the coming year, the plant will soon be operating at practically full load and economy and over-all energy cost will both be improved.

During the period until October 1, when the Presque Isle Station was placed in operation, load conditions were very critical on the entire system for which the Company was furnishing energy. This required heavy operation of both the Ishpeming Steam Electric Station and the Ishpeming Diesel Electric Station. Several small difficulties were experienced in these stations requiring temporary periods of shutdown which, though inconvenient and sometimes resulting in deterioration of service, were not serious enough at any time to require actual curtailment of load. The Ishpeming Steam Station was out of service for short periods during the month of January due to difficulties which were caused by a fire occurring in the cinder hopper of the first pass of the boiler. During February there was a shutdown necessitated by the failure of the bearing on the forced draft fan. This particular shutdown resulted in low voltage conditions on the system, but no serious difficulties were experienced. During March one of the fans on the cooling tower of the Ishpeming Steam Station failed and necessitated the removal of fifty per cent of the cooling tower from service. This increased

the temperature of the cooling water with a resulting limitation on the amount of energy which could be generated in the station. In August a serious water leak occurred in the coal feeder. This leak had been in existence for several days, but on August 17 it reached the point where the station could no longer be operated until the leak was repaired. It took about one and one-half hours to make the necessary repairs and although conditions were critical throughout the system during the period, no serious difficulties were experienced.

Although the Presque Isle Station began actual commercial operation on October 1, there were a number of difficulties being experienced and it was thought advisable to keep the Ishpeming Steam Station operating during most of the month. On October 28, however, it was felt that the Presque Isle Station operation had been stabilized to the point that the Ishpeming Steam Station could be shut down. Accordingly, the plant was taken out of operation on October 28, and all energy necessary for system operation was furnished from that time on by the operation of the hydraulic plants of The Cleveland-Cliffs Iron Company and the Presque Isle Station.

Trouble had been experienced for a number of years with corrosion of the steel pipeline to the Escanaba Power Plant. In February an inspection of this pipeline was made by the Koppers Company, and they made recommendations and quoted prices on treating the inside of the pipeline with a bitumastic enamel. On July 5, the plant was shut down and the contractor began the application of this enamel. All told, there were over 400 small holes that appeared in the pipe after it was cleaned by sandblasting. These small holes were repaired by welding and the contractor proceeded to apply the bitumastic enamel. Work was completed on October 12 and the plant was placed back into operation October 15. In order to gain entrance to the pipeline, it had been necessary to cut several large holes in the pipe which were closed by welding in new sections, and also the weaker places were repaired by placing patches in the pipe. When the pipe contracted at the beginning of winter due to the colder temperatures to which it was exposed, several of the welded joints which had been made during the summer cracked and it was necessary to make further repairs on the pipeline. These repairs, of course, had the effect of destroying the bitumastic coating immediately under them. It will be desirable next summer, therefore, to inspect the pipe throughout and replace the bitumastic coating at any points where it has been destroyed or where improper coverage was obtained during the application of the material last summer.

The connection between the Houghton electric transmission system, the transmission system formerly operated by The Cliffs Power & Light Company, and the Presque Isle Station was completed and energized on June 16. This connection was used intermittently during ensuing months but was not placed into steady operation until the trial operation of the Presque Isle Station was commenced. At this time the line was closed in and considerable amounts of energy were transmitted over it from time to time thereafter. This connection consists of a 69000 volt transmission line from the Atlantic Substation in Houghton County 79 miles to the Cedar Substation in the southeast corner of the City of Ishpeming. This substation contains the switching and transformer equipment necessary to connect the 69000 volt line to the 33000 volt transmission lines formerly operated by our company. From the Cedar Substation the 69000 volt line extends 17 miles to connect with the Presque Isle Station of the Upper Peninsula Generating Company. At the time this line was planned, it was not thought advisable to make a connection for the operation of the Humboldt Mine. However, the plans for the placing in operation

of the Republic Mine early in 1956 indicated that low voltage would be experienced due to the power requirements of the Humboldt and Republic operations, and it was agreed that it was desirable to convert the line from Humboldt to Republic to 69000 volts and connect it with the 69 kv line between the Atlantic and Cedar Substations. Accordingly, work was started in the latter part of the year on the construction of the tie line and the insulating of the Humboldt-Republic line for operation at 69000 volts instead of 33000 volts. It is anticipated that this tap and the conversion of the Republic Mine substation to 69000 volts will be accomplished early in 1956, prior to the commencement of operation of the new mine and ore beneficiating plant at Republic.

Due to the increase in mining operations being more rapid than had been anticipated and due also to changes in the energy requirements of the Upper Peninsula Power Company, it was thought that additional capacity on this system would be required by the first of the year 1958. Studies of this load growth had been made earlier in the year and discussions following this study resulted in a meeting in September of members of our company, Stone & Webster Service Corporation, Stone & Webster Engineering Corporation, and the Upper Peninsula Power Company for the purpose of discussing the advisability of starting immediately upon the addition of a second unit in the Presque Isle Station. Consideration of this matter continued and a meeting was held in the early part of December at which the results of the studies were further discussed. The Upper Peninsula Power Company had made arrangements with the City of Escanaba for the operation on a rental basis of a new 24000 kw power plant to be constructed by the City of Escanaba. It was the general opinion at the meeting in December that the additional capacity which would be made available by tying this new Escanaba power plant to the Eastern Division of the Upper Peninsula Power Company at Gwinn would permit the postponement of the commencement of operation of the second unit at Presque Isle until the early part of 1959. Since the December meeting, however, further analyses and estimates have been made and there is still consideration being given to proceeding with the second unit at Marquette this year. One factor entering into the discussions is the advantage which would be gained by purchasing equipment on firm price quotations which were made by some manufacturers last fall prior to an increase in equipment costs. The purchase of equipment under these quotations would result in a material saving in first cost of the new unit, and this advantage, together with reconsideration of the possible system demands, makes further consideration of starting construction in the near future advisable.

ELECTRIC POWER DEPARTMENT
ANNUAL REPORT
YEAR 1955

STATISTICAL DATA - 1955

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Precipitation -	0.96	0.89	2.65	2.84	4.24	1.24	3.75	3.61	2.21	4.01	2.32	2.10

Total precipitation at Ishpeming during 1955 - 30.82" (2.568 ft.)
Average " " Marquette - 32.80" (46 year record)

CARP RIVER PLANT:

Drainage area above intake dam	66.66 sq. miles
Cubic feet precipitation in 1955	4,772,304,801
Kilowatt hours generated in 1955	15 993 000
Cubic feet water utilized in 1955 (90 cu. ft. - 1 kwh)	1 439 370 000
" " " wasted over intake dam in 1955	579 600 000
" " " in Carp storage Dec. 20, 1954	389 076 950
" " " " " " Dec. 20, 1955	337 164 874
" " " taken from Carp storage in 1955	51 912 076
Total run-off in 1955 (cubic feet)	1 967 057 924
Run-off per square mile of drainage area (cubic feet)	29 508 820
Second-feet run-off	0.936

	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	1955
Total Precip.	24.35	35.42	33.77	30.82
Sec.-ft. Run-off	0.69	0.85	0.84	0.93

McCLURE PLANT:

Drainage area above intake dam	140.52 sq. miles
Cubic feet precipitation in 1955 (Hoist Plant - 35.70"-2.97')	11,654,481,484
Kilowatt hours generated in 1955	42 091 000
Cubic feet water utilized in 1955 (125 cu. ft. - 1 kwh)	5 261 375 000
" " " wasted over intake dam in 1955	0
" " " in Hoist storage basin Dec. 20, 1954	1 962 348 484
" " " " " " Dec. 20, 1955	1 298 780 969
" " " decrease in 1955	663 567 515
" " " in Silver Lake Dec. 20, 1954	0
" " " " " " Dec. 20, 1955	0
" " " taken from Silver Lake in 1955	0
Total run-off in 1955 (cubic feet)	4 597 807 485
Run-off per square mile of drainage area (cubic feet)	32 719 951
Second-feet run-off	1.038

	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	1955
Total Precip.	37.27	28.81	43.28	40.65	50.90	29.27	41.56	38.13	35.70
Sec.-ft. Run-off	1.22	0.78	1.24	1.37	2.09	0.97	1.33	1.29	1.03

ELECTRIC POWER DEPARTMENT

STATISTICAL DATA - 1955

Energy Delivered to Transmission System
by C.C.I.Co. and U.P.G.Co. Plants

	Kwh Delivered to Lines				
	CCICo. Steam	CCICo. Hydro	CCICo. Diesel	UPGCo. Steam	Total
Jan.	4,996,478	6,373,385	1,635,220	--	13,005,083
Feb.	4 467 263	7 245 370	1 225 180	--	12 937 813
Mar.	4 867 589	7 778 235	964 980	--	13 610 804
Apr.	3 832 840	8 604 495	1 165 690	--	13 603 025
May	4 265 270	8 652 280	1 639 850	--	14 557 400
June	4 426 130	8 372 090	1 692 890	--	14 491 110
July	4 525 348	6 885 550	1 928 630	--	13 339 528
Aug.	4 541 737	6 986 705	1 813 600	467,000	13 809 042
Sept.	3 526 650	4 680 489	643 650	7 465 000	16 315 789
Oct.	3 063 556	5 313 810	474 905	3 533 655	12 385 926
Nov.	472 540	6 195 140	3 755	1 952 259	8 623 694
Dec.	--	6 166 950	35 330	212 507	6 414 787
Total	42,985,401	83,254,499	13,223,680	13,630,421	153,094,001

ELECTRIC POWER DEPARTMENT

STATISTICAL DATA - 1955

Utilization of Energy Delivered to
Transmission System by C.C.I.Co. and U.P.G.Co. Plants

	Kwh Utilized			
	C.C.I.Co.	Humboldt Mining Co.	U.P. Power Co.	Total
Jan.	5,463,004	1,150,737	6,391,342	13,005,083
Feb.	5 609 773	1 082 827	6 245 213	12 937 813
Mar.	5 561 923	1 517 913	6 530 968	13 610 804
Apr.	5 880 665	1 412 045	6 310 315	13 603 025
May	6 358 465	1 329 677	6 869 258	14 557 400
June	6 317 663	1 395 193	6 778 254	14 491 110
July	6 275 752	1 335 465	5 728 311	13 339 528
Aug.	6 474 115	1 443 530	5 891 397	13 809 042
Sept.	6 604 534	1 424 728	8 286 527	16 315 789
Oct.	7 325 332	1 522 133	3 538 461	12 385 926
Nov.	7 297 557	853 597	472 540	8 623 694
Dec.	6 170 043	223 444	21 300	6 414 787
Total	75,338,826	14,691,289	63,063,886	153,094,001