Safety Department

Annual Report

Year 1956

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	MAAS	MATHER-A	MATHER-B
MAIN LEVELS:						
Drilling In Rock (Wet)			(All			1.68
Loading Rock	2.29		Test			2.16
Drilling In Ore			(Samples)		1.65	
Timbering						.84
Loading Ore					13.86	
SCRAPING TRANSFER DRIFTS:*						
Drilling In Ore (Wet)		1.36		1.37		
Scraping Ore	1.24					2.92
Scraping Rock	4.59	1.91				5.60
Drilling In Rock (Wet)		2.00			.94	1.91
Charging Holes						1.48
STOPES:						
Long Hole Drilling (Rotary)				2.28	6.81	
Scraping Ore		2.94				
AVERAGE COUNTS FOR:						
MAIN LEVELS	3.44				8.58	1.83
SUB-LEVEL DRIFTS	1.24	1.65		1.37	.94	3.30
SCRAPING TRANSFER DRIFTS						2.92
STOPES		2.94		2.28	6.81	
GENERAL AVERAGES:	3.00	2.17		1.73	5.29	2.36

* Combined with Sub-Level Drifts in this section.

Safety Department

Annual Report

Year 1956

11. ACCIDENTS AND PERSONAL INJURY

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

Mine Rescue Training

Training was conducted in June and December by members of the department, all of whom are instructors certified by the U.S. Bureau of Mines.

As all of these men had training before, these were refresher courses requiring only eight hours. The course consisted of wearing the Mc Caa 2-hour Self Contained Breathing Apparatus, the Chemox Oxygen Self Generating Apparatus and the two-hour All-Service Gas Mask in dense smoke in the training tunnel. The use of all auxiliary equipment was demonstrated with classes participating and the use of the inhalator and Pneolator was demonstrated.

A total of 184 men took training during June and 148 during December, for a total of 332.

11. ACCIDENTS AND PERSONAL INJURY

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

TABLE XXVII

MINE RESCUE TRAINING - MICHIGAN MINES

JUNE & DECEMBER, 1956

Mine Or Department	No. Of Men Trained JUNE	DEC.	TOTAL
BUNKER HILL - MAAS MINES	35	20	55
CAMBRIA-JACKSON MINE	5	5	10
CLIFFS SHAFT MINE	28	27	55
ENGR. & GEOL. DEPTS.	5	7	12
MATHER MINE, "A" SHAFT	52	46	98
MATHER MINE, "B" SHAFT	59	43	102
TOTALS	184	148	332 *

* This total represents the combined trainings of June and December of 1956 and is not the number of men on our mine rescue roster.

Safety Department

Annual Report

Year 1956

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)	68,396
Cotton-Tipped Merthiolate Applicators	1,906
Knuckle-Bandages	1,456
Plain Gauze Pads (3" x 3")	346
Oz. Of Spirits Of Ammonia	280
1" Roll Bandages	173
Oz. Of Tincture Of Merthiolate	161
Rolls Of Adhesive Tape (½")	153
Picric Acid Gauze Pads (For Burns)	137
2" Roll Bandages	133
2" Compress Bandages	124
5/8 Oz. Tubes Of Foille (For Burns)	118
3" Roll Bandages	98
Leather Finger Cots	68
3" Compress Bandages	64
Triangular Bandages (40" Cravat)	42
Oz. Of Absorbent Cotton	26
2 Oz. Bottles (For Tincture Of Merthiolate)	22
Tubes Of "Surfacaine" (For Burns)	16
Pairs Of Scissors	6
TOTAL	73,725

Safety Department

Annual Report

Year 1956

11. ACCIDENTS AND PERSONAL INJURY

f. Miscellaneous

Once a month all mine rescue equipment was checked and placed in first-class condition. Reports submitted.

Made recommendations on type of fencing and shaft covers for closing of Lloyd Mine. These jobs completed during the year except fence around the old Lloyd Shaft.

All vaporizing liquid fire extinguishers were removed from surface properties and the use of Carbon-Tetrachloride prohibited for all purposes because of toxicity involved. For common cleaning purposes, new types of solvents are being used and a special solvent is being used for cleaning oxygen equipment (F.O. 145).

The old brick chimney at the Lake Mine was blasted down.

Assisted Negaunee and Ishpeming Fire Departments by training men in use of gas masks and first-aid. In return, Negaunee Fire Department tested company fire hydrants with booster pump.

Made periodic checks of Fuse Cutters and Crimpers at all mines.

Ernest Bengry was transferred to Operating Research Department.

In cooperation with the Geological Department, made a survey of industrial noise at surface properties and Crusher Station at Cliffs Shaft Mine.

I was elected Vice President and Program Chairman, Lake Superior Mines Safety Council.

Attended sub-committee hearing on State Mine Safety Bill at Lansing.

Attended and took part in meetings at Virginia, Minnesota, Duluth, Minnesota and Washington, D.C. on committee hearings on the Federal Mine Safety Bill. Helped prepare written statements for these meetings.

Made survey of electric cap lamp batteries which were being used by some miners to blast electrically. New type of valve assembly to replace old type of valve assembly. New type assembly placed in all Edison Cap Lamp batteries to prevent use in blasting.

Requested and received "Certificates of Honor" from The Joseph A. Holmes Safety Association for employees who have worked 40 or more years without a lost-time injury and one for the company as a whole for operating 14,407,577 man-hours without a fatal injury.

Checked many complaints for fencing, blasting damage, etc.

Safety Department

Annual Report

Year 1956

11. ACCIDENTS AND PERSONAL INJURY

f. Miscellaneous (Continued)

Assisted U.S. Bureau of Mines in production of motion picture film on "Falls Of Ground".

Started air sampling in "Jet Piercers" for carbon monoxide gas. This will continue for a long time, using C.O. Tester and Vacuum Air Samples.

Submitted accident statistics to U.S. Bureau of Mines, County Mine Inspector, Edison Electric Association and Lake Superior Mines Safety Council.

Comparison Of Available Accident Statistics

The only accident statistics available for 1956 to use as a comparison to our own comes from The Accident Exchange, Lake Superior Mines Safety Council, which includes thirteen (13) companies operating in the Lake Superior District. They include the major operators along with a few smaller operators, some of which do not have underground mines. The fair analysis of these statistics requires knowledge of the type of mining being done by each company. An example of this is: The two companies in first and second place (Table XXX) have open pit mining only, which is considered less hazardous than underground mining. Our position rating in third place is very good for our operations.

The table covering the Lake Superior Accident Exchange gives us some very interesting figures. The low Frequency rating by some companies is gained by what they call rehabilitation which makes Frequency rates look good but the cost is great.

Comparisons on the other table (Table XXIX) shown are C.C.I. Co. 1956 ratings compared to other ratings taken from 1955 which are the only statistics available at this time.

f. Miscellaneous (Continued)

TABLE XXIX

COMPARISON OF FREQUENCY, SEVERITY RATINGS
(Taken From Available Statistics)

	FREQUENCY	SEVERITY
1955 National Rating, Coal Mining (Underground)	24.65	6,293
1955 " " , Other Mining (Not Including Coal)	20.52	3,569
1955 " " , Metal Mining (Underground)	27.64	4,571
1955 Lake Superior District Mines (26 Companies Reporting)	15.63	1,863
1956 The Cleveland-Cliffs Iron Co., Compensable Injuries	19.07	763
1956 " " " " " , All Injuries	30.73	797
1956 " " " " " , Open-Cut Mining	18.39	305
1956 " " " " " , Concentrating Plants	33.50	511
1956 " " " " " , Top Slicing	0.00	0
1956 " " " " " , Sub-Level Caving	14.44	1,329
1956 " " " " " , Stoping	33.65	718
1956 " " " " " , Block Caving	41.01	1,069
1956 " " " " " , Shaft Sinking & Develop.	0.00	0
1956 " " " " " , General Shops	22.60	955
1956 " " " " " , Elec. Power Dept.	0.00	0
1956 " " " " " , General Roll	0.00	0
1956 " " " " " , Pelletizing Plant	80.87	1,084
1956 " " " " " , Miscellaneous	18.17	36

1955 LAKE SUPERIOR DISTRICT	FREQUENCY	SEVERITY
	15.63	1,863
	8.47	1,919
	13.69	663
	11.87	459
	21.67	1,841
	28.96	2,491
	41.61	7,176
	7.04	730
	8.60	471

TABLE XXX

COMPARATIVE ACCIDENT STATISTICS
LAKE SUPERIOR MINES SAFETY COUNCIL EXCHANGE GROUP
YEAR - 1956

Company Or Division	MAN HOURS WORKED	Disabling Injuries: FATALITIES	PERMANENT PARTIAL	TOT. DISAB. INJURIES	DAYS LOST *	FREQUENCY	SEVERITY
SNYDER MINING COMPANY	640,324	0	0	4	117	6.20	183
JONES & LAUGHLIN STEEL CORP., MINNESOTA ORE DIVISION	1,095,558	0	1	7	650	6.39	593
The CLEVELAND-CLIFFS IRON CO.	7,289,922	0	3	224	5,810	30.73	797
WHITE PINE COPPER COMPANY	2,339,021	0	0	107	1,901	46.00	813
REPUBLIC STEEL CORPORATION	535,694	0	0	6	578	11.20	1,079
RESERVE MINING COMPANY	4,130,583	0	7	24	7,226	5.80	1,749
The M. A. HANNA COMPANY	6,712,808	2	1	44	14,596	7.00	2,174
OLIVER IRON MINING DIV., U.S. STEEL CORPORATION	11,907,494	3	9	60	26,311	5.04	2,210
PICKANDS MATHER & COMPANY	10,813,100	4	5	60	28,171	5.50	2,605
INLAND STEEL COMPANY	1,872,764	1	2	43	8,926	22.96	4,766
NORTH RANGE MINING COMPANY	1,457,478	0	1	69	8,582	47.34	5,888
The MONTREAL MINING COMPANY	1,363,514	1	1	75	9,162	55.00	6,719
CALUMET DIVISION, CALUMET & HECLA, INC.	4,183,521	5	2	164	37,394	39.20	8,938
TOTALS	54,341,781	16	32	887	149,424	16.32	2,750

* Includes Time Charges.

ANNUAL REPORT OF THE MINING ENGINEERING DEPARTMENT FOR THE YEAR ENDING DECEMBER 31, 1956

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 Maas Ohio Republic 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. E. L. Joppa, General Manager, Mines, 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 was 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 1956 also shows 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, 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 was 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.

C. MINING LEASES

The following mining leases and options for leases were executed and placed on file during 1956:

Lease No. 164

Forty-year lease from The Cleveland-Cliffs Iron Company to Hanna Coal & Ore Corporation, dated March 1, 1956, covering an undivided 1/2 interest in two metes and bounds descriptions lying respectively in the NW¼ and the NE¼ of Section 26, 47-27, Marquette County, being part of the Tilden Mine. Also filed under this lease number are the Supplemental Lease Agreement and the Agreement to Mine Ore.

Lease No. 165

Ninety-nine year lease from The Cleveland-Cliffs Iron Company to Marquette Iron Mining Company, dated April 2, 1956, covering the Republic Mine in Section 7, 46-29.

Ninety-nine year lease from The Cleveland-Cliffs Iron Company to Marquette Iron Mining Company, dated April 2, 1956, covering the NE¼ and SW¼ of Section 19, 47-26, except the surface of the N½ of NW¼ of NE¼ and of the SW¼ of NE¼, being a part of the Empire Mine.

Sublease until December 31, 2008, from The Cleveland-Cliffs Iron Company to Marquette Iron Mining Company, dated April 2, 1956, covering the NW¼ and the SE¼ of Section 19 and entire Section 20, both in T. 47 N., R. 26 W., being the balance of the Empire Mine.

Also filed under this mining lease number are the various other agreements between Cliffs and Marquette Iron as compiled in the printed booklet entitled "Marquette Iron Basic Agreement."

Lease No. 166

Assignment of sublease from Richmond Iron Company to The Cleveland-Cliffs Iron Company dated January 3, 1956, covering the Richmond Mine, the SW¼ of Section 27, 47-26. This property is owned by The Pittsburgh & Lake Superior Iron Company and leased to the Cascade Corporation who subleased to Richmond Iron Company.

Lease No. 167

Option for fifty-year mining lease from Frank Sacco and wife to The Cleveland-Cliffs Iron Company, dated May 22, 1956, expires June 30, 1959 but with privilege of one-year extension, covering the SW¼ of NW¼ and the NW¼ of SW¼ of Section 36, 43-23, Delta County (Rock Area).

Lease No. 168

Option for one hundred year mining lease from Thomas J. Wright and wife to The Cleveland-Cliffs Iron Company, dated November 13, 1956, expires November 30, 1959, covering an undivided one-half interest in the E½ of SE¼ of Section 24, 41-18, Delta County (South Sturgeon-Indian Lake Area).

Lease No. 169

Option for one hundred year mining lease from Leo J. Spielmacher and wife to The Cleveland-Cliffs Iron Company dated November 13, 1956, expires June 30, 1961, covering the W½ of the SW¼ of Section 19, 41-17, Schoolcraft County (South Sturgeon-Indian Lake Area).

The following mining leases and options were terminated during 1956:

Lease No. 85

Lease from Rose Maas and the Maas Land Company to The Cleveland-Cliffs Iron Company, dated January 22, 1949, covering the N½ of NW¼ of Section 26, 48-31, Baraga County (Portland Mine). Notice served October 15, 1956; termination effective December 31, 1956.

Lease No. 125

Lease from the Department of Conservation of the State of Michigan to The Cleveland-Cliffs Iron Company, dated October 5, 1954, covering numerous descriptions in the Perkins Area of Delta County. All descriptions but one were surrendered February 14, 1956. Notice of termination of lease served December 4, 1956; termination effective February 15, 1957.

Lease No. 127

Option for fifty-year mining lease from Edward Dohbel to The Cleveland-Cliffs Iron Company, dated December 16, 1954, expires December 15, 1957, covering SE¼ of NW¼, NE¼ of SW¼, NW¼ of SE¼, and SW¼ of SE¼, all in Section 26, 43-22, Delta County (Osier Area). Notice of termination dated December 4, 1956.

Lease No. 130

Option for fifty-year mining lease from Albert Cayer and wife to The Cleveland-Cliffs Iron Company, dated December 16, 1954, expires December 15, 1957, covering the E½ of NE¼ of SE¼ and E 3/4 of SE¼ of SE¼ of Section 14, 43-22, Delta County (Osier Area). Notice of termination dated December 4, 1956.

Lease No. 131

Option for fifty-year mining lease from Lorin Rinard and wife to The Cleveland-Cliffs Iron Company, dated December 16, 1954, expires December 15, 1957, covering the SW¼ of NE¼ of Section 23, 43-22, Delta County (Osier Area). Notice of termination dated December 4, 1956.

Lease No. 132

Option for fifty-year mining lease from Albert Juneau and wife to The Cleveland-Cliffs Iron Company, dated December 16, 1954, expires December 15, 1957,

covering the SE¼ of SW¼ of Section 13, 43-22, Delta County (Osier Area). Notice of termination dated December 4, 1956.

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, covering the SE¼ of NE¼ of Section 4, 42-23, Delta County (Rock Area). Notice of termination dated December 4, 1956.

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, covering the NE¼ of NW¼ of Section 9, 42-23, Delta County (Rock Area). Notice of termination dated December 4, 1956.

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, covering the W½ of NE¼ of SE¼, NW¼ of SE¼, E½ of SW¼, W½ of W½ of SE¼ of SE¼, all in Section 14, 43-22, Delta County (Osier Area). Notice of termination dated December 4, 1956.

Lease No. 136

Option for fifty-year mining lease from Elmer J. Lepisto and Viola M. Lepisto to The Cleveland-Cliffs Iron Company, dated January 6, 1955, expires December 15, 1957, covering the NE¼ of NE¼ and the NW¼ of NE¼ of Section 4, 42-23, Delta County (Rock Area). Notice of termination dated December 4, 1956.

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, covering the SW¼ of NW¼ and NW¼ of SW¼ of Section 36, 43-23, Delta County (Rock Area). Examination of an abstract of title to this property showed title to be in Frank Sacco and wife - see new mining lease No. 167.

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, covering the East 3/4 of SW¼ of NW¼ and SE¼ of NW¼ of Section 2, 42-23, Delta County (Rock Area). Notice of termination dated December 4, 1956.

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, covering the E½ of SE¼ of Section 19, SE¼ of SW¼ of Section 20, NE¼ of NW¼ of Section 29, and the N½ of NE¼ of Section 30, all in 42-22, Delta County (Perkins Area). Notice of termination dated December 4, 1956.

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, covering numerous descriptions in the Rock and Osier Areas. Notice of termination as to all descriptions except the NE¼ of SE¼ and the NW¼ of SE¼, Section 31, 43-22, dated December 4, 1956.

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, 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, excepting an undivided 1/2 interest in the ores and minerals therein (Perkins Area). Notice of termination dated December 4, 1956.

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, covering the NE¼ of NE¼ and SE¼ of NE¼, Section 24, 42-23, Delta County (Perkins Area). Notice of termination dated December 4, 1956.

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, covering the W½ of SW¼ of NW¼ and the N½ of NW¼ of SW¼, all in Section 2, 42-23, Delta County (Rock Area). Notice of termination dated December 4, 1956.

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, covering the SE¼ of SE¼ of Section 20, 42-22, Delta County (Perkins Area). Notice of termination dated December 4, 1956.

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, covering the SW¼ of SE¼ of Section 19, 42-22, and the land in that part of the NW¼ of NW¼ of Section 24, 42-23 lying East of the C. & N. W. right of way, excepting an undivided 1/2 interest in the ores and minerals therein, Delta County (Perkins Area). Notice of termination dated December 4, 1956.

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, covering NW¼ of NE¼, NE¼ of NE¼, N 1/8 of SE¼ of NE¼ of Section 29, 42-22, Delta County (Perkins Area). Notice of termination dated December 4, 1956.

Lease No. 149

Option for fifty-year mining lease from Frank V. Freeman and wife to The Cleveland-Cliffs Iron Company, dated March 4, 1955, expires December 15, 1957, covering the NW¼ of NE¼ of Section 24, 42-23, Delta County (Perkins Area). Notice of termination dated December 4, 1956.

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, covering the NE¼ of NW¼ of Section 19, 42-22, Delta County (Perkins Area). Notice of termination dated December 4, 1956.

Lease No. 152

Option for fifty-year mining lease from The Federal Land Bank of Saint

Paul to The Cleveland-Cliffs Iron Company, dated March 11, 1955, expires December 15, 1957, covering 1/2 interest in the minerals in the SW¼ of Section 12, the NW¼ of Section 24 and the NW¼ of SW¼ of Section 24, all in 42-23, Delta County (Perkins Area). Notice of termination dated December 4, 1956.

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 N½ of Section 24, 43-22, Delta County (Osier Area). Notice of termination dated December 4, 1956.

Lease No. 154

Fifty-year mining lease from the Department of Conservation of the State of Michigan to The Cleveland-Cliffs Iron Company, dated May 5, 1955, covering various descriptions in Township 42 North, Range 22 West, Delta County (Perkins Area). Notice of termination served December 4, 1956; termination effective February 15, 1957.

Lease No. 155

Fifty-year mining lease from the Department of Conservation of the State of Michigan to The Cleveland-Cliffs Iron Company, dated May 5, 1955, covering various descriptions in Township 42 North, Range 23 West, Delta County (Rock and Perkins Areas). Notice of termination served December 4, 1956; termination effective February 15, 1957.

Lease No. 156

Fifty-year mining lease from the Department of Conservation of the State of Michigan to The Cleveland-Cliffs Iron Company, dated May 5, 1955, covering various descriptions in Township 43 North, Range 21 West, Delta County (Osier Area). Notice of termination served December 4, 1956; termination effective February 15, 1957.

Lease No. 157

Fifty-year mining lease from the Department of Conservation of the State of Michigan to The Cleveland-Cliffs Iron Company, dated May 5, 1955, covering various descriptions in Township 43 North, Range 22 West, Delta County (Osier and Rock Areas). Notice of surrender of all descriptions except the S½ of SE¼ of Section 31, 43-22, S½ of NE¼, S½ of NW¼, E½ of SW¼ and SE¼ of Section 32, 43-22, was served December 4, 1956; surrender effective February 15, 1957.

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, covering mineral rights in SW¼ of SW¼, Section 13, 42-22, Delta County (Perkins Area). Notice of termination dated December 4, 1956.

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, covering the W½ of W½ and NE¼ of NW¼ of Section 24, 42-22, Delta County (Perkins Area). Notice of termination dated December 4, 1956.

Lease No. 163

Fifty-year mining lease from Elsbeth McColman, et. al. to The Cleveland-Cliffs Iron Company, dated December 1, 1955, covering the NE¼ of NW¼, NW¼ of NW¼ and SW¼ of NW¼ of Section 17, 44-35, Iron County. Notice of termination served February 15, 1956; termination effective April 20, 1956.

D. THE FORCE

The personnel of the Mining Engineering Department remained approximately the same as 1955 except for the following additions:

1. Raymond E. Oja, Surveyor, and Melvin E. Gustafson, Surveyor Helper, were hired on January 2nd and 9th respectively and were assigned to the Cameo Exploration to supply the necessary survey control for the drilling and geophysical prospecting.

2. Ronald Foisie, Surveyor Helper, reentered the Mining Engineering Department on May 16th and was immediately transferred to the Geological Department to assist in the processing of diamond drill core.

3. Harley E. Clickner, Mining Engineer, returned from his two year hitch with the Armed Forces on August 13th and was assigned to the Bunker Hill--Maas Operation.

4. Holland L. Werner, Surveyor Helper, reentered the Mining Engineering Department on November 1st to replace Joseph J. Scoleri on the Mather Mine, "A" Shaft's survey crew who terminated his employment on October 31st to join his family in California.

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

1. Ralph K. Oja was hired on June 13th as a temporary Surveyor to assist in the engineering work at the Humboldt Mine.

2. James C. Cleven and Roger B. Pohlman were hired on June 13th as temporary Compassman and Compassman Helper respectively to assist in the survey control work in the Trenary Area.

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

Name	Position	Entered	Left	1956 Employment
Grant T. Hollett	Chief Mining Engineer			12 Months
Lawrence L. Arnold	Engineer	July 16th		5½ Months
Eric G. Beinlich, Jr.	Engineer			12 Months
Harley E. Clickner	Engineer	August 13th		4½ Months
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
Bernhardt H. Petersen	Technical Foreman			12 Months
Kenelm C. Winslow	Engineer			12 Months

Name	Position	Entered	Left	1956 Employment
Daniel P. Isaacson	Ass't Engineer			12 Months
Carl A. Koski	Ass't Engineer			12 Months
Frank A. Koski	Ass't Engineer			12 Months
William H. 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			12 Months
Henry C. Coron, Jr.	Surveyor			12 Months
William R. Lehmann	Surveyor			12 Months
Alfred B. Nault	Surveyor			12 Months
Ernest A. Oja	Surveyor			12 Months
Raymond E. Oja	Surveyor	January 2nd		12 Months
Joseph J. Scoleri	Surveyor		October 31st	10 Months
John R. Sleeman	Surveyor			12 Months
Martin D. Tasson	Surveyor			12 Months
Allan E. Wakkuri	Surveyor			12 Months
Clyde C. Anderson	Helper			12 Months
Melvin E. Gustafson	Helper	January 9th		11½ Months
Arthur W. Hemmila	Helper			12 Months
Donald G. Johnson	Helper			12 Months
Donald E. Lampi	Helper			12 Months
Arnold A. Sundell	Helper			12 Months
Richard L. Swanson	Helper			12 Months
Wilburt H. Thomas	Helper			12 Months
Holland L. Werner	Helper	November 1st		2 Months
Ralph K. Oja	Surveyor	June 13th	September 14th	3 Months
James C. Cleven	Compassman	June 13th	September 14th	3 Months
Roger B. Pohlman	Compassman Helper	June 13th	September 14th	3 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	16 Years, 4½ Months
Lawrence L. Arnold	July, 1956	5½ Months
Eric G. Beinlich, Jr.	July, 1952	4 Years, 6 Months
Harley E. Clickner	June, 1952	2 Years, 5 Months
Robert M. DeGabriele	December, 1945	11 Years, 1 Month
Robert J. Flynn	April, 1953	3 Years, 8 Months
Robert G. Fountain	August, 1951	5 Years, 4 Months
Oiva W. Hakala	July, 1951	5 Years, 6 Months

Name	Date Entered	Length of Service
Allen H. Heikkinen	August, 1952	4 Years, 5 Months
Albert Henry	June, 1953	3 Years, 6 Months
LeRoy Hosking	March, 1954	2 Years, 10 Months
R. Charles Kincaid	July, 1951	5 Years, 6 Months
Eino A. Koski	March, 1952	4 Years, 9½ Months
Bernhardt H. Petersen	November, 1950	6 Years, 1½ Months
Kenelm C. Winslow	August, 1953	3 Years, 5 Months
Daniel P. Isaacson	November, 1940	11 Years, 4½ Months
Carl A. Koski	June, 1941	12 Years, 1 Month
Frank A. Koski	January, 1936	16 Years, 9 Months
William H. Stannard	November, 1940	16 Years, 2 Months
Lembit L. Liivoja	January, 1952	4 Years, 11½ Months
Anselm H. Mantyla	July, 1948	8 Years, 5½ Months
George B. Manzoline	December, 1947	6 Years, 9½ Months
Louis R. Miller, Jr.	August, 1945	11 Years, 3½ Months
Jean C. Jensen	July, 1951	5 Years, 5½ Months
Clifford H. Amel	May, 1944	12 Years, 7½ Months
Robert E. Anderson	July, 1948	8 Years, 6 Months
Clarence P. Ayotte, Jr.	April, 1948	8 Years, 8½ Months
Allan L. Bjork	April, 1952	4 Years, 9 Months
Charles W. Cornish	January, 1951	4 Years, ½ Month
Henry C. Coron, Jr.	April, 1953	3 Years, 6 Months
William R. Lehmann	February, 1952	4 Years, 10 Months
Alfred B. Nault	September, 1946	10 Years, 3½ Months
Ernest A. Oja	March, 1943	13 Years, 10 Months
Raymond E. Oja	January, 1956	1 Year
John R. Sleeman	February, 1947	9 Years, 10½ Months
Martin D. Tasson	August, 1948	6 Years, 5 Months
Allan E. Wakkuri	January, 1951	5 Years, 11½ Months
Clyde C. Anderson	December, 1950	6 Years, 1 Month
Melvin E. Gustafson	January, 1956	1 Year
Arthur W. Hemmila	June, 1953	3 Years, 8 Months
Donald G. Johnson	June, 1953	2 Years, 4 Months
Donald E. Lampi	April, 1951	5 Years, 9 Months
Arnold E. Sundell	February, 1951	5 Years, 11 Months
Richard L. Swanson	June, 1952	2 Years
Wilburt H. Thomas	January, 1951	6 Years
Holland L. Werner	April, 1953	1 Year, 8½ Months

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	231		4	18
Lawrence L. Arnold	115½		½	
Eric G. Beinlich, Jr.	243	2		12
Harley E. Clickner	96			

Name	Days Worked	Overtime	Sick	Absent
Robert M. DeGabriele	253			
Robert J. Flynn	244			9
Robert G. Fountain	243			10
Oiva W. Hakala	234½	2	12½	8
Allen H. Heikkinen	247½	9½	2	13
Albert Henry	243		4	6
LeRoy Hosking	243			10
R. Charles Kincaid	237			16
Eino A. Koski	245			8
Bernhardt H. Petersen	243			10
Kenelm C. Winslow	234	1½		10½
Daniel P. Isaacson	231½	2	7	16½
Carl A. Koski	239			14
Frank A. Koski	237	3	1	18
William H. Stannard	231½		6½	15
Lembit L. Liivoja	223½		19½	10
Anselm H. Mantyla	234		3	16
George B. Manzoline	241-3/4			11¼
Louis R. Miller, Jr.	235		8	10
Jean C. Jensen	244			9
Clifford H. Amel	264-3/4	21-3/4		10
Robert E. Anderson	249	10	4	10
Clarence P. Ayotte, Jr.	252	12		13
Allan L. Bjork	244	3		12
Charles W. Cornish	246-3/4	3-3/4		10
Henry C. Coron, Jr.	259-3/4	27-3/4	5	16
William R. Lehmann	251	11	3	10
Alfred B. Nault	245¼	12¼	5	15
Ernest A. Oja	241	1	1½	11½
Raymond E. Oja	234		19	
Joseph J. Scoleri	211	7	1	10
John R. Sleeman	259½	16½		9
Martin D. Tasson	245½	6½		14
Allan E. Wakkuri	252½	11½	2	10
Clyde C. Anderson	255	21	6	13
Melvin E. Gustafson	249			
Arthur W. Hemmila	253	11		11
Donald G. Johnson	263½	15½		5
Donald E. Lampi	242	1		12
Arnold A. Sundell	249-3/4	12¼	2½	13
Richard L. Swanson	257½	10½	1	5
Wilburt H. Thomas	234	8	17	10
Holland L. Werner	40	1		
Ralph K. Oja	68	5		
James C. Cleven	63			
Roger B. Pohlman	63			

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	4	28	199	231
Lawrence L. Arnold		43	72½	115½
Eric G. Beinlich, Jr.	45	3	195	243
Harley E. Clickner	19	7	70	96
Robert M. DeGabriele	Distribution not reported.			253
Robert J. Flynn		203	41	244
Robert G. Fountain		20	223	243
Oiva W. Hakala	31	11	192½	234½
Allen H. Heikkinen		182	65½	247½
Albert Henry		99	144	243
LeRoy Hosking		104	139	243
R. Charles Kincaid	27½	10	199½	237
Eino A. Koski	46	5	194	245
Bernhardt H. Petersen	Distribution not reported.			243
Kenelm C. Winslow		47½	186½	234
Daniel P. Isaacson	57½	16	158	231½
Carl A. Koski	102½	58-3/4	77-3/4	239
Frank A. Koski		187	50	237
William H. Stannard			231½	231½
Lembit L. Liivoja			223½	223½
Anselm H. Mantyla			234	234
George B. Manzoline			241-3/4	241-3/4
Louis R. Miller, Jr.			235	235
Jean C. Jensen			244	244
Clifford H. Amel		227¼	37½	264-3/4
Robert E. Anderson	130	11½	107½	249
Clarence P. Ayotte, Jr.	144½	12	95½	252
Allan L. Bjork	70½	35	138½	244
Charles W. Cornish		216¼	30½	246-3/4
Henry C. Coron, Jr.		147	112-3/4	259-3/4
William R. Lehmann	132½	9	109½	251
Alfred B. Nault	99	3	143¼	245¼
Ernest A. Oja		214	27	241
Raymond E. Oja		202	32	234
Joseph J. Scoleri	120½	8	82½	211
John R. Sleeman	127½	11½	120½	259½
Martin D. Tasson		209½	36	245½
Allan E. Wakkuri	124¼	2	126¼	252½
Clyde C. Anderson	109	42	104	255
Melvin E. Gustafson		222	27	249
Arthur W. Hemmila	127	2	124	253
Donald G. Johnson	131½	41¼	90-3/4	263½
Donald E. Lampi		215	27	242
Arnold A. Sundell	111-3/4	2	136	249-3/4
Richard L. Swanson	141	10½	106	257½
Wilburt H. Thomas	130½	16½	87	234
Holland L. Werner	18	½	21½	40
Ralph K. Oja		51½	16½	68
James C. Cleven		51	12	63
Roger B. Pohlman		49½	13½	63

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 - 1956

	BUNKER HILL--MAAS	CAMBRIA-JACKSON	CLIFFS-SHAFT	HUMBOLDT	MATHER "A"
MINE ENGINEER	Harley E. Clickner	Combined		Albert Henry	Oiva W. Hakala
ASS'T MINE ENGINEER			Carl A. Koski		Daniel P. Isaacson
SURVEYOR	Robert E. Anderson	with	Allan L. Bjork	Henry C. Coron, Jr.	Clarence P. Ayotte, Jr. William R. Lehmann
HELPER	Clyde C. Anderson Donald G. Johnson Richard L. Swanson	Mather Mine,			Wilburt H. Thomas Holland L. Werner
TECHNICAL FOREMAN	Bernhardt H. Petersen Eric G. Beinlich, Jr. John R. Sleeman (Conveyor Belt Installation)	"B" Shaft	Robert M. DeGabriele (Construction Engineer)		

	MATHER "B"	OHIO	REPUBLIC	TILDEN
MINE ENGINEER	R. Charles Kincaid		Robert J. Flynn	
SURVEYOR	Alfred B. Nault Allan E. Wakkuri	Henry C. Coron, Jr.	Charles W. Cornish	Henry C. Coron, Jr.
HELPER	Arthur W. Hemmila Arnold A. Sundell			
TECHNICAL FOREMAN	Eino A. Koski (Development Engineer)	Allen H. Heikkinen (Pit Foreman) Clifford H. Amel (Pit Foreman)		Allen H. Heikkinen (Pit Foreman) Clifford H. Amel (Pit Foreman)

	NEGAUNEE & REPUBLIC TOWNSITES	MARQUETTE RANGE GENERAL SURVEY CONTROL	SURVEY CONTROL GEOLOGICAL DEPARTMENT CAMEO EXPLORATION	OFFICE	
MINE ENGINEER	LeRoy Hosking			DRAFTSMEN	William H. Stannard (Chief) Lembit L. Liivoja Anselm H. Mantyla George B. Manzoline
ASS'T MINE ENGINEER		Frank A. Koski			
SURVEYOR	Ernest A. Oja	Martin D. Tasson	Raymond E. Oja		
HELPER	Donald E. Lampi		Melvin E. Gustafson	DEPARTMENT CLERK	Jean C. Jensen
				BLUEPRINT MACHINE OPERATOR	Louis R. Miller, Jr.
				CHAUFFEUR	Henry C. Coron, Jr.

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	1,054.50	9.8644
Bunker Hill Mine	788.50	7.3761
Cambria-Jackson Mine	118.75	1.1109
Cliffs-Shaft Mine	702.50	6.5716
Humboldt Mine	373.25	3.4916
E&A HM-11	3.00	.0281
E&A HM-18	1.00	.0094
E&A HM-36	1.50	.0140
Lloyd Mine	63.00	.5893
Maas Mine	416.25	3.8938
Mather Mine,		
"A" Shaft	1,298.50	12.1469
"B" Shaft	1,350.75	12.6356
E&A NM 44-0-a (Crusher, Pan Feeder and Grizzly - 5th Level)	2.00	.0187
E&A NM 44-0-d (200' of Belt Drift - 5th Level)	2.25	.0210
E&A NM 90 (Conveyor Belt and Crusher)	4.00	.0374
E&A NM 90 ba (9th Level Conveyor Belt)	102.00	.9542
E&A NM 90 bc (9th Level Discharge End and Excavation)	14.00	.1310
E&A NM 90 bd (9th Level Load End Excavation)	6.50	.0608
E&A NM 90 be (9th Level Conveyor Drift Excavation)	3.00	.0281
E&A NM 102 (Installation of Sub-Level Conveyor Belts - 8th and 9th Levels)	2.50	.0234
E&A NM 111-B-1-b (Installation of Conveyors and Crushers)	19.00	.1777
E&A NM 112 (House Moving Project - Cliffs Fourth Addition)	13.00	.1216
E&A NM 113-5-d (Drifting - 5th Level)	12.00	.1123
E&A NM 113-6-d (Drifting - 6th Level)	2.00	.0187
E&A NM 113-6-m (Pumping Station - 6th Level)	2.00	.0187
E&A NM 113-7-d (Drifting - 7th Level)	8.00	.0748
E&A NM 113-8-d (Drifting - 8th Level)	9.25	.0865
E&A NM 113-9-d (Drifting - 9th Level)	55.00	.5145
E&A NM 113-10-b (Pockets, Trenches and Equipment - 10th Level)	5.00	.0468
E&A NM 113-10-d (Drifting - 10th Level)	70.75	.6618
E&A NM 113-10-j (Exploration - 10th Level)	.75	.0070
E&A NM 113-10-k (Raise above Level - 10th Level)	2.75	.0257
E&A NM 113-10-m (Pumping - 10th Level)	.50	.0047
E&A NM 115-ME (Crusher and Conveyor - 10th Level)	10.00	.0935
E&A NM 116-9-a (Drifting - 9th Level)	57.75	.5402
E&A NM 123-A-3 (Pumping - "B" Shaft)	3.00	.0281
E&A NM 125 (Sub-Level Conveyor Belts - "A" Shaft	1.00	.0094

Property	Total	%
Ohio Mine	398.50	3.7278
Republic Mine	419.25	3.9219
Pelletizing Plant	27.25	.2549
E&A MI 1 (House Moving Project - Republic)	57.50	.5379
E&A MI 6 (Republic Mine Expansion)	4.50	.0421
E&A MI 8 (First Addition to Plat of Republic)	72.00	.6735
E&A MI 491-A-a-2 (Republic Mine Engineering)	160.75	1.5037
E&A MI 654-A-1-a (Pelletizing Plant Engineering)	153.75	1.4383
Spies Mine	15.75	.1473
Tilden Mine	208.25	1.9481
Morris Mine	4.00	.0374
Deferred Accounts:		
Estimating Empire Reserves	29.00	.2713
Cliffs Group Improvement Study	3.50	.0327
Relocation of Railroads	78.50	.7343
Negaunee Sewer Relocation	7.00	.0655
Tilden Mine Expansion	26.50	.2479
Land Offer 3120C	3.75	.0351
Land Offer 3121C	1.25	.0117
Land Offer 3163C	2.00	.0187
Land Offer 3201C	4.00	.0374
Land Offer 3613	3.00	.0281
Outside Exploration 1155	25.00	.2339
Outside Exploration 1159	169.25	1.5833
Outside Exploration 1160	76.50	.7156
Outside Exploration 1162	90.00	.8419
Outside Exploration 1163	13.00	.1216
Outside Exploration 1164	107.00	1.0009
Outside Exploration 1165	52.50	.4911
Outside Exploration 1179	56.00	.5239
Canadian Cliffs, Limited	12.00	.1123
Upper Peninsula Power Company	26.50	.2479
E&A AM 36 (Relocation - Healy Avenue and Ann Street)	28.50	.2666
E&A CC 619 (Bunker Hill--Athens Drifting)	168.75	1.5786
E&A CC 659S (Belleview Exploration)	60.50	.5659
E&A CC 662 (Maas--Bunker Hill Connecting Drift)	260.00	2.4322
E&A CC 684 (Bunker Hill Heating Plant)	2.00	.0187
E&A CC 685 (Bunker Hill Shop Addition)	14.00	.1310
E&A CC 729 (Stocking Area - Tilden Mine)	5.00	.0468
E&A CC 734 (Cascade East End - Shallow)	13.25	.1239
E&A CC 735 (Cascade East End - Deep)	11.25	.1052
E&A CC 745 (Drilling - McColeman Lands)	5.00	.0468
E&A CC 752 (Development Work - Maas Mine)	49.00	.4584
E&A CC 753 (Relocate Compressor and Trestle - Bunker Hill Mine)	60.00	.5613
E&A CC 754 (Drifting and all other Development Work - Bunker Hill Mine)	324.50	3.0355
E&A CC 770 (Section 4, 47-27)	2.50	.0234
E&A CC 778 (Stripping - Ohio Mine)	68.75	.6431
E&A CC 780 (Rock)	59.75	.5589
E&A CC 781 (Osier)	65.25	.6104
E&A CC 783 (Perkins)	4.50	.0421

Property	Total	%
E&A CC 794 (New Garage Building - Bunker Hill Mine)	23.00	.2152
E&A CC 801-A-1-f (Cliffs Ore Improvement Plant - Mining Engineering)	140.50	1.3143
E&A CC 801-A-1-g (Cliffs Ore Improvement Plant - Project Engineering)	127.50	1.1927
E&A CC 813 (Tilden Area)	82.25	.7694
E&A CC 814 (New Richmond Area)	52.50	.4911
E&A CC 822 (Cliffs Fourth Addition)	34.50	.3227
E&A CC 825 (Cascade East End)	136.50	1.2769
E&A CC 832 (South Sturgeon--Indian Lake)	1.00	.0094
E&A CC 833 (Trenary)	1.50	.0140
E&A CC 834 (Gladstone--Cornell)	1.00	.0094
	10,690.00	100.0000%

F. COSTS

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

	1954	1955	1956
Salaries	$275,507.92	$232,704.00	
Travel & Entertainment	1,497.21	772.00	
Dues & Subscriptions	100.00	146.00	
Telephone & Telegraph	530.25	575.00	
Printing, Stationery & Special Supplies	10,929.32	6,554.00	No
Heat, Light, Power & Water	985.03	224.00	
Furniture & Fixtures	2,222.86	65.00	
Unemployment Insurance	2,299.38	12.00	
Auto Expense	9,220.88	7,049.00	
Old Age Benefits Tax	4,050.08	84.00	Detail
Donations	49.47	0	
Group Annuity Premiums	6,201.90	8,015.00	
Repairs & Maintenance	830.69	56.00	
Insurance	921.19	837.00	
Postage & Express	233.62	201.00	
State Franchise, Property & Miscellaneous Taxes	50.63	20.00	Available
Depreciation - Buildings & Equipment	2,956.00	3,279.00	
Cleaning & Janitor Supplies	254.44	0	
Personal Injury Expense	0	12.00	
Field & Specialized Equipment including Maintenance	3,335.44	1,418.00	
Building Alterations	0	331.00	
Rentals	13.33	0	
Miscellaneous	2,749.06	1,647.00	
Totals	$324,938.70	$264,001.00	$301,095.00

H. AUTOMOBILES

The Ford Ranch Wagon (1952 model) was operated throughout the year by the Republic Mine engineering crew and the Ford Ranch Wagon (1953 model) by the surface survey crew. The Chevrolet Handyman (1953 model), which was assigned to the Ohio--Tilden engineering crew, was operated until May, 1956, when it was damaged and replaced by a 1956 model Ford Ranch Wagon. Both the Chevrolet Carryall (1955 model) and the Ford Ranch Wagon (1956 model) were operated throughout the year by the Townsite and Humboldt Mine engineering crews respectively.

The following table shows the mileage covered in 1956, the total mileage to the end of the year and the date the cars were received in the Department:

Car	Miles 1956	Miles Total	Date Received	Date Disposed of
Ford Ranch Wagon (1952 model), #29	16,810	67,800	6/20/52	
Ford Ranch Wagon (1953 model), #48	10,450	50,250	7/30/53	
Ford Ranch Wagon (1956 model), #77	11,430	12,280	11/30/55	
Ford Ranch Wagon (1956 model), #85	13,847	13,847	6/1/56	
Chevrolet Carryall (1955 model), #69	9,843	19,620	5/21/55	
Chevrolet Handyman (1953 model), #49	5,844	41,785	8/14/53	6/1/56

I. MINES

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

BUNKER HILL MINE - Harley E. Clickner, Mining Engineer

(1) The Nordberg air compressor was dismantled and replaced by two Ingersoll-Rand Compressors, which will furnish increased compressed air capacity for the Bunker Hill--Maas consolidation. Center lines and elevations for this installation were established by the survey crews.

(2) Considerable time was spent by the survey crews maintaining the necessary control for the excavation of the 14th Level crusher station and the installation of steel and equipment. The 14th Level conveyor-haulage installation was completed in December of 1956.

(3) A ventilation raise was driven from the Bunker Hill 14th Level to the 12th Level.

(4) In May, construction commenced on the new Garage Building and the addition to the Shop Building. Lines and grades were established by the survey crew and construction is being carried out by the Surface Department.

(5) Drawings and surveying were required for the construction of the new Northeast trestle.

(6) A six-angle check survey was made from the Maas 7th Level to the Bunker Hill Shaft at 2nd Level elevation, and a plumbing was conducted from 2nd Level to 6th Level. Drifting was again resumed in the 6th Level conveyor-haulage drift in March.

(7) Branch raises were driven from the main ore pass between 2nd and 6th Levels. The purpose of the branch raises is to allow ore fines to by-pass the 2nd Level crusher.

(8) In September, the Bunker Hill Shaft was plumbed from 2nd Level to 6th Level to check the previous plumbing. Results indicated the previous plumbing was accurate, and courses were computed for two 3-7/8" diamond drill holes which are being drilled from the Maas 700 drift to the proposed crusher station on Bunker Hill 6th Level elevation. The purpose of these holes being to serve as guides to facilitate breakage and to aid ventilation when ore passes are driven from the crusher station to the Maas 7th Level.

(9) An inventory of underground equipment was conducted at the Bunker Hill and Maas Mines.

(10) The measuring pockets on 10th and 12th Levels were redesigned to accommodate the new 12-ton skips. Vibrating pockets were installed on 12th and 14th Levels.

(11) Considerable time was spent by the survey crews on the installation of the new skip hoist. The previous hoist footing was modified to meet the specifications of the new hoist and center lines and elevations were established.

(12) Steel work on the Bunker Hill headframe was completed and the sheave wheels were aligned.

(13) The Maas and Bunker Hill Shafts were gauged and the necessary corrections made to the sets and runners.

(14) A large majority of the Mining Engineer's time was spent in report writing, mine planning, cash forecasts and general supervision of the survey crew.

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

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

(2) The Mining Engineer was responsible for writing the monthly and annual reports, figuring contract miners' incentive earnings, calculating the Michigan State Tax and Federal Tax Estimates, laying out of mining areas and assisting in the 1957 production and cost estimates.

(3) The survey crew gauged the shaft runners, surveyed the stockpile and assisted in the construction and installation of the North stocking trestle.

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

(1) The alteration of the surface plant, specifically, the renovation of an old boiler house into a central shops building, the new bit shop addition on the West end of the central shops building, the haulage track in the tunnel and shops building, the haulage track into the West timber field and the new discharge line between "C" Shaft and the Carp River, called for surface control work, "lines and grades" work, layout and inspection during their construction and installation.

(2) The rock excavation pertinent to the new pumping system; i.e., the sump, pumphouse, etc., made it necessary to perform continuous survey control work.

(3) During the construction of foundations, steel frame work, dams, catwalks, pumping station facilities and the installation of pumps, pump station equipment and the new discharge line, the Mining Engineer and his survey crew were called upon for "lines and grades" work, layout, leveling and inspection during construction.

(4) Engineering personnel assigned to this property gauged all the "C" Shaft runners twice during the year.

(5) Tri-Annual surveys were conducted, the maps posted and reports compiled and forwarded to the Oliver Iron Mining Division of the United States Steel Corporation.

(6) Accurate production analyses records were maintained throughout the year by engineering personnel as per the 1954 Mixing Agreement of The Cleveland-Cliffs Iron Company and the Oliver Iron Mining Division. Several new monthly analyses reports to the Lessor were also undertaken by engineering personnel.

(7) A Parshall flume was installed in the new mine discharge ditch under supervision of the engineering personnel. This flume will be used to gain information on the new pumping installation.

(8) Progress of several shrinkage stopes in the mine was followed throughout the year by the Mining Engineer and the survey crew and all necessary survey control work was done by the crew.

(9) 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.

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

(11) The routine underground surveys necessary for the mining and development contracts, the location and marking of lease boundaries underground and the surveying of several diamond drill holes on the Cliffs-Shaft Mine.surface were taken care of as called for throughout the year.

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

(13) The runners in "B" Shaft were gauged on July 10th. This shaft is used occasionally and is maintained as a second outlet. The runners in "A" Shaft were not gauged since the cage has been removed and the "A" Shaft hoist has been dismantled.

(14) The survey crew was called upon to do some survey control work upon the mine surface preparatory to some geophysical work which was being conducted by the Geological Department.

HUMBOLDT MINE - Albert Henry, Mining Engineer

(1) The jet pierced blast holes were located with the desired depth and chamber. The explosive charges were calculated and the loading was supervised. The jet time breakdown was recorded to show delays.

(2) The monthly pit progress was surveyed and recorded on the maps along with the geological data. Mining plans and stripping estimates were prepared. New reserve estimates were made showing crude ore, pit waste and stripping necessary for each bench in the pit.

(3) Wagon drilling control was given as needed and a 5½" Gardner-Denver drill was tested.

(4) Other major work included a preventive maintenance program for the pit equipment, geophysical control and tailings water data.

MATHER MINE

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

(1) Each month a complete survey of the mine was made to map the geology and the work completed in the various areas of the mine. This information was used to prepare four sets of maps which were distributed to the District Superintendent of Underground Mines, Mine Superintendent, Mine Engineer and Mine Captain. At the end of each quarter an additional set of maps was prepared and sent to the Bethlehem Steel Company. Ten sets of point maps were prepared each month for use by the supervisory personnel underground.

(2) Routine survey work required the greater part of the time of the two, two-man survey crews. All development contracts were provided with lines and grades and frequently rechecked during the progress of the work. Usually approximately twenty crews were engaged in sub-level development work and two to three crews in main level development work. Development work was completed on the 3100' 9th Level conveyor belt drift and crusher box and the second sub-level conveyor belt drift above the 8th Level was also completed. Work was begun on the second and third sub-level conveyor belt drifts above the 9th Level. This type of development required very careful control and planning.

(3) Other work accomplished during the year is as follows: Ventilation survey and posting of fire maps, shaft gauging, tax estimates, stope analysis, stockpile analysis of iron, silica and sulphur with accumulative

totals for each pile being carried, stockpile surveys, accumulation of data on underground water, assisted in preparing quarterly steel and timber requirements and assisted in the preparation of quarterly capital expenditure forecasts.

(4) Weekly and monthly reports on all activities at the mine were prepared. A separate report of the activities most directly concerned with the mining engineering phase of the operation was also prepared each month.

(5) For the last quarter of the year the Mining Engineer assumed the duties of the Mine Geologist in planning and supervising the diamond drilling, logging the core and preparing a detailed monthly report.

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

(1) The two, two-man survey crews assigned to this property took care of the day to day surveying of the mining and development contracts, calculating and recording stope analysis data, posting of analysis maps and taking water elevations in the Jackson Pit Area.

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

(3) Application of exploration drilling with a small percussion-type drill was continued during the year. This program required the presence of the Mining Engineer and survey crews to lay out the drill holes and compile the results.

(4) The Mining Engineering Department personnel conducted check surveys on the footwall headings of the 9th and 10th Levels. The Mather "A"-"B" footwall drift on the 9th Level was connected during December of 1956.

(5) The Mather Mine, "B" Shaft's standard ore stockpile was surveyed this fall to determine the balance of the ore in stock at the end of the shipping season.

(6) The quarterly E&A forecast and the 1957 production estimate was also handled by the Mining Engineer along with a monthly subsidence report on the various drill holes at the Mather Mine, "B" Shaft.

(7) A considerable amount of the survey crews' time was required with the installation of three lengthy underground conveyor belts.

OHIO MINE - Allen H. Heikkinen, Mining Engineer

(1) All churn drill holes were laid out periodically in pattern, depth and according to plan for pit operations throughout the year and also to provide for future stripping and production. The Joy Rotary Drill was tested in various sections of the pit and progress recorded on bit service and footage.

(2) All blasting done during the year was confined to the West Pit. Different types of powder were used to improve efficiency and to some extent

were satisfactory. A letter was written on each blast, stripping and production, stating powder cost and breakage. A report was also submitted each month, outlining the field and office work performed.

(3) Sections were drawn up and planimetered for an estimate of rock and surface stripping required for the 1957 production.

(4) Field surveying consisted of:

(a) Profiles for new haul roads
(b) Elevations and benchmarks for pit work
(c) Located and witnessed the Beaufort Lease line
(d) Stripping limits on the South side of the West Pit
(e) Each month a set of maps were posted showing production and stripping progress.
(f) A complete set of iron pins for control and use in the mining area.
(g) Profile for draining, from tailings pond to swamp, and general surveying required for mine operation

REPUBLIC MINE - Robert J. Flynn, Mining Engineer

(1) The 1956 stripping calculations were made. Cross-sections and estimates were completed showing the removal of ore through the 1965 season. This information was for the Michigan State Tax Commission.

(2) The Joy 60-BH rotary blast hole drill was brought in for test drilling. Holes were laid out and weekly reports made on the operation of this machine.

(3) A study was made to determine the best possible route of the permanent pit road to the 1100' elevation. Three possible routes were calculated showing the volumes of footwall and hangingwall material to be removed and also the volume of ore which would remain in the pit.

(4) A main oxygen line and necessary feeder lines to serve the pit were surveyed. Monthly estimates were also made showing the oxygen loss through these lines.

(5) A ledge contour map was prepared, from field work, of the orebody between the 600 N. and 3000 N. coordinates. From this map and the geological sections, the volume of ore above the 1560 elevation was calculated and plan maps prepared showing the yearly removal of ore through the 1959 season.

(6) A survey was made for a possible road through the center of the pit to the 1560 bench and a road staked to serve the removal of hangingwall material to daylight a portion of the 1520 bench.

(7) All drill holes were laid out, surveyed and posted on a blast hole map.

(8) Monthly maps were posted, printed and distributed showing all stripping, grading, construction and ore removed during the previous month.

(a) Stockpile was surveyed and quantities calculated.
(b) Railroad track was relocated in the stockpile area.
(c) M. A. Hanna boundaries were located.
(d) Monthly pit surveys, hard maps and tracings were posted.
(e) In the area North of the pocket track in the West Pit, a survey was run and an estimate made of the stripping necessary to clear this area.
(f) New control points were put in the West Pit for future work to be done.

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 8/31/55	Tons As of 8/31/56
Athens	680,566	*
Bunker Hill	2,731,043	4,865,344
Cambria-Jackson	458,767	182,901
Cliffs-Shaft	1,316,679	1,125,468
Lloyd	76,953	0
Maas	3,291,952	3,283,970
Pioneer & Arctic	0	2,089,500
Mather,		
"A" Shaft	8,802,460	7,698,313
"B" Shaft	17,340,277	14,170,902
Total Developed Ore	34,698,697	33,416,398
Undeveloped Reserves		
Section 3, 47-27	302,378	302,378
Grand Total All Ores	35,001,075	33,718,776

* - Combined with Bunker Hill Mine for 1956

STOCKPILES

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

The following table shows the comparison of ore in stock on November 1, 1955 and November 1, 1956:

(9) The ore tonnage and powder calculations for all primary field blasts were made and the loading of these holes supervised.

(10) A map was started showing the daily location of the shovel in the orebody; with this is a chart showing the percentage of crude iron and the grindability and concentratability of each daily production.

(11) Plan maps and sections were prepared showing the 1957 stripping.

(12) The early part of the year was spent completing dikes #9, #10 and #11 which included grades, lines and slope staking of these areas.

(13) Yardage calculations were made of dirt lost in the washout of dike #4 and the material needed to repair this dike and reinforce the South network of dikes. The necessary field work to complete these projects was also done.

(14) Other projects handled in conjunction with the tailings area were: location and construction of a tailings line from the mill to the dike, construction of a return ditch from the tailings pond to Milwaukee Lake, a survey to determine the drainage pattern of the reuse water overflowing from Milwaukee Lake and returning to the Michigamme River and the layout and inspection of a pumphouse at Milwaukee Lake.

(15) Gravel samples of dikes #3 and #4 were taken for analyses.

(16) The water level of the tailings pond and the relative seepage of water through dike #4 was measured at frequent intervals.

(17) The painting of the concentrating plant was inspected until the job was completed.

(18) Footings for a new ball storage bin and reagent storage tank were laid out and the concrete work supervised.

(19) The yardages for blacktopping and sodding of various areas around the shops were calculated, the work inspected and the actual areas remeasured upon completion of the project.

(20) A two-foot interval contour map was completed of the area bounded by the coordinates 0+00 N. to 8+00 N. and 2+00 W. to 1000 E. This map will serve as a guide for possible plant expansion.

(21) A study, including cross-sections and yardage calculation, was made of the possibility of expanding the pocket tracks to enable the loading of concentrates at triple the present capacity.

TILDEN MINE - Allen H. Heikkinen, Mining Engineer

(1) Churn drill holes were laid out periodically to keep ahead of the drillers. All three pits were worked during the 1956 season, April to June. A record was kept of each blast, stating powder used, tonnages and cost.

(2) Survey work was as follows:

Mine	Nov. 1, 1955	Nov. 1, 1956
Bunker Hill		
Athens Shaft	83,690	0
Bunker Hill Shaft	21,056	146,059
Cambria-Jackson	0	18,684
Cliffs-Shaft	39,054	32,197
Humboldt	86,412	28,820
Lloyd	148,064	112,801
Maas	91,263	1,405
Mather,		
"A" Shaft	14,648	160,150
"B" Shaft	32,247	113,372
Ohio	0	11,535
Spies	25,140	0
Republic	0	157,659
Tilden	62,572	57,866
Totals	604,146	840,548

SHAFT GAUGING

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

Mine	Date
Bunker Hill	March 17th
Cambria-Jackson	March 4th September 16th
Cliffs-Shaft ("B")	July 9th
("C")	June 15th
Maas	March 10th September 23rd
Mather,	
"A" Shaft	February 12th September 20th
"B" Shaft	March 11th September 23rd

REPUBLIC TOWNSITE - LeRoy Hosking, Engineer

(1) Thirty houses are now in the Plat of Republic. The water distribution and sanitary sewer systems and the sewage disposal plant are in operation. All the field work pertinent to the house moving program was carried out by the engineering crew.

(2) Preliminary field work and preparation of plans and estimates for the First Addition to the Plat of Republic were completed. Requests for bids on grading, drainage, water distribution and sanitary sewer systems were sent to contractors. Formal approval of the plat by the Township, County and State had not been received by the end of the year.

CITY OF NEGAUNEE PLATS - LeRoy Hosking, Engineer

(1) Considerable work was done on plans for the Fourth Addition Plat which is now in the hands of the State Auditor General.

(2) The field work required by the Fourth Addition house moving was provided by the Townsite Crew.

(3) Investigations of other possible areas, which could be platted, were made. Improvement costs on the Collins Property and the Maas stockpile area, East of the Fourth Addition, were estimated.

(4) Lots were surveyed in the Third Addition to the City of Negaunee to meet the needs of the home construction program.

EAGLE MILLS PELLETIZING PLANT - LeRoy Hosking, Engineer

(1) The major project at this property was the construction of an Ore Thawing Building which was done under the close surveillance of the field crew.

EAGLE MILLS ORE IMPROVEMENT PLANT - LeRoy Hosking

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

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

(3) Final cross-sections were run and quantity estimates prepared for the settlement between The Cleveland-Cliffs Iron Company and the Lake Superior and Ishpeming Ry. Co.

(4) Miscellaneous survey work, such as, elevations, lines and grades, was done for building and equipment erection.

(5) An Upper Peninsula Power Company transmission line to the Ore Improvement Plant was surveyed.

MATHER MINE SUBSIDENCE - LeRoy Hosking and Frank A. Koski, Engineers

(1) All of the houses in the expected cave area have been moved.

(2) The complete engineering for the Lake Superior and Ishpeming

Ry. Co.'s relocation between "A" and "B" Shafts of the Mather Mine was done by Company personnel.

(3) The Upper Peninsula Power Company's transmission line was relocated.

(4) Boundaries for a fence line around the possible subsidence area were established.

(5) The field crew, on loan to the Michigan Gas & Electric Company, surveyed a new route for the main line from Negaunee to Ishpeming and also located a new site for the gas storage tank.

(6) Mining Engineering Department personnel cooperated with the Duluth South Shore & Atlantic and Chicago & North Western Ry. Cos. in the relocation of their line between Ishpeming and Negaunee.

NEGAUNEE SUBSIDENCE - LeRoy Hosking and Frank A. Koski, Engineers

(1) Considerable time was spent in mapping the general sewer layout of the City of Negaunee, both sanitary and storm. This information is important both in connection with new plat development and an expensive revision which will be required by future subsidence.

(2) With the above problem in mind a reconnaissance has been made of a proposed road from the Cherry Street extension to County Road 480 around the East end of the Maas Mine cave area.

(3) The periodic check elevation of the iron subsidence pins at the Athens, Bunker Hill and Cambria-Jackson Properties was made.

(4) In conjunction with the proposed line of the Chicago & North Western Ry. Co., a profile was made of the County Road 492 relocation to establish whether an overpass or a regular grade crossing was feasible.

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

ISHPEMING DISTRICT - TILDEN AREA

(1) Preliminary and final surveys were made of all new drill holes.

(2) The original survey was extended to facilitate control of future operations.

NEGAUNEE DISTRICT - BELLEVIEW EXPLORATION, SECTION 18, 47-26

(1) Field work was required for the extension of survey control and the planning of routes and roads for the present and future drilling and geophysical work.

CASCADE DISTRICT - CASCADE EAST END

(1) Control points for both horizontal and vertical control were surveyed for use in the aerial mapping of this area.

SURVEY CONTROL - CAMEO EXPLORATION

TRENARY AREA

(1) Survey control for geophysical work was established.

UPPER PENINSULA POWER COMPANY

The Upper Peninsula Power Company's transmission lines in the North Lake District were rerouted to avoid the Lloyd Mine subsidence area.

BOARD OF EDUCATION - CITY OF ISHPEMING

A utilities and property survey was made for the City of Ishpeming's Board of Education in conjunction with their new building program.

RESEARCH LABORATORY

Building lines and sewer grades were established for the new MOC Pilot Plant at the Research Laboratory.

OTHER

(1) The Townsite Crew performed the engineering required in the erection of a new stocking trestle at the Bunker Hill Mine.

(2) An estimate was made for the proposed Humboldt to M-95 cut-off road.

(3) The Mining, Land and Legal Departments and the Cities of Ishpeming and Negaunee frequently required information contained in our files and maps and also obtained by work in the field.

HOLIDAYS

The following holidays were granted during the year:

January 2nd	- New Year's Day
May 30th	- Memorial Day
July 4th	- Independence Day
September 3rd	- Labor Day
November 22nd	- Thanksgiving Day
December 24th & 25th	- Christmas
December 31st	- New Year's Eve

Respectfully submitted,

Ralph E Magnuson, Jr.

Ralph E. Magnuson, Jr.
Chief Mining Engineer

REM:jcj
2-15-57
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RESEARCH LABORATORY

ANNUAL REPORT - YEAR 1956

The Annual Report for 1956 is subdivided into six main sections. These sections are reported separately and are related to different phases of work conducted by the Metallurgical Department. These specific sections are: (1) General Testing Program, (2) Pyrolysis & Agglomeration, (3) Research and Development Work and Flotation Projects, (4) Microscopy Section, (5) FluoSolids Reactor Pilot Plant, and (6) 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 any specific test data, conclusions, or recommendations reached by completing any investigation. Any projects which can be considered of short term duration or minor in nature are not covered in the Annual Report, however, have been referred to in the monthly reports.

PART I

GENERAL TESTING PROGRAM

MAJOR PROJECTS:

Pilot Mill tests:

During the year pilot mill tests were conducted treating Empire crude ore and MOC calcine. These tests were conducted to establish flowsheets for concentrating natural and artificial magnetite. A more detailed description of these tests is included in Part III.

Aerofall - Cascade Mill Tests:

During the year pilot mill tests were conducted testing Aerofall and Hardinge Cascade Mill pilot scale grinding units. These tests were conducted to determine the relative merits of employing an autogenous grinding unit for preparing feed. The investigation included an evaluation of the possible advantages as related to power, steel wear, operating costs, capital investment, and other factors as compared to employing the conventional rod mill - ball mill combination.

Land Offers & Outside Explorations:

A number of priority samples were submitted during the year under land offer and outside exploration numbers. The bulk of these samples that were submitted were analyzed and if the crude iron content was high enough to warrant testing, batch test work was conducted.

Plant Control Work - Humboldt-Republic-Pelletizing Plant-Ohio:

Plant control work conducted at the Laboratory for the operating plants involved was routine work such as structures, bouyoucos determinations, heavy media loss determinations, and grindability tests.

RESEARCH & DEVELOPMENT PROGRAM:

Research and Study:

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

Sample Shipments:

During the year various samples of lean ore, high grade ore, and concentrates were shipped to various companies and laboratories for testing and development work. A list of the samples shipped during the year is presented below:

Date	Company	Amount & Samples	Purpose
2/1/56	Federal Foundry Chicago, Illinois	25 lbs. concentrate	Experimental test work on balling tests.
2/9/56	Mr. Jerome A. Schwartz Chicago 13, Illinois	One bag specular hematite (2 samples each 30 lbs.)	Test work with new concentrating device.
2/17/56	Professor S.R.B. Cooke University of Minnesota	60 lbs. Humboldt ore	Flotation test work
2/17/56	Mr. Mertenson, Bergingenlor MNIF Trondheim, Norway	Two 10-pound samples of Humboldt ore	Samples for examination.
3/12/56	Thompson & Lichner Co.Inc., Brookline, Mass.	27 bags of C.S. Crushed No. 2 grade iron ore. (2,000 lbs.)	Use as a radiation blanket.
3/20/56	Harshaw Chemical Co. Cleveland, Ohio	10 pounds of pellets.	Use in oil refinery process.

Continued - - -

Date	Company	Amount & Sample	Purpose
3/21/56	Lindberg Engr. Co. Chicago, Illinois	4 samples of iron ore conc.	Test new method of determining chem. analyses.
3/21/56	Mr. E.L. Kirkwood Cleveland, Ohio	1 box of pellets.	Dramaturgy.
3/22/56	Mr. A. McAfee Cleveland, Ohio	25 lbs. Mx-425, E.W.Coon stockpile sample.	Sample to show McLouth Steel.
3/23/56	Mr. A.D. Kennedy Mich. Bureau of Mineral Res. Houghton, Michigan	4 bags of samples 100 lbs. in each. Empire E-201, Tilden T-159, Lloyd Silica L-36, & Republic R-68	Preliminary test work.
3/30/56	Mr. E.L. Kirkwood Cleveland, Ohio	2 boxes fired pellets.	Dramaturgy.
4/19/56	C.K. Williams & Co. Easton, Penn.	5# Humboldt concentrate 5# Ohio concentrate.	Ore Sales Request.
4/20/56	Mr. S. K. Scovil Cleveland, Ohio	2 jars of samples. Humboldt conc. and Cliffs Group ore blends.	Possible mix of ore.
4/23/56	Mr. Louis F. Haller Penn. State Univ. University Park, Penn.	1 box, 3 samples H. flot. concentrates, low grade micaceous spec. hematite agglomeration product.	Display specimens to be used in classrooms.
5/1/56	Tumbling Supply Company Grand Rapids, Michigan	1 box pellets.	Possible use as grinding media for polishing parts.
5/11/56	Lurgi Frankfurt, Germany	10 tons of Republic crude.	Reduction roasting tests.
5/23/56	Mr. L.J. Erck took to Germany	3 lbs. Aerofall R-68 5 lbs. Albanel Comp.	For batch test work.
5/23/56	Allegheny Ludlum Steel Co. Brackenridge, Penn.	25 lbs. of pellets.	Preliminary tests at steel mill.
5/25/56	Mr. A. D. Kennedy, Michigan Tech. Houghton, Michigan	13 - 500 gm. samples of composites T-143 & T-147	For control batch MOC tests.
6/7/56	Mich. Std. Alloy Castings Company	4552# C.S. lump ore	Sale of ore.
6/20/56	Alumina Co. of America Cleveland, Ohio	2,020 lbs. (18 bags) Republic flot. concentrates.	To be utilized for foundry mold tests
6/20/56	Mr. H.Y. Choi Univ. of Minnesota	80# Humboldt crude ore.	Fish. Fatty Oil flotation tests.
7/13/56	Williams Patent Crusher & Pulverizer Company St. Louis, Missouri	1368#Cliffs Shaft No. 2, 1176 lbs. H-86 crude.	Crushing tests.

Continued - - -

Date	Company	Amount & Sample	Purpose
7/26/56	Eutectic Welding Alloys Co. Flushing 58, N.Y.	1 bag, 100 lbs. Humboldt flotation concentrates.	For test work.
7/26/56	Lehigh Portland Cement Co. Mason City, Iowa	1 bag, 75 lbs. Tilden siliceous ore	Requested by Sales Department.
7/31/56	Nordberg Mfg. Co. Milwaukee, Wisconsin	15 bags, 1,000 lbs. iron ore samples from Mather "B"	For crushing tests.
8/31/56	Republic Steel Co. Cleveland, Ohio	2 bags Republic crude ore (150 lbs.) 2 bags Republic flotation concentrate (150 lbs.)	Company requested representative samples.
9/19/56	Lincoln Electric Co. Cleveland 17, Ohio	1 bag (48 lbs.) Eagle Mills pellets	Welding rod coating.
9/21/56	Mr. A. D. Kennedy Mich. Bureau of Mineral Res. Houghton, Michigan	10 - 5 lb. boxes of samples RH2-F thru O	For standard MOC tests.
9/21/56	Mr. A. D. Kennedy Mich. Bureau of Mineral Res. Houghton, Michigan	9 bags of Ungava composite samples	For test work.
10/1/56	Lurgi, Germany	6 barrels of concentrate. 20 barrels of crude ore.	For test work in kiln.
10/2/56	Mr. A. D. Kennedy Mich. Bureau of Mineral Res. Houghton, Michigan	29 pounds of Sample No. 104	Ungava Bay samples for test work.
10/10/56	Wards Natural Science Establishment, Inc., Rochester, N.Y.	13 bags specular hematite, 12 bags red hematitic ore	For specimen use.
10/11/56	Komarek-Greaves & Co., Chicago, Illinois	200 pounds flotation concentrates	For briquetting tests.
10/19/56	Mr. A. D. Kennedy, Mich. Bureau of Mineral Res. Houghton, Michigan	76 - 5 pound boxes of samples	For standard MOC tests.
10/23/56	Nordberg Mfg. Co., Milwaukee, Wisconsin	520 pounds of ore samples	For crushing tests.
10/24/56	Chicago Firebrick Co., Chicago, Illinois	100 pounds low grade iron ore	For test work utilizing new refractory.
10/25/56	Anaconda Mining Co., Butte, Montana	50 pounds low grade specular hematite	For testing utilizing new dust collector.
11/1/56	E.J. Lavmo Company, Norriston, Penn.	10 lbs. Republic flotation concentrates	For test work utilizing new process.
11/5/56	Allenwood Steel Company, Conshohocken, Penn.	1 bag of pellets.	For test work.

Continued - - -

Date	Company	Amount & Sample	Purpose
11/14/56	W.F.H. Schultz, Inc., Atlanta, Georgia	230 bags (9.6 tons) of pellets.	Request for tonnage sample.
11/27/56	Mr. A. D. Kennedy Mich. Bureau of Mineral Res. Houghton, Michigan	32 - 5 lb. boxes Richmond, 5,6,and 7	For standard MOC test work
11/29/56	Allegheny Ludlum Steel Corp., Brackenridge, Penn.	200 lbs. Tilden siliceous ore. 200 lbs. Republic concentrates	For test work
11/29/56	National Lead Company, Baroid Division, Houston, Texas	100 lbs. Republic concentrates. 100 lbs. Cliffs Shaft lump ore. 100 lbs. Brazilian ore.	Test work with dense ore.
11/ /56	Mines Experiment Station, Univ. of Minnesota, Minneapolis, Minn.	1 Car Republic ore 1/2 Car Mather A) 1/2 Car Mather B) 1/2 Car Bunker Hill) 1/2 Car Maas _)	For MOC tests For sintering tests
12/4/56	Mr. J. Long, Treasurer, The C.C.I. Company, Cleveland, Ohio	5 lbs. Humboldt flotation tailings.	Requested by Mr. Long.
12/7/56	Dings Magnetic Separator Co. Milwaukee 46, Wisconsin	175 lbs. ore samples	To test new type magnetic separator.
12/17/56	Carpco Research & Engr. Co., Jacksonville, Florida	8 lbs. specular hematite	For high tension test work.
12/18/56	Eutectic Welding Alloys Corp., Flushing, New York	1,000 lbs. Republic concentrates	Requested for test 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 samples are not tested, however, a crude iron analysis is obtained and small composites built up so that a reference sample can be saved.

Time Charges for 1956:

Listed below is a tabulation for the last six years showing the Laboratory staff and total hours as reported on the cost sheets. The staff has been enlarged considerably during 1956. The startup of the MOC Pilot Plant required the acquisition of ten technicians and additional engineering personnel to supervise the project. The number of engineers on the staff has grown from six in 1951 to thirteen at the

present time. With the present plans for new concentrating plants and expansion of present ones, the number of metallurgists working for the Metallurgical Department will have to be increased as these properties start operations.

Year	Staff		Total Hours
	Engineers	Technicians	
1956	13*	26**	68,888
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 6/11/56
Two metallurgists hired 7/9/56
One metallurgist hired 9/4/56

** Ten technicians hired during 1956 for MOC Pilot Plant.

TIME DISTRIBUTION - YEAR 1956

Account		Hours
Bunker-Hill		1015
Cambria-Jackson		461
Cliffs Shaft		1692
Maas		615
Mather "A"		1250
Mather "B"		1258
Tilden		232
Hawkins		148
Lloyd		96
Ohio		321
Humboldt		2483
Republic		2607
Pellet Plant		962
Outside Exploration	1127C	4
	1128	4
	1132	2
	1136	93
	1136C	14
	1173	47
	1180	89
	1184	15
	1186	7
	1190	7
	1193	120
	1195	112
	1197	2
Land Offer	1583	12
	1584	12
	2595	447
	2639	3
	2792	18
	2954	42
	3036C	19
	3135C	5
	3159C	5
	3179C	39
	3190C	46
	3191C	10
	3193C	17
Land Offer	3201C	615
	3202	5
	3203C	2
	3204C	37
	3206C	6
	3207C	5
	3208C	17
	3209C	16
	3210	4
	3576	2
	3580	7
	3581	38
	3585	16
	3602	12
	3603	2
	3607	10
	3612	14
	3613	160
	3614	12
	3615	2
	3628	12
	3634	23
	3638	2
	3643	21
	3649	56
	3690C	5
Flotation Study		2339
Agglomeration Research		6935
Research & Study		1185
Magnetic Oxide Conversion		2112
Microscopy Section		376
Miscellaneous Samples		47
Teal Lake Lands		380
Brazilian Ore		201
Aerofall Mill Testing		638
Cascade Mill Testing		223
Holman Ore		109
Experiments & Investigations - MIMCO		11801
Accounts Receivable		331

Continued - - -

Account	Hours
Empire Testing	2212
Republic - CC-491-A-r	619
Empire Pilot Mill - CC-661	542
Cascade - CC-734 & CC-825, (9 Holes)	2436
Perkins - CC-669 & CC-783	34
Osier - CC-699 & CC-781	273
Aerofall Mill CC-726	1721
Lake Shaft - CC-739	100
Belleview - CC-659 (13 Holes)	1715
MOC Pilot Plant - CC-744	5204
Cliffs Shaft - CC-770	32
Tilden - CC-813 (13 Holes)	2799
New Richmond - CC-814, (11 Holes)	923
Rock - CC-780	3
Pelletizing Plant - MI654	211
Total Hours - 1956	60,778
Operating MOC Plant-Total	8,110

Chemical Charges:

The following is the distribution of chemical charges made by the Chemical Laboratory during 1956. The total number of analyses completed during 1956 was 25,878 which is considerably higher than the number of chemical analyses completed in 1955. The increase in the number of chemical determinations reflects the increased number of investigations being conducted at the Research Laboratory. During 1955 the chemical determinations were lower chiefly because several of the projects being studied, such as the balling disc study, did not require any chemical analyses. Most of the projects worked on in 1956 required detailed chemical analyses.

Distribution of the chemical analyses along with the time distribution affords one with a good overall picture of the projects worked on at the Laboratory and, by the same token, identifies the projects that were the most important.

TOTAL NUMBER OF DETERMINATIONS ANALYZED IN 1956 FROM RESEARCH LABORATORY SAMPLES

Account	Analyses	Account	Analyses
Maas Mine	185	Spies Mine	12
Bunker-Hill Mine	238	Ohio Mine	333
Cliffs Shaft Mine	425	Marquette Iron Mining Co.	1547
Lloyd Mine	25	Cliffs Group Study	1103
Tilden Mine	375	Agglomeration Research	18
Cambria-Jackson Mine	143	Agglomeration Research J	356
Mather Mine "A" Shaft	498	Agglomeration Res. Sinter Study	473
Mather Mine "B" Shaft	527	Research & Study	38
Humboldt Mine	518	Experiments & Investigations	2215
Republic Mine	385	Flotation Study	82

Continued - - -

Account	Analyses	Account	Analyses
Flotation Study D	920	Land Offer 3613	193
Aerofall Mill	1004	3620	8
Canadian Cliffs Project #17	93	3634	40
Empire Deferred Account	87	3643	30
Accounts Receivable Schultz Inc.	2	3649	46
Pellet Plant, Eagle Mills	167	Outside Exploration 1128	10
MOC Pilot Plant	27	1159	2
Land Offer 2595	81	1180	8
2954	1	1184	10
3036	15	1186	9
3179C	42	1187	8
3190	3	1190	8
3190C	48	E&A CC-659	2497
3191	4	661	408
3191C	16	668	608
3193C	5	669	34
3195	9	699	103
3201C	663	702	38
3202	13	726	921
3204C	16	734	1884
3208C	9	739	148
3209C	12	744	597
3210	7	770	75
3548	12	780	56
3581	5	781	57
3585	8	783	16
3607	22	813	3240
3611	30	814	2007

Metallurgical Reports and Memoranda:

The metallurgical reports and memoranda issued by the Metallurgical Department during 1956 are listed below. This list cannot be taken as a true index of the amount of work completed or in process at the Laboratory. Some reports and memoranda represent long term studies which may consume months, while other reports represent only a day or two of batch test work. Some of the projects carried out usually in the classification of service projects are not reported in reports or memoranda and are only covered in letter form to the management.

METALLURGICAL REPORTS - YEAR 1956

Report No.	Subject
165	Desulfurization of Mather Mine B Shaft Special Ore on the Laboratory Pot Grate and the Ford Motor Company's Traveling Grate at the Rouge Plant.
166	1955 Mine Ore Structure Study
167	Metallurgical Characteristics of The Cherty Martite from Drill Hole No. 38, Section 27, Cascade
168	MOC-Concentration Tests on DDH 38, Section 27, T47N-R26W - Cascade District
169	Ohio Mine Concentrating Plant Operation - 1955 Season
170	Cliffs Group Ore Improvement Study, 1955
171	MOC-Concentration Tests - DDH 39, Section 27, T47N-R26W - Cascade District
172	MOC-Concentration Tests - DDH 1, Section 26, T47N-R26W - Cascade District

Continued - - -

Report No.	Subject
173	Sintering of Cliffs Group Ores by Updraft and Downdraft Methods
174	Metallurgical Testing on Belleview Exploration - DDH Nos. 23,24,25,26, and 27, Section 18
175	Metallurgical Testing on Belleview Exploration DDH Nos. 28,29, and 30, Section 18
176	MOC-Concentration Tests on Composites from DDH Nos. 21, 22, and 23, Section 27, 47-27 - Tilden District
177	Testing of Brazilian Ore Samples
178	Preliminary Testing on Empire Drill Hole Composites
179	Aerofall and Cascade Mills on MOC Grinds - Republic Ore
180	MOC-Concentration Tests on Composites from Drill Holes 40,41,42,43, and 44, Section 27 and DH 2, Section 26, Cascade District
181	MOC-Concentration Tests on Composites from Drill Holes 1, 2, and 3, Section 23, T47N-R27W Foster Area, Tilden District
182	Laboratory Examination of an Iron Cylinder
183	First Shipment of Pellets Consigned to International Harvester
184	Metallurgical Testing on Belleview Exploration DDH Nos. 31,32, 33, and 34
185	Check Sampling Program - Pittsburgh Steel Company
186	Preliminary Metallurgical Testing on Belleview Exploration Diamond Drill Holes 23 through 34
187	Results of MOC-Magnetic Concentration Tests on Composites from Tilden Area DDH Nos. 56, 57, 58, Section 26, 47-27
188	Flotation Without Desliming of Humboldt and Republic Ores
189	Results of MOC-Magnetic Concentration Tests on Composites from Tilden District Diamond Drill Holes No. 4, Section 23, No. 55, Section 26, No. 3 Section 25; T47N-R27W
190	Electrostatic Separation
191	Laboratory Examination of a Copper-Bearing Iron Ore Sample from Fierro, New Mexico

METALLURGICAL MEMORANDA - YEAR 1956

Memo No.	Subject
355	Underground Chute Analyses for November, 1955, Cliffs Shaft Mine
356	1955 General Sampling Correlation Study - Check Sampling
357	Microscopic Examination of Reduced Specular Hematite Ore from the Republic Mine
358	Land Offer 3569 - Mx-1560
359	Land Offer 3576 - Mx-1569, -1570, -1571, -1572, & Mx-411
360	Outside Exploration 1127C - MxC-819 and MxC-821
361	Land Offer 3613 - Mx-1581, -1582, -1580 & Mx-420
362	Land Offer 3612 - Mx-1583 & Mx-1584
363	Cliffs Shaft Mine Stockpile Sampling - Check Sampling
364	Land Offer 3585 - Mx-1561 and Mx-1562
365 & Geology Report No. 12	Preliminary Examination of Wisconsin Thorium Bearing Rocks
366	Heavy Media Tests - Stockpile Samples - Cliffs Shaft Mine
367	Land Offer 3620 - Mx-424
368 & Geology Report No. 13	Microscopic Examination of Core Specimens and Composite Samples from DDH No. 1, Section 26, Cascade, Mich.
369	Tilden Mine - Ore Structure Sample - Check Sampling
370	Land Offer 3195C - MxC-721
371	Tumble Drum Tests - Cliffs Group Ores
372 (Supplement)	E.W. Coon Company - Stockpile Sampling - Check Sampling
373	Land Offer 3611 - Mx-426 thru Mx-430
374	Cliffs Shaft Mine Stockpile Sampling - Check Sampling
375	Cliffs Shaft Mine Stockpile Sampling - Check Sampling
376	DDH No. 2, Section 26, T42N-R22W (Perkins) - Mx-365Q,S,T,U
377	Cascade Test Pits - Mx-1737 thru Mx-1739

Continued - - -

Memo No.	Subject
378 & Geology Report No. 14	Microscopic Sampling, Drill Core Samples from Drill Hole 41, Section 27, Cascade Area
379 & Geology Report No. 15	Metallurgical Characteristics of Drill Core Samples from DDH No. 21, Section 27, Tilden
380 (Supplement)	St. Lawrence River Sands - Land Offer 2595 - Mx-437
381	MxC-724
382	Land Offer 3193C - MxC-722
383	The Results of a Preliminary Study on the Beneficiation of a Slag Recovery Product from The Buncher Company
384 (Supplements)	Sample No. MxC-723
385 (Supplement)	Bessemer Iron - Land Offer 3613
386	Cliffs Shaft Mine Structure Samples - Check Sampling
387	St. Lawrence River Sands - Mx-444 - Land Offer 3201C
388	Land Offer 3203C - Sample MxC-728
389	Land Offer 3190C - Samples MxC-725, -726, and -727
390 & Geology Report No. 16	A Laboratory Investigation of St. Lawrence River Sand Deposits
391	Land Offer 3639 - Mx-448 thru Mx-455
392	Standard Magnetic Oxide Conversion Testson Drill Hole Composites - Tilden Area, T-166, -168, and -169
393	Ore Boat Loading Observations - Check Sampling
394 (Supplement)	Cliffs Shaft Mine Pocket No. 1 Crushed Ore Structure Sample - Check Sampling
395	Standard Magnetic Oxide Conversion Tests on Drill Hole Composites - Tilden Area
396	Observation of Lower Lakes Ore Boat Sampling - Check Sampling
397	Land Offer 3191C - MxC-720
398	Land Offer 3206C - MxC-729
399	Land Offer 3207C - MxC-730
400	Standard Magnetic Oxide Conversion Tests on Drill Hole Composites - Tilden Area
401	MOC Tests Conducted at Michigan Bureau of Mineral Research - Cascade Drill Hole 47
402 (Supplement)	Land Offer 3204C - MxC-733 thru MxC-737
403	Land Offer 3135C - MxC-750 thru MxC-752
404 (Supplement)	Land Offer 3190C - MxC-753 thru MxC-762
405	Outside Exploration 1132 - MxC-772 and MxC-773
406 (Supplement)	Land Offer 3208C - MxC-731
407 (Supplement)	Land Offer 3209C - MxC-732
408 (Supplement)	Sample from Consolidated Mining and Smelting Company - Sample MxC-771
409	Progress Report - Tilden Area, T-169, -170, -171
410	Structure Analyses - Cliffs Group Improvement Plant
411	Progress Report - Upgrading MOC Magnetic Concentrates by Amine Silica Flotation
412	Progress Report - Tilden Area
413	Hercules Powder & Arizona Chemical Companies' Flotation Reagents
414	Progress Report - Froth Prevention Study
415	Progress Report - Upgrading MOC Magnetic Concentrates by Amine Silica Flotation
416	Progress Report - Tilden Area
417	Batch Testing General Mills' Fatty Acid - Aliphat 44-D
418	Outside Exploration 1128 - MxC-763 thru MxC-766
419	Quality Control Tests of Pellets Shipped to The Wheeling Steel Corporation
420	Carpco High Tension Separation of Humboldt Ore Sample HMGC-C2
421	Standard MOC Tests - Richmond DDH Nos. 45 and 46
422	Standard MOC Tests - Cascade DDH No. 47, Section 26
423	Land Offer 3202 - Sample MxC-738
424	Land Offer 3210 - Sample MxC-739
425	The Effect of Adding Alum to Republic Concentrate on the Wet and Dry Strength of Pellets

Continued - - -

Memo No.	Subject
426	Report on Balling Discs and Oscillating Feeders at the Eagle Mills Pelletizing Plant
427	Summary of Heavy Media Tests - Lloyd Mine Samples
428	Progress Report - Amine Flotation, Tilden Area
429	Outside Exploration 1128 - MxC-767, -768, & -769
430	Outside Exploration 1136 - Ungava Samples, Michigan Bureau of Mineral Research Test Work
431	Cascade East End - Standard MOC Tests,
432	Summary of Batch Flotation Testing of Arizona Chemical Company's, Hercules Powder Company's, and General Mills' Fatty Acid Reagents
433	Standard MOC Tests - Richmond Exploration, DDH Nos. 49 and 50
434	Land Offer 3179C - MxC-744 thru MxC-746
435	Land Offer 3634 - Mx-460 thru -463 & -1911
436	Land Offer 3580 - Samples Mx-464, -465, & -468
437	Land Offer 3638 - Sample Mx-466
438	Outside Exploration 1197 - Mx-467, -469, -470, 485, -1910
439	Land Offer 3581 - Mx-471, -472, -473, -476, -477, -478, -479, -480, -481, -483
440	Outside Exploration 1186 - Mx-474, -475, and -1681
441	Land Offer 3615 - Mx-482
442	Land Offer 3603 - Mx-1678, -1679, -1680
443	Land Offer 3628 - Mx-484
444	Land Offer 3602 - Mx-1861
445 (Supplement)	Land Offer 3649 - Mx-1862 thru Mx-1865
446	Outside Exploration 1190, Mx-1912, -1913, -1914, -1915, -1916, -1917
447	Progress Report - Amine Flotation, Tilden Area
448	Heavy Liquid Tests on Brazilian Ore Sample Mx-436
449	Cliffs Shaft Mine Surface Lump Ore Sampling Hammers - Check Sampling
450	Check Sampling Outside Iron Ores Used in Cleveland-Cliffs' Mixture Cargoes - Check Sampling
451	Progress Report - Results of Standard MOC Tests - Tilden Area
452 & Geology Report No. 18	The Composition and Texture of the Manganese Ores from Orient Province, Cuba

PART II

PYROLYSIS & AGGLOMERATION

LABORATORY GRATE FIRING INVESTIGATIONS:

Laboratory grate firing investigations concerning updraft pelletizing of specular hematite flotation concentrate were concluded during the first part of the year. The final tests were a study of fuels less expensive than anthracite for the updraft pelletizing process. These fuels included a low grade beehive coke from The Jones Coal and Coke Company, and a carbonized bituminous coal char from Island Creek Coal Sales Company. The variables studied were as follows:

1. Low Grade Coke:

   (a) Size
   (b) Amount
   (c) External (Surface of Pellets)
   (d) Internal

2. Char:

   (a) Size
   (b) Amount

In January, members of this section visited the Dwight-Lloyd Research Laboratory in Cleveland to observe updraft pelletizing tests of Humboldt concentrate on a pilot plant sintering machine. The object of this visit was to acquaint the personnel with the operation of a traveling grate and to gain experience for future work at Eagle Mills.

A detailed study was conducted on the different methods of sintering Mather "B" Special, Maas, and Lucky Star ores individually and as different mixtures with each other and Humboldt concentrate. The variables studied were as follows:

1. Preparation of Grate Feed:

   (a) Normal mixing action
   (b) Balling disc
   (c) Size of disc feed
   (d) Moisture content

2. Downdraft Method:

   (a) Size of feed
   (b) Bed depth
   (c) Amount of returns
   (d) Size of returns
   (e) Amount of fuel
   (f) Type of fuel
   (g) Size of fuel

3. Updraft Method:

(a) Size of feed
(b) Bed depth
(c) Number of
(d) Amount of returns
(e) Size of returns
(f) Amount of fuel
(g) Type of fuel
(h) Size of fuel
(i) Additives
(j) Tests on updraft sintering to be conducted at Mines Experiment Station during 1957

Ford Motor Company representatives visited the Research Laboratory in July to observe batch sintering tests and obtain technical information necessary to start a pyrometallurgical research program at Ford similar to that conducted at the Research Laboratory.

CONSTRUCTION AND OPERATION OF 2000 TPD AGGLOMERATION PLANT:

Construction of the agglomeration plant at Eagle Mills was entirely completed in August by The McDowell Company and Cleveland-Cliffs started operating the plant on September 1, 1956. Research personnel fully equipped the quality control laboratory at the pellet plant by purchasing, testing, and installing all the necessary equipment. In June, the entire staff of the pyrometallurgical section was transferred to Eagle Mills to aid in making the final preparation of equipment for operation and assist inexperienced personnel in the startup of the plant.

STANDARD LABORATORY TESTS FOR GREEN AND DRIED PELLETS:

The testing of bentonite samples submitted to the Research Laboratory by the various companies interested in supplying Eagle Mills with bentonite was completed during the year. From these tests, four companies were selected to supply the bentonite during startup, but only two of these companies would be ultimate suppliers. The companies selected were as follows:

1. American Colloid Company - Miller and Company
2. Federal Foundry and Supply Company
3. Baroid Sales - Interstate Supply and Equipment Company
4. Eastern Clay Products

Several standard balling tests were conducted to study variables affecting the balling disc circuit at Eagle Mills. The study included the effect of (1) allowing the bentonite and concentrate to set for a fixed period of time before balling, (2) balling the bentonite-concentrate mixture immediately after blending, (3) adding soda ash to

the mixture to increase the swelling property of bentonite and the wet and dry strengths of the pellets, (4) adding coarse and fine fired returns with slaked lime to the balling disc feed, and (5) adding soda ash to react with the slaked lime in the returns.

BALLING DISC STUDIES:

A new type balling disc contour was developed and tested during the year. A saucer-shaped contour was installed in the 4.5 foot diameter balling disc and several successful balling tests were conducted. A special type oscillating scraper bar was developed to trim the saucer shaped contour of the disc. This contour is covered in C.C.I. disc patent application.

A review of all activity concerning the development of the balling disc throughout the Company was conducted for patentable purposes. The developments have been recorded, but have not as yet been issued as a final memorandum.

REDUCIBILITY APPARATUS:

A laboratory reducibility apparatus was installed in the pyrometallurgical section during the year to study the reducing properties of Cleveland-Cliffs' natural and agglomerated iron ores. The apparatus duplicated that at the University of Minnesota, Mines Experiment Station and includes a source of nitrogen and hydrogen, a flow meter, deoxidizing tower, drying towers, automatic pyrometer, torsion balance, and heating furnace. Preliminary tests have been conducted on the apparatus to determine a standard procedure.

BRAZILIAN ORE STUDY:

Four Brazilian ore samples were submitted to the Research Laboratory for standard tests and product evaluation. The tests conducted on the samples are listed below:

1. Structure analysis
2. Chemical analysis of each size fraction
3. Determination of ferrous iron content
4. Bulk density determinations
5. Porosity determinations
6. Apparent and true density determinations
7. Standard ASTM tumble tests
8. Reducibility determinations
9. Microscopic and macroscopic examination

PART III

RESEARCH AND DEVELOPMENT WORK AND FLOTATION PROJECTS

PILOT PLANT MILLING:

Empire Ore:

Empire crude ore was treated in the magnetic separation pilot mill during the first half of the year. Conventional rod mill discharge and the products of the Aerofall and the Hardinge Cascade autogenous grinding mills were fed to the circuit. With these three types of mill feed, no significant difference in metallurgy was detected. Preliminary comparisons of total energy requirements for comminution were made. Further testing was carried out using two stages of ball milling as compared to one stage. Concentrate grade generally was from 60 to 61 percent iron with from 80 to 85 percent iron unit recovery. Preliminary tests on the 96 percent minus 400 mesh final concentrate with a small drum type filter yielded a filter cake containing roughly 17% moisture.

FluoSolids MOC Calcine:

Starting in November, MOC calcine was milled in the magnetic separator circuit. The Jeffrey magnetic separators used in this circuit are commercial size diameter drums of the latest design. Dings has also furnished two of their latest design units for testing.

The flowsheet was as follows: A two-stage cobbing of the "as is" calcine; ball milling of the cobber concentrate along with a cyclone return product; cleaning the ball mill discharge in (1) a single drum countercurrent separator and, (2) a hydroclassifier to reject fine siliceous material; cyclone separation at 150 mesh; and treating the minus 150 mesh cyclone overflow in the 3-drum finisher. With an MOC calcine containing about 39.9% iron, a final concentrate was made assaying about 66.0% iron and 7% silica with a roasted weight recovery of about 53% and about 85% iron unit recovery.

DRILL CORE TESTING:

Core material from the following drill holes in the several districts was subjected to standard MOC-magnetic concentration tests and the results have been presented in metallurgical reports.

Property	Drill Hole Nos.	Locations
Belleview	23 thru 34	Section 18, T47N-R26W
Cascade	38 thru 44,	Section 27, T47N-R26W
	1 and 2	Section 22, T47N-R26W
Tilden	1,2,3,4	Section 23, T47N-R27W
	3	Section 25, T47N-R27W
	55,56,57,58	Section 26, T47N-R27W
	21,22,23	Section 27, T47N-R27W

Standard MOC tests have been started but not completed for the following drill holes:

Tilden	Holes Nos. 4 & 5	Section 25, T47N-R27W
	Holes 59 and 60	Section 26, T47N-R27W

Due to an increased work load at the Laboratory, drill core composites and surface samples from the Cascade and Richmond Districts have been subjected to standard MOC testing at the Michigan Bureau of Mineral Research. The results of this testing have been reported as received.

The testing of all the holes in the Belleview Area was completed with an accelerated program in which the usual drill core composites were aggregated into test composites. These were subjected to standard MOC tests and also to a standard grind and Davis tube test on the crude material. The bulk of the concentration tests on all 12 drill holes using either procedure were unsatisfactory from the standpoint of grade and/or recovery.

MINGAN RIVER SANDS TESTING:

Several auger drill samples of magnetic-bearing river sands from the Mingan Area, Province of Quebec, were received at the Research Laboratory. A standard procedure developed for recovering a magnetic concentrate is as follows: separation of a crude magnetic concentrate, screening the crude concentrate on 65 mesh to remove a large part of the middling material as oversize, grinding the minus 65 mesh material to minus 200 mesh and, finally, magnetic separation of the minus 200 mesh material to produce the final concentrate. The final concentrate from the several samples averaged about 69.2% Fe, 0.55% SiO_2, and 2.00% TiO_2 with an average crude weight recovery of about 2.0%.

HIGH TENSION SEPARATION:

The work by Carpco Research and Engineering Corporation on the high tension separation method for producing a high grade concentrate was reviewed. High tension separation produced the following concentrate from a deslimed Humboldt ore:

Humboldt Ore - HMGC

	% Wt.	% Wt. Crude	% Fe	% SiO2	% Dist. Fe	% Dist. Fe Crude
Concentrate	44.26	40.40	67.50	2.60	87.87	84.53
Tailing	55.74	50.88	7.40		12.13	11.67
Slimes		8.72	34.00			3.80
		100.00	32.26			100.00

Because of the possibility of producing a high grade concentrate, the inquiry into high tension separation will be continued.

FROTH PREVENTION STUDY:

The reground specular hematite pulp at the Eagle Mills Pelletizing Plant tended to form a tough, voluminous froth in the thickener, resulting in a loss in iron units and at the same time a loss in the fine size particles, the presence of which improves balling characteristics of the concentrate. Controlled batch tests were run at the Laboratory in an attempt to find some chemical additive which would destroy or prevent the formation of froth.

In controlled tests, alum added to the Laboratory rod mill in the regrinding was found to inhibit to some degree the formation of froth. However, laboratory balling tests on a concentrate that had been reground with a small amount of alum indicated that the alum was detrimental to pelletizing. This study will be continued. It appears that bypassing the thickener and pumping the ball mill discharge directly to the filters will minimize the problem.

FLOTATION STUDIES:

The laboratory study of undeslimed flotation of the specular hematites that was initiated in 1955 was continued in 1956. The laboratory conditions that favored the best flotation were outlined. Conditions that gave the best results were grinding-conditioning at about 75% solids, a somewhat prolonged grinding-conditioning time, regulation of both fatty acid and caustic soda additions so as to get maximum

performance from the fatty acid collector, and a rougher pulp pH of from 9.0 to 10.5. The results of the laboratory tests were issued in a metallurgical report.

Among the possible benefits that might be achieved in a mill using undeslimed flotation would be (1) improved metallurgy with the same or somewhat higher reagent additions, (2) simplification of the mill circuit, and (3) the recovery in the concentrate of fine size iron particles which would contribute to better pelletizing characteristics.

Fatty Acids:

The Hercules Powder Company and General Mills, Incorporated market tall oil fatty acids comparable in grade and identical in price to those supplied by the Arizona Chemical Company. Each company sells a high grade and a lower grade product. Samples of each were tested in the Research Laboratory on a batch test basis. The high grade Hercules product, Pamak 1, functioned as well as the presently used reagent, Acintol No. 2, in the batch test, but a mill test was required to complete the evaluation.

Subsequently, 20 drums of Pamak 1 were tested at the Republic Mill with no difference in collecting ability detected as compared to Acintol No. 2. At present both Arizona Chemical Company and Hercules Powder Company supply the fatty acid reagent for the flotation plants.

Amine Flotation:

Amine flotation of a siliceous middling fraction was used to upgrade Tilden MOC magnetic concentrates. A flotation procedure was established to be used for testing MOC concentrates from the Tilden drill holes. The actual flotation testing involves a prior depolarization of the magnetic concentrate using a 60 cycle alternating current demagnetizing coil, conditioning the aqueous, depolarized pulp with sodium hydroxide and Gum 3502 starch, adding the amine collector such as the 12 carbon amine, Armour & Co. Armac C, and levitating the siliceous middling.

A Tilden MOC magnetic concentrate containing about 59.0% iron and 14.9% silica was upgraded by amine flotation to from 65.8 to 67.1% iron with silica ranging from 6.2 to 4.6%. Batch test weight and iron unit recoveries ranged from 71.0 to 78.3% and 80.2 to 86.7% respectively.

PART IV

MICROSCOPY SECTION

During the Year 1956, the work completed in the Microscopy Section for the Metallurgical Department is summarized as follows:

HUMBOLDT AND REPUBLIC MINES - FLOTATION CONCENTRATION:

Concentratability of some Crude Samples:

The presence of calcium carbonate in the Republic specular hematite-chert could reduce the grade of ore concentrate to some extent.

The replacement of gangue and magnetite by hematite and goethite in the oxidized magnetic iron formation at Humboldt could not produce an acceptable concentrate grade by flotation and/or MOC-concentration.

The abundance of fine specular hematite disseminated in chert at the Republic could increase the grinding time and reduce the efficiency of flotation concentration.

Available Iron in Tailings:

The iron in the tailings examined is in the form of iron oxides, and occur as locked particles, free particles, and fine inclusions in chert.

The iron content in the tailings could be as low as 3% if positive recovery of free ore particles was possible.

Other things being equal, the tailings produced from the Republic Mill contain higher percentages of unrecoverable iron than that from the Humboldt Mill.

CASCADE AND TILDEN PROJECTS - MAGNETIC OXIDE CONVERSION-CONCENTRATION:

The iron formation in the Cascade and Tilden Districts has been intensively oxidized. It is mainly composed of martite, goethite, hematite, earthy hematite, quartz, and chert.

The martite is one of the chief constituents and it appears to have favorable concentrating characteristics only when associated with chert.

Based on the mineralogical composition, ore texture, ore size, and the degree of oxidation, the iron formation in the districts has been classified into most desirable, desirable, undesirable, and most undesirable materials for ore beneficiation upon the standard laboratory MOC-concentration tests.

EMPIRE AND BELLEVIEW AREAS - MAGNETIC SEPARATION:

The mineralogical composition, mineral texture, ore size, and the average iron content in the magnetic iron formation of the Belleview are essentially the same as that in the Empire Area, but the magnetite content is noticeably lower and which has attributed to the lower percentage of iron unit recovery from the Belleview iron formation.

LAND OFFERS AND OUTSIDE EXPLORATIONS:

Specimens and samples from nine land offer and six outside exploration properties were examined. The main objectives of the study are to determine the mineralogical characteristics and their effect on ore beneficiation.

SPECIAL RESEARCH:

Agglomeration Study:

The material under investigation was a section of the blocked iron cylinder produced by the Blocked Iron Corporation utilizing reground New Jersey concentrates. The investigation was an attempt to discover the type of constituents added to the concentrates and the pressure-temperature conditions employed during the blocking.

Magnetic Oxide Conversion-Concentration:

A number of MOC products produced from samples from the Republic, Cascade, and Tilden areas were studied. The purpose was to determine the degree of reduction and its effects on magnetic concentration.

MISCELLANEOUS:

Brazilian ore samples and a pellet which has been reduced to metallic were also studied.

PART V

FLUOSOLIDS REACTOR PILOT PLANT

During this year, a one-ton-per-hour Dorr FluoSolids reactor was installed in the pilot plant building back of the Laboratory and preliminary run-in of the unit completed. The results of the first test run indicated that a number of changes were necessary and, by year's end, these had been made and the reactor was ready to start on further testing.

Republic crude (Sample R-70) containing an average 38% iron was the reactor feed for the first test run, from October 16 to 25, 1956. During this run an estimated 50 tons of calcine were produced analyzing an average 39.8% iron. Davis tube tests made after grinding the MOC product yielded a concentrate assaying 69.77% iron, 3.52% silica. The reactor feed was prepared by wet grinding the crude ore in a rod mill to 9.2% plus 10 mesh, filtering and stockpiling.

Basically, this reactor consists of two cylinders, one sitting atop the other. In a portion of the top compartment a bed of fluidized ore is heated to about 1600° F and then transferred by gravity to the lower compartment. In this lower section the bed of heated ore (now at about 1200° F) is maintained in a fluidized state by reducing gases and as a result of this contact between ore and gas, magnetic oxide conversion takes place. Following the MOC treatment the hot calcine is discharged by gravity, cooled and quenched.

Physically, the reactor has gross dimensions of: height, 32', with maximum and minimum diameters of 5' and 4' respectively. Internally, the combustion compartment (or top cylinder) is 3'6" diameter by 11'2" high and a part of this volume holds the fluid bed, the remainder being freeboard space. The MOC compartment (or bottom cylinder) has an interior bed volume 2' diameter by 7' high above which there is a freeboard volume 2-1/2' diameter by 6' high.

The reactor shell is of steel, lined with insulating brick backing firebrick.

Necessary reducing gases are produced by partially burning propane in a Westinghouse ExoGas combustor (10,000 cfh capacity). After passing through the lower MOC chamber, excess gases are burned for heat in the upper chamber. Necessary additional heat in the upper compartment is obtained by burning raw propane gas.

The plant contains a considerable amount of accessory equipment necessary for the operation of the reactor, items such as feeders, quench tank, drag classifier densifier, thickener, and dry cyclones. Four 1000 gallon propane tanks connected to a 70 gallon per hour vaporizer supply propane gas to the reactor plant.

ROD MILL FOR DRY GRINDING OF MOC PLANT FEED:

A dry grinding rod mill (3' dia. x 5' long) complete with necessary bin, conveyors and screen was laid out and installed at the MOC Pilot Plant. This unit was put in so as to be able to check the grinding characteristics of the various ores when dry grinding to produce a minus 14 mesh MOC plant feed. All of the machinery was installed during the latter part of the year but operation of this unit awaits completion of the building. Material available during the winter months contains up to 8% moisture and this is too wet for use in a dry grinding rod mill unless some pre-drying can be practiced.

PELLET HARDENING FURNACE:

Plans were made and equipment ordered for the construction of a batch type pellet hardening furnace. This furnace is to be about 1 square foot inside by approximately 12' high and will be used to heat treat pellets prepared from various MOC concentrates. Construction of this furnace is slated for early in 1957.

PART VI

CHECK SAMPLING PROGRAM

A visit was made to Pacific Isle Mining Company's (Formerly E.W. Coon Company) Wakefield, Michigan Mine to sample the mine ore stockpile, at the request of the Ore Sales Department. The object of this sampling was to obtain samples for structure tests and chemical analyses.

In August, 1956 the writer observed lower lakes chemists ore cargo sampling in Cleveland, Ohio. The purpose of the trip was to observe lower lakes chemists sampling Cliffs Group Ore consigned to Pittsburgh Steel.

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 Cliffs Group Ore on a cooperative basis with Pittsburgh Steel.

A trip was made with the first cargo of pellets consigned to the International Harvestor Company, Wisconsin Steel Works, Chicago, Illinois. The purpose of the trip was twofold: (1) to observe the loading and unloading of pellets, and (2) to collect a series of samples at the destination in order to check sampling procedures, amount of degradation that occurred, and obtain data with specific reference to angle of repose and shear angle.

During the 1956 shipping season, a number of outside ore shipments from the North Range and Pacific Isle Mining Companies were check sampled at the request of the Ore Grading Department.

Ore samples were collected from mine pocket and stockpile shipments during the 1956 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 1956

Electric energy produced in the generating facilities of The Cleveland-Cliffs Iron Company during the year 1956 amounted to 153,546,560 kwh. Of this amount, 127,261,913 kwh (82.9%) were billed directly by our company as follows: The Cleveland-Cliffs Iron Company - 90,876,458 kwh (59.2%) for its operations, 10,687,506 kwh (7.0%) for the operations of the Humboldt Mining Company, and 25,697,949 kwh (16.7%) were used by the Upper Peninsula Power Company. The hydro-electric plants of the Company produced 53% of the energy, the Presque Isle Plant of the Upper Peninsula Generating Company produced 29.7%, the Ishpeming Steam Plant produced 15.1% and the Ishpeming Diesel Plant produced 2.2%.

In addition to the 25,697,949 kwh (16.7%) billed from our company to Upper Peninsula Power Company, 26,284,647 kwh (17.1%) were delivered to that company by Upper Peninsula Generating Company and billed for our account by the Generating Company to the user in accordance with mutual agreements. Part of this energy was used in the area formerly supplied by The Cliffs Power & Light Company and part of it was transmitted to the Atlantic Substation of the Upper Peninsula Power Company for utilization in its Northern Division. Of the amount which we supplied to them, 50.6% was obtained by the use of our portion of the generating facilities of the Presque Isle Plant of the Upper Peninsula Generating Company, 41.6% was supplied by the Ishpeming Steam Plant, 6.5% by the Ishpeming Diesel Plant and 1.3% by the hydroelectric facilities of our company.

Our company, including the Humboldt operation, used 101,563,964 kwh, an increase of 13% over the amount that was used for these same operations in 1955. Even with this increase, the utilization of energy was about 20% less than was forecast for the year. An unforeseen strike in the mining industry of thirty-seven days was partially responsible for the reduction in energy consumption below the estimate. Contributory also were the curtailed operations of the Humboldt and Republic Mines. The construction and operating difficulties which were encountered at the Pelletizing Plant and the resulting delays caused thereby were also instrumental in reducing the energy consumption below the estimate.

These reductions in energy requirements below those which were anticipated tended to increase production costs of energy because of the burden of the fixed charges on the Company's portion of the Upper Peninsula Generating Company which it did not use for energy production. The reduction in energy use also caused a very appreciable reduction in the earnings which were paid to the Company by the Upper Peninsula Power Company because it enabled that company to take advantage of the unused energy at the Presque Isle Plant and avoid use of energy from our plants. Our company receives no earnings from its portion of the Presque Isle Plant when used by the Power Company but would receive earnings if that same energy were procured from our wholly-owned facilities.

In spite of these adverse conditions due to energy consumption being below the anticipated quantity, cost of energy to our company's operations, including wheeling charges, was reduced from $.00914 per kwh in 1955 to $.00872 per kwh during 1956. The total earnings before income taxes, however, dropped from $166,405 in 1955 to $89,091 in 1956.

The output from the Company's hydroelectric stations during the year was slightly below the expected normal and slightly below the output during 1955. Extreme drought conditions were experienced during the years 1946, 1947 and 1948. The drought cycle in the Upper Peninsula seems to be on a cycle of about eleven years. It is to be anticipated, therefore, that for the next few years hydro

production will be near or below average expectancy. The production during the year 1956 amounted to 81,477,396 kwh compared with a normal expectancy of approximately 85,000,000 kwh and an output during the year 1955 of 83,254,499 kwh. Precipitation in the Ishpeming area amounted to 25.52" compared with an average precipitation over a 44-year period of 30.75" and a precipitation of 30.82" during 1955. The reduction in precipitation, consequential in water available for hydroelectric purposes, would have caused a greater reduction in energy generated by the hydro facilities were it not for the greater economy of production which can be obtained in the hydro plants due to base load operations. Such operations are made possible by the greater loads on the transmission system and the additions of fuel-burning equipment which have been made during the past few years, particularly the addition of the Presque Isle Plant to our generating facilities.

At the beginning of the year, studies relative to the installation of a second unit at the Presque Isle Plant were being made by our company and the Upper Peninsula Power Company. To assist in these studies, the Upper Peninsula Generating Company had retained the Stone & Webster Engineering Corporation. Individual studies were conducted by all three companies and their findings were discussed in several joint sessions throughout the year. The findings of these joint discussions were brought before the Board of Directors of the Generating Company from time to time during the year and culminated in a decision reached at the Directors' meeting of October 9, at which meeting authorization was given to proceed with the engineering and financing which would be necessary for the installation of a second 22,000 kw unit in the plant. It was anticipated at that time that this second unit would be available for operation approximately January 1, 1959.

In view of the installation of the second unit in the Upper Peninsula Generating Company's plant, it was thought advisable to revise the basic agreement of July 15, 1953, between The Cleveland-Cliffs Iron Company and the Upper Peninsula Power Company. This revision was necessary to adapt the agreement to the changes which have taken place and which are anticipated in the system covered by the agreement. It was also anticipated that in the revision of the agreement, a different method of distributing costs could be obtained which would enable the generating facilities of the entire system to be operated in a manner which would provide the maximum system economy and the maximum economy of generation for both companies participating. Such a contract revision necessitated detailed load studies and numerous meetings between the parties involved. Such meetings were held from time to time in Boston, Cleveland and Ishpeming. The last such meeting held was in Boston on December 13 and 14, at which time it was decided to work out a final revision of the suggestions which had been made previously in regard to this agreement and forward them to the various interested parties in hopes that a satisfactory agreement could be reached immediately after the first of the year. These points were drafted and mailed out in the latter part of the year and a meeting was to be held in the early part of January for the discussion and possible adoption of a basic form of contract revision which was to become effective at the time the second unit at the Presque Isle Plant went into operation.

The Presque Isle Plant began commercial operation during October, 1955. During the ensuing months small difficulties were experienced, resulting in shutdowns from time to time for repair and correction of difficulties. These repairs were made on a temporary basis and the plant was kept in operation until a complete inspection and overhaul were conducted beginning April 17 and lasting until May 15. During this period both the boiler and turbine equipment were thoroughly inspected both inside and outside, and various additions and changes which had been indicated as being desirable were accomplished throughout the

plant. The plant was found in very good condition and it is anticipated that a similar complete inspection will not be necessary for the turbine equipment for a period of three or four years. It is, of course, necessary to have an annual inspection of the boiler plant for insurance purposes.

In addition to the general difficulties and minor operating problems which were experienced at the Presque Isle Plant, very high maintenance costs were being encountered in the pulverizing equipment which was obtained from the Riley Stoker Corporation as part of the boiler. The maintenance costs on this equipment were about five times as much as would normally be expected. Numerous discussions were held with the manufacturer as to the possible cause of this high maintenance, and the general consensus of opinion seemed to be that the difficulties were being caused by sand with which the coal had become contaminated as it was being piled for storage and reclaimed into the power plant. As a result of this decision, only new coal which had been very carefully handled to avoid sand contamination was burned in the plant from the latter part of the summer until the end of the year, during which time it was noted that a very radical decrease in maintenance costs was experienced. This test is to be continued into 1957 and the results therefrom will be used as a guide in the purchase of pulverizing equipment for the second unit and also as a guide for the manner in which the coal will be handled for the plant in the future. There was a serious accident to the pulverizing equipment on June 13, at which time an internal part failed and wrecked the entire internal portion of one pulverizer. It is not thought, however, that this failure was due to sand contamination but rather due to a faulty part and that no repetition of the accident will be experienced in the future.

The Presque Isle Plant was operated continuously during the year with the exception of the period from April 17 to May 15, when it was shut down for inspection and overhaul, and for the period from July 10 to July 31. During this latter period the strike in the iron ore industry had reduced the load on the system to the point that the Presque Isle Plant was operating below its economical load and it was deemed advantageous to shut down this plant during that period and utilize the Ishpeming Steam Plant. Rumors at the end of July concerning the resumption of operations by the mines caused the plant to be placed back in operation at that time, however, and it was continued in service.

The Ishpeming Steam Plant was inactive the greater portion of the time from the first of the year until the beginning of the inspection and overhaul of the Presque Isle Plant in April. During this period it was operated from time to time when difficulties were experienced in the Presque Isle Plant. On one of these occasions, which occurred on January 20, an attempt to start the plant disclosed a leak in a water wall tube in the combustion chamber of the boiler which had been caused by erosion. This was temporarily repaired at that time and later was given permanent repairs by a man from the Riley Stoker Corporation on February 20. On March 26, a complete inspection and overhaul of the entire plant was undertaken and the plant was placed in permanent service on April 17. Beginning of operations on April 17 was necessitated by the fact that the Presque Isle Plant was being taken out of service at that time, but by the time that the Presque Isle Plant was returned to service, load conditions had changed to the point that it was necessary to keep the Ishpeming Steam Plant in service. Its operations continued for the rest of the year with the exception of temporary periods of inactivity such as week ends, the first ten days of the iron ore strike, and similar conditions of low load requirements of the system.

During the early part of 1956, a committee was organized by various communities and industries in the Upper Peninsula attempting to negotiate for the extension of natural gas into the area from a line which is being projected into

the Menominee-Marinette area. Due to the large quantities of fuel which our company may need in the future for both electric energy production and the reduction of iron ores, our company took an active part in the promoting of this extension of gas service. There was some thought given at the beginning of the activity to our company joining with the Upper Peninsula Power Company for the purpose of transmitting the gas from the Wisconsin border. However, this plan was abandoned, but several meetings were held throughout the rest of the year with gas transmission companies in an effort to promote the construction of facilities by those companies. At the end of the year no definite commitments had been received from any company, but it is felt that there is a good possibility that such gas service may be made available to our company some time in the near future.

Due to the strike in the Westinghouse Electric Corporation plants, delivery of the equipment necessary to convert the McClure Power Plant to automatic operation was seriously delayed and installation of that equipment was not started until August and was completed about the middle of November. Prior to the installation of the automatic equipment, two cases of trouble developed which necessitated reduction in the operation of the plant. The first occurred during the month of January, at which time an attempt to close the main valve to the No. 2 unit resulted in the valve becoming jammed and the valve stem being bent. This necessitated the draining of the pipeline and the reinstallation of the valve stem. On May 19, the field breaker of the No. 1 unit opened for some unknown cause and the resulting induced voltage punctured the insulation in the field coils. This necessitated the unit being taken out of service and the rotor of the generator was sent to Milwaukee for reinsulation. It was returned and the unit was placed in operation on July 27. Several months later the field coils loosened due to the manner in which they were installed at the time they were repaired in Milwaukee. The concern which conducted the repairs corrected the matter in Ishpeming and the unit has been in operation since that time.

During the period that the automatic equipment was being installed in the McClure Power Plant, it was necessary to shut down each of the units from time to time to permit the attachment and installation of the new apparatus. During these periods both units were inspected and were found to be in such condition as to warrant complete dismantling and overhauling. These units were both overhauled during 1941 and there have been no extensive repairs or replacements on the hydraulic part of the generating units since that time. A complete overhaul of both turbines was accordingly scheduled to begin during January, 1957, and at that time both turbines will be completely reconditioned.

During 1954 extensive repairs were made on the concrete portion of the Carp pipeline. At that time there were several leaks in the pipeline which were not repaired and it was the intention of the Company to complete these repairs at its first opportunity. Load requirements on the system prior to the beginning of operation of the Presque Isle Plant, however, made such repairs impossible during 1955, but they were undertaken in 1956 beginning early in June. The repairs were conducted by Intrusion-Prepakt, Inc. throughout the months of June and July and were completed early in August. The pipeline is now in such condition that no future repairs are anticipated unless new leaks develop.

The contract with the United Steelworkers of America CIO expired on October 14, 1956. Our company had had a letter previous to that date, calling attention to the expiration of the contract, but no negotiations regarding the drafting of a new contract were undertaken until October. Several meetings were held prior to the expiration of the contract and the provisions of a new contract were agreed upon. These conditions were virtually the same as those negotiated

in the contract with the Mining Department, the main exception being that the Electric Power Department contract continues to expire on October 14 rather than July 1 as is the case with the Mining Department contract. The new contract which was executed is for a three-year period and the provisions include the same wage scale and wage change dates as are provided in the Mining Department contract.

Labor relations during the year continued to be very good with no grievances arising which were carried to arbitration. Several meetings were held prior to the commencement of automatic operation of the McClure Power Plant in which we discussed with the Grievance Committee the disposition of the various employees who would be affected by the change in operating schedule necessitated by the changing to automatic operation of that plant. All matters were settled in a manner which was agreeable to the Grievance Committee and no difficulties were experienced.

ELECTRIC POWER DEPARTMENT
ANNUAL REPORT
YEAR 1956

STATISTICAL DATA - 1956

Month	Jan	Feb	Mar	Apr	May	June	July	Aug.	Sept	Oct	Nov	Dec
Precipitation -	0.74	0.20	1.08	2.00	3.56	3.39	4.11	2.78	2.14	0.64	3.19	1.69

Total precipitation at Ishpeming during 1956 - 25.52" (2.127 ft.)
Average " " " - 30.75" (44 year record)

CARP RIVER PLANT:

Drainage area above intake dam	66.66 sq. miles
Cubic feet precipitation in 1956	3,952,761,804
Kilowatt hours generated in 1956	17,592,000
Cubic feet water utilized in 1956 (90 cu. ft. - 1 kwh)	1,583,280,000
" " " wasted over intake dam in 1956	53,532,000
" " " in Carp storage Dec. 20, 1955	337,164,874
" " " " " " Dec. 20, 1956	332,412,360
" " " taken from Carp storage in 1956	4,752,514
Total run-off in 1956 (cubic feet)	1,632,059,486
Run-off per square mile of drainage area (cubic feet)	24,483,341
Second-feet run-off	0.774

	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	1956
Total Precip.	24.35	35.42	33.77	30.82	25.52
Sec.-ft. Run-off	0.69	0.85	0.84	0.93	0.77

McCLURE PLANT:

Drainage area above intake dam	140.52 sq. miles
Cubic feet precipitation in 1956 (Hoist Plant - 31.71"-2.642')	10,349,963,053
Kilowatt hours generated in 1956	39,150,000
Cubic feet water utilized in 1956 (125 cu. ft. - 1 kwh)	4,893,750,000
" " " wasted over intake dam in 1956	0
" " " in Hoist storage basin Dec. 20, 1955	1,298,780,969
" " " " " " " Dec. 20, 1956	1,554,892,584
" " " increase in 1956	256,111,615
" " " in Silver Lake Dec. 20, 1955	0
" " " " " " Dec. 20, 1956	91,408,800
" " " added to Silver Lake in 1956	91,408,800
Total run-off in 1956 (cubic feet)	5,241,270,415
Run-off per square mile of drainage area (cubic feet)	37,299,106
Second-feet run-off	1.180

	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	1956	1957
Total Precip.	37.27	28.81	43.28	40.65	50.90	29.27	41.56	38.13	35.70	31.71	
Sec.-ft. Run-off	1.22	0.78	1.24	1.37	2.09	0.97	1.33	1.29	1.03	1.18	

Average precipitation at Hoist Plant - 36.35" (36 year record)

ELECTRIC POWER DEPARTMENT

STATISTICAL DATA - 1956

Energy Delivered to Transmission System
by CCICo. Generating Facilities

	Kwh Delivered to Lines				
	CCICo. Steam	CCICo. Hydro	CCICo. Diesel	UPGCo. Steam	Total
Jan.	--	6,186,540	88,310	204,913	6,479,763
Feb.	152,055	6,043,630	24,105	872,898	7,092,688
Mar.	--	5,827,232	10,050	1,279,442	7,116,724
Apr.	429,450	6,384,659	455,705	1,085,435	8,355,250
May	4,233,267	7,554,700	1,740,660	1,023,700	14,552,327
June	2,577,755	6,725,775	229,415	2,539,085	12,072,030
July	2,077,000	6,095,120	93,015	--	8,265,135
Aug.	2,735,180	5,320,220	37,510	437,187	8,530,097
Sept.	2,646,485	6,993,355	281,105	3,942,650	13,863,595
Oct.	2,424,983	8,791,015	76,700	2,614,902	13,907,600
Nov.	3,326,925	7,232,225	317,600	3,766,171	14,642,921
Dec.	2,488,208	8,322,925	15,680	1,556,970	12,383,783
Total annual use by UPPCo. of CCICo. energy from UPGCo.	_____	_____	_____	26,284,647	26,284,647
Total energy produced by CCICo. generating facilities	23,091,309	81,477,396	3,369,855	45,608,000	153,546,560

ELECTRIC POWER DEPARTMENT

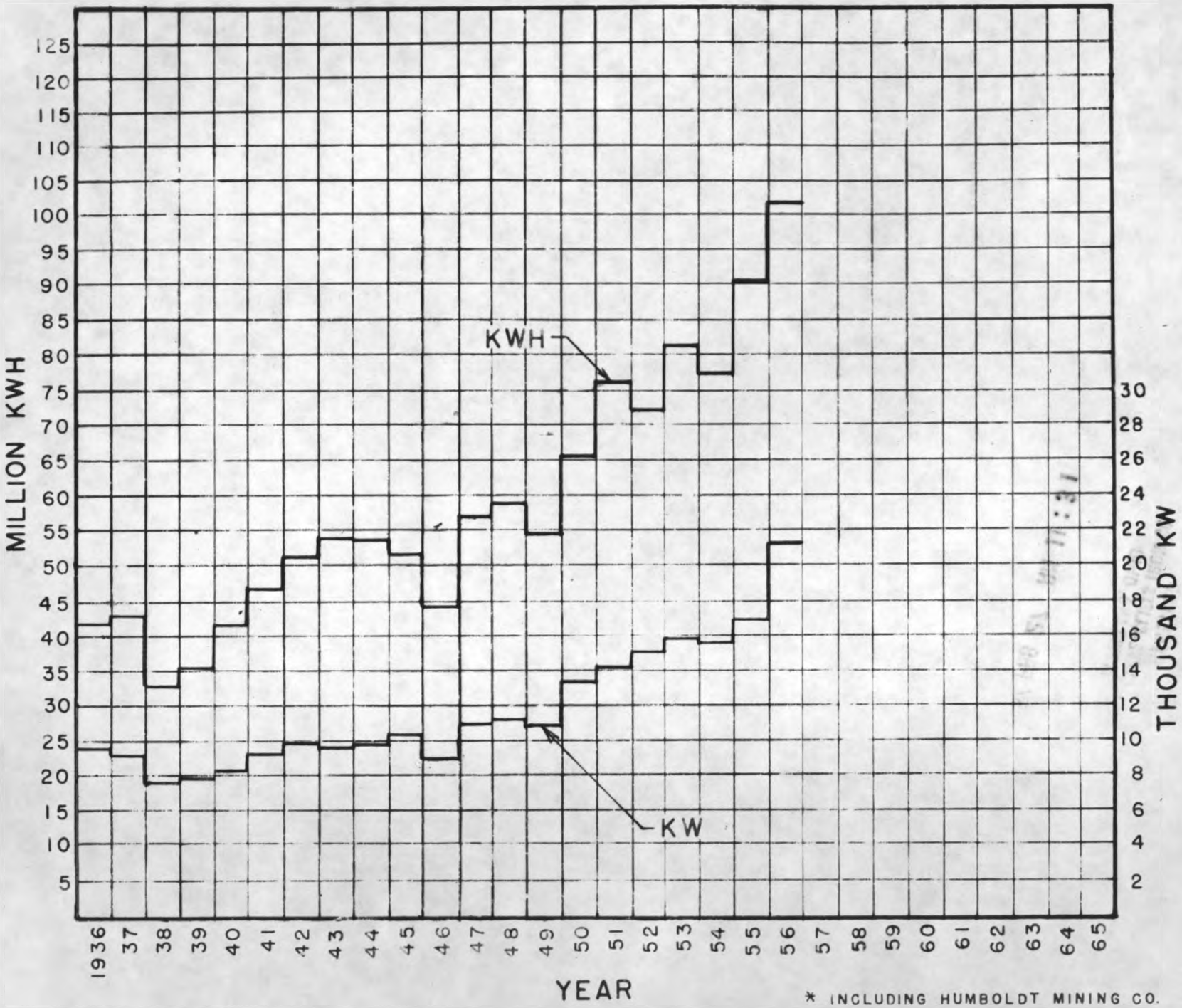
STATISTICAL DATA - 1956

Utilization of Energy Delivered to
Transmission System by CCICo. Generating Facilities

	Ishpeming Steam Kwh	%	Hydro Kwh	%	Diesel Kwh	%	UPGCo. Kwh	%	Total Kwh	% of Total
The Cleveland-Cliffs Iron Co.	1,248,492	1.3	72,631,155	80.0			16,996,811	18.7	90,876,458	59.2
Humboldt Mining Co.	218,905	2.0	8,142,059	76.2			2,326,542	21.8	10,687,506	7.0
Upper Peninsula Power Co.	21,623,912	41.6	704,182	1.3	3,369,855	6.5	26,284,647*	50.6	51,982,596	33.8
Total	23,091,309	15.1	81,477,396	53.0	3,369,855	2.2	45,608,000	29.7	153,546,560	100.0

*Sold directly to UPPCo. by UPGCo.

ENERGY & POWER REQUIREMENTS
C.C.I. CO. OPERATIONS *



* INCLUDING HUMBOLDT MINING CO.

EMPLOYEES' INSURANCE AND COMPENSATION DEPARTMENT

ANNUAL REPORT YEAR 1956

The Annual Report of the Employees' Insurance and Compensation Department is presented herewith.

The usual activities of the Department were carried out during the year 1956. These activities cover matters of general welfare of employees, compensation, insurance, pensions and various activities on a community basis. The Department also supervises the Police and Plant Protection and cooperates with the public relations program and Company sponsored employee activities. The Superintendent of the Employees' Insurance and Compensation Department is also Associate Editor of the "Cliffs News."

Each year in our Annual Report we point out for the purpose of carrying a continuous record that this Department was formerly known as the Pension Department and was under the supervision of Mr. W. H. Moulton, whose title was Secretary of the Pension Department. Mr. Moulton retired on July 1, 1938. The Department then became the Welfare Department and carried on under that name until the newer activities covering compensation, insurance and pension became a more important function of the Department. Mr. Walter F. Gries assumed charge of the Department in 1938 and at that time was given the title of Superintendent of the Welfare Department.

The Department carries on a great many functions having to do with the health, welfare and general happiness of our employees. Many of the activities carried on by the Department are not of a welfare nature in the sense that welfare is generally understood. Much of the activities of the Department might well be described as coming under the heading of Employee and Public Relations.

The Employees' Insurance and Compensation Department and its divisions work very closely with the Safety Department, which is under the direction of Mr. A. J. Stromquist. The coordinated efforts of the two departments has undoubtedly benefited all employees.

Mr. W. E. Johnson, Compensation Agent, has served in this capacity since 1926. Mr. Johnson's background of experience has made him a very valuable employee. His efficiency as well as his cooperation and loyalty to the Company have proved over the years to be a great asset to the Company and to its employees.

Mr. Lowell C. Holmgren has for several years been in charge of our insurance and hospitalization matters, as well as pension and retirement payrolls. The insurance and hospitalization program has expanded over the years and Mr. Holmgren has assumed charge of the new activities and the expanded program.

Mrs. Shirley O. Mattson has served as secretary to the Superintendent and to the Department since October 15, 1954. Mrs. Mattson is in charge of the files, all reports, safety glasses, and correspondence.

EMPLOYEES' INSURANCE AND COMPENSION DEPARTMENT

ANNUAL REPORT YEAR 1956

Mr. Fred Olson serves as a clerk in the compensation and insurance division and came to this Department from the office of the Spies Mine in Iron River, Michigan in July 1955. Mr. Olson makes out many of the forms and keeps the records on hospitalization and insurance matters.

Mr. Emil Hoff continues to serve in the capacity of Chief of Police for the Company. He is an experienced and trained police officer and was formerly captain of police at the Mather Mine "A" Shaft. Mr. Hoff keeps abreast of new developments in police work and is kept quite busy covering the whole area, supervising plant protection and making investigations of various kinds. The Superintendent of the Department acts as the head of the Police Department and Mr. Hoff confers with him practically daily on matters which concern plant protection and police coverage. Mr. Hoff is an officer of the U. P. Law Enforcement Officers Association and we have had the advantage of excellent cooperation with the Michigan State Police.

The personnel of the Employees' Insurance and Compensation Department is as follows:

Walter F. Gries, Superintendent
Walter E. Johnson, Compensation Agent
Lowell C. Holmgren, Assistant, Compensation and Group Insurance Division
Mrs. Shirley O. Mattson, Secretary to the Superintendent
Emil Hoff, Chief of Police
Fred Olson, Stenographer, Compensation Bureau.

WELFARE DEPT. ANNUAL REPORT YEAR 1956

1.

a. WORKMEN'S COMPENSATION

The direct work of the Compensation Department has been taken care of by Mr. Walter E. Johnson as has been the plan since 1926.

While there were a number of cases that required extra attention during the year, most of them were largely routine. However, the following cases were a little unusual.

JAMES BERTINO
EMIL NICOLLE - SPIES MINE
JOSEPH GAGNE

These cases were briefly reviewed in the 1955 Annual Report where it was indicated that all three had filed claims for silicosis under the Michigan Workmen's Compensation law. It was our feeling that Emil Nicolle had the most valid claim and during the year we redeemed liability for $5,000.00.

The case of James Bertino was finally settled for $2,500.00. While he had evidences of silicosis, we did feel that his disability would not preclude him from working at some type of work. However, if he had returned to our employment there would be nothing to prevent him from again filing a claim after a year or two and we would again be faced with the same question of fighting his claim. He had been offered $3,500.00 through his attorney and the attorney had recommended that he accept it. However, his son decided that it was not enough and talked his father into going through with a hearing. This was held at Crystal Falls and resulted in a reduction of our offer from $3,500.00 to $2,500.00 and we settled on that basis.

The case of Joseph Gagne did not go to a hearing. We found that he was much more reasonable than the other two. Because of his age and the fact that he owned his own home and had lived in Iron River for a good many years, he felt that he did not wish to move to Ishpeming to accept employment and did not think that he could stand the daily drive in case he decided to live in Iron River and work here. Mr. Gagne was very reasonable and finally decided that he would take a disability pension with the understanding he would be entitled to an age pension upon reaching age 65. In order to eliminate a future claim, we entered into a redemption agreement with Mr. Gagne providing for the payment of $626.00 as compensation. This redemption will eliminate any future claim in his case.

URHO OJA - MATHER MINE "B" SHAFT

This is a back case which originated on January 13, 1956, when Oja claims that he suffered a strained back while hoisting timber into his working place--the strain occurring as he was trying to land a load of timber. He worked for a few days following the incident and then had to lay off due to the pain between the shoulder blades. We suspected that a part of the disability might have been due to an old automobile accident which he had several years earlier, but could find no proof that this might have been the contributing cause. However, his partner did state, when we interviewed him, that just a few days before the January 13th incident, Mr. Oja had struck the back of his neck against a knot in some standing timber while they were hoisting timber. We had him checked medically by two doctors and also at the Duluth Clinic. While they could find no bony damage, they could not rule out that he might have some pain.

URHO OJA - MATHER MINE "B" SHAFT (cont'd)

He was not a particularly desirable employee and due to the fact that back cases are extremely difficult to fight, and also due to the fact that should he return to work, we had no assurance that he would not bring a claim at some future date. After consultation with our attorneys, it was decided to settle. They demanded $6,000.00 at first, but it was finally reduced to $2,700.00 and settlement was made on that basis.

CHANGES IN MICHIGAN WORKMEN'S COMPENSATION LAW

During the year there were several amendments made to the Michigan Workmen's Compensation Law--the main one being an increase in the weekly compensation rate. Effective August 1, 1956, the following rates were established and the old rates are also shown for comparison.

	New Rate	Old Rate
Single	$ 33.00 weekly	$ 32.00 weekly
With 1 dependent	36.00 "	34.00 "
2 dependents	40.00 "	36.00 "
3 "	45.00 "	38.00 "
4 "	51.00 "	40.00 "
5 "	57.00 "	42.00 "

The weekly payments due in death cases would range from $33.00 for 1 dependent, up to a maximum of $51.00 for 5 or more dependents. The period of liability for medical expense was increased so that it practically makes it unlimited. Previously, the law provided for medical for the first six months following the date of the accident, with three additional 6 month periods as ordered by the Commission. The present amendment now reads that medical expense should be furnished for the first 6 months after the injury and thereafter for such additional 6 month periods as the Commission in its discretion may order. Apparently these additional 6 month periods can be ordered at any time during the disability period. The law does provide that if application is made, we do have the right to file objections to the granting of the additional medical.

Up until October 1, 1956, the law provided for the payment of 800 weeks of disability in cases of the loss of sight of both eyes, or the loss of both legs, both arms, or of any two of the members enumerated above, permanent and complete paralysis of both legs or both arms, or of one leg or one arm, or incurable insanity or imbecility. An additional clause was added on October 1, 1956, covering the permanent industrial loss of use of both legs, or both hands, or both arms, or one leg and one arm. In those cases the permanency of the disability is to be determined not less than 30 days before the expiration of 500 weeks from the date of injury.

There are a few other minor changes but they will have little bearing on our operations.

WELFARE DEPARTMENT

11.

a. WORKMEN'S COMPENSATION

Following is a list of the more serious cases other than fatalities which occurred in 1956:

Mine and Report No.	Name	Nature of Injury	Compensation Paid to 12/31/56
Cliffs-Shaft 1350	Clayton Weinberg	Compound fracture, mid forearm-left, radius & ulna.	1116.00
Maas 795	Clarence Brisson	Amputation tip of rt. index finger.	1530.00
Maas 811	John W. Larson	Amputation right index finger.	-- *
Mather "A" Shaft 297	Eino Leklin	Ruptured disc	1234.33 *
Mather "A" Shaft 310	Dominic Carello	Fracture, right knee	306.00 *
Cambria-Jackson 105	Clement Koski	Compound fracture tibia & fibula, rt. leg. Extensive soft tissue damage.	1656.00 *
Cambria-Jackson 107	Victor Carlson	Fracture right leg.	456.00 *
Mather "B" Shaft 155	Henry Posio	Amputation left index finger.	561.00 *
Mather "B" Shaft 158	Eino Koskela	Ruptured disc	648.00 *
Mather "B" Shaft 165	Alfred Plattenberg	Compound fracture right leg.	456.00 *
Mather "B" Shaft 166	Arthur Pellinen	Fracture right leg. Dislocation right ankle.	456.00 *

* Payments still being made.

WELFARE DEPARTMENT

WELFARE DEPT. ANNUAL REPORT YEAR 1956

1.

a. WORKMEN'S COMPENSATION (Continued)

Settlements were made in the following cases during 1956. The table below indicates the percentage of permanent disability and the member involved.

James Rich	Holman-Cliffs	5% left third finger	53.00
Mike Markovich	"	30% right hand	1,354.24
Melvin Olson	"	25% left foot and ankle	1,556.63
Kenneth Nelson	"	20% left foot and ankle	1,224.30
Herman Bignall	"	5% right foot and ankle	349.80
Arthur Fogelberg	"	50% left third finger	530.00
Jovan Popovich	Hill-Trumbull	45% right index finger	763.20
William Lehto	Hawkins	20% back	2,798.40
Fred Schmidt	"	15% back	1,615.68
Albert Mottonen	"	Settlement - back	586.25
George Hecemovich	Canisteo	10% right foot and ankle	612.15
Ralph Trout	"	10% right foot and ankle	599.60
Walter Simonette	"	5% right arm and leg	1,097.10
Victor Niemi	Princeton	Occupational disease	4,000.00
Joseph Gagne	Spies	Occupational disease	626.00
Emil Nicolle	"	Occupational disease	5,000.00
James Bertino	"	Occupational disease	2,500.00
Ted Ruotsala	Canisteo	5% left foot	349.80
Edgar Staples	Maas	Redemption a/c right hand	2,204.00
Frank Hiissila	Mather "A"	Occupational disease	3,500.00
Urho Oja	Mather "B"	Back case	2,700.00
Paul Maino	Athens	Redemption	2,000.00

WELFARE DEPARTMENT

WELFARE DEPT. ANNUAL REPORT YEAR 1956

1.
a. WORKMEN'S COMPENSATION (Continued)

Compensation Payments Including Medical and Special Expense

Year	C. C. I. Co.	Negaunee Mine Co.	Athens Iron Mining Co.	Cliffs Pow. & Light Co.	Mesaba-C. Mining Co.	CCI Co. Opt. Agt. Atkins	Humboldt Mng. Co.	Marq. Iron Mng. Co.	Miscellaneous Companies	TOTAL
1912 to 1946	1,700,390.45	321,425.99	183,821.45	24,257.67	129,740.16	174.50			10,282.71	2,371,092.93
1947	76,355.69	28,582.02	14,540.71	1,153.75	9,186.43	1,353.77				131,172.37
1948	73,727.12	28,162.82	8,548.15	687.00	9,083.73	824.57				121,033.39
1949	96,910.98	37,433.06	15,401.72	916.50	9,356.57	1,248.75				161,267.58
1950	87,512.40	35,352.22	12,815.81	740.00	10,757.22	3,522.62				150,700.27
1951	111,447.53	45,102.62	10,814.25	734.50	13,757.87	1,286.55				183,143.32
1952	125,226.20	51,320.60	13,005.82	1,187.22	20,234.46	1,159.70	56.40			212,190.40
1953	119,178.56	56,553.21	14,997.55	689.20	12,392.29	336.50	343.45			204,490.76
1954	103,742.80	58,141.65	7,718.89		18,463.90		2,487.89			190,555.13
1955	108,150.86	44,514.59	7,393.87		8,927.53		2,319.13			171,305.98
1956	120,023.62	77,165.75	5,285.60		13,174.94		1,953.23	1,559.97		219,162.91
	2,733,666.21	783,754.53	294,443.82	30,365.84	255,074.90	9,906.96	7,160.10	1,559.97	10,282.71	4,126,115.04

Detail of Miscellaneous Companies:

Holman-Cliffs Mining Company	2,131.39
Canisteo-Cliffs Mining Company	2,768.69
Alexandria Mine	5,382.63
	10,282.71

WELFARE DEPARTMENT

ANNUAL REPORT - 1956
STATEMENT OF COMPENSATION PAYMENTS FROM
JANUARY 1, 1956 TO DECEMBER 31, 1956

	Average No. of Employees	No. of Fatal Accs.	No. of Non-Fatal Accidents			Actual Comp. Paid in 1956	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	Estimated Compensation Still Pending	Medical & Special Expense	Cases Pending		
																				Fatal	Acc	O.D.
Bunker Hill	366		17	14	76	6,202.34									190.00	2,979.67	3,032.67	1,036.00	5,762.78		2	
Cambria-Jackson	145		3	5	8	4,742.00			782.00		1,248.00					336.00	2,376.00	2,316.00	3,520.52	1	2	
Cliffs Shaft	370		9	20	90	8,932.33								840.00		5,136.00	2,956.33	5,625.00	9,314.65		3	
E&A cc-345 - Negaunee Shaft						1,456.00								1,456.00				6,328.00		1		
General Storehouse	173			4	21														2,124.28			
Ishpeming Office	227				3														1,623.90			
Lloyd	8		2	1	4	7,756.46			1,092.00			1,352.00		2,912.00	1,199.12		1,201.34	20,544.87	1,149.48	1	2	2
Maas	243		18	12	41	14,191.50				66.50	1,352.00		1,248.00	1,560.00	1,664.00	3,822.00	4,479.00	8,084.00	3,797.38	2	4	
Ohio	47		1	1	11	232.50											232.50		524.05			
Princeton						4,000.00									4,000.00							
Spies						9,825.00							1,352.00		295.00	8,178.00		390.00	1,154.54		1	
Tilden	32				6														136.05			
Cliffs Shaft Lab Sample Crusher						1,008.00							1,008.00									
General Shops			1	1	15	1,213.67										992.00	221.67		183.05			
Research Lab				1	11														86.00			
Miscellaneous	30			1	3														239.60			
Cleveland Roll	31																		209.40			
E&A cc-491 - Republic	7																		133.40			
Unc. Const. E&A cc-739			3			684.01											684.01		843.01			
Unc. Const. E&A cc-770			1			821.67											821.67		193.90			
Electric Power Dept.	40				1														296.40			
Humboldt	83		3	2	22	985.45											985.45		967.78			
Republic	100		4	1	33	199.50											199.50		677.21			
Pelletizing Plant	47		3	3	6	100.00											100.00	400.00	583.26		2	
Negaunee						1,323.00	231.00			1,092.00								2,016.00			1	
Mather Mine "A" Shaft	591		29	31	126	29,155.03		2,184.00			1,184.00		4,353.67	718.70	810.00	10,873.00	9,031.66	46,976.40	11,946.02	4	12	
Mather Mine "B" Shaft	676		36	38	261	20,473.01					1,248.00				3,026.00	4,793.33	11,405.68	32,010.00	14,268.69	2	5	1
Athens						5,096.00				2,000.00			1,536.00	1,560.00				5,620.00	189.60		1	1
Total - Michigan Mines	3,216	0	129	135	738	118,397.47	231.00	2,184.00	1,874.00	3,158.50	5,032.00	1,352.00	9,497.67	9,046.70	11,184.12	37,110.00	37,727.48	131,346.27	59,924.55	11	35	4
Hibbing Office	81																		731.25			
Hibbing - Miscellaneous	31				4														253.50			
Agnew	41			3	8														280.80			
Canisteo	117		4	8	54	4,915.99									612.15	3,124.70	1,179.14	120.00	2,174.41		1	
Hawkins	150		3	5	66	6,073.64							3,279.68	638.23			2,155.73	3,240.00	2,747.68	1	1	
Hill-Trumbull	131		3	3	40	2,713.86								1,664.00			1,049.86	3,792.00	1,398.00	1		
Holman-Cliffs	145		6	5	60	6,295.98							2,154.24			3,135.73	1,006.01		2,766.90			
Sargent	21		1	1	13	7,309.70					1,762.50		2,912.00			2,635.20		25,144.00	3,019.78	1	1	
Wanless	24				15														159.00			
Total - Minnesota Mines	751	0	17	25	260	27,309.17					1,762.50		8,345.92	2,302.23	612.15	8,895.63	5,390.74	32,296.00	13,531.32	3	3	
Total - All Mines	3,967	0	146	160	998	145,706.64	231.00	2,184.00	1,874.00	3,158.50	6,794.50	1,352.00	17,843.59	11,348.93	11,796.27	46,005.63	43,118.22	163,642.27	73,456.27	14	38	4

WELFARE DEPT. ANNUAL REPORT YEAR 1956

11.

a. WORKMEN'S COMPENSATION (Continued)

ANNUAL STATEMENT OF COMPENSATION PAYMENTS
FROM JANUARY 1st, 1956 TO DECEMBER 31, 1956

Compensation paid on 1956 cases	43,118.22	
Estimated compensation still pending	163,642.27	
Cost of medical and hospital service and special expenses	73,456.27	
		280,216.76
Less pending for years 1946-1954 incl.	144,389.27	
Less medical and special expense on accidents occurring prior to January 1, 1956	9,609.58	
		153,998.85
		126,217.91
Less compensation paid on 1956 occupational disease cases		1,545.00
Estimated cost of 1956 accidents		124,672.91
Percentage of payrolls on accident cases		.00585
Percentage of payrolls including Occupational Disease cases		.00590
Number of fatal accidents		0
Number of compensable accidents		146
Number of lost-time accidents - non-compensable		160
Number of slight accidents		998

The following occupational disease cases occurred during 1956. The cost of these cases is included in the regular compensation costs, but for statistical purposes they are not included in the accident table.

Number of deaths	0
Number of disability cases	4

During 1956, a total of $16,480.45 was paid on occupational disease cases and it is estimated it will cost $29,478.21 to complete payments on the seven cases still active on December 31, 1956. Of these, one originated in 1952, two in 1953, one in 1954, one in 1955, and two in 1956. During 1956, three Spies Mine silicosis cases were settled for $8,178.00. This amount is included in the 1956 payment of $16,480.45 shown above, but the claims originated shortly after the closing of the Spies Mine in June 1955.

WELFARE DEPARTMENT

EMPLOYEES' INSURANCE AND COMPENSATION DEPARTMENT

ANNUAL REPORT YEAR 1956

1.

b. GROUP INSURANCE - Bargaining Units

Hourly-rate, bargaining employees were covered during 1956 by a group life, disability, hospital and surgical plan with the Aetna Life Insurance Company underwriting the life and disability features and Blue Cross - Blue Shield organizations providing the hospital and surgical benefits. The provisions of the plan as it existed through August 31, 1956 were essentially as detailed in the Annual Report for 1955. A liberalization of Blue Cross - Blue Shield benefits on April 1, 1956 provided broader coverage on maternity, limited hospitalization for dental work, tuberculosis, nervous and mental disorders, outpatient surgery, various types of therapy and administration of anesthesia and radiation therapy. These additions resulted in a one-dollar increase in the Blue Cross - Blue Shield premium rate which was absorbed by the insurance benefits account with no increase in contributions on the part of the employee. On September 1, 1956 a new group plan was set up by Company-Union negotiations.

Premium rates for the policy period from December 1, 1955 through August 31, 1956 follow:

Life - .84 per thousand
Sickness and accident - .073 per dollar
Retired life insurance
Pensioners before 1/1/55 - $4.96 per thousand
Pensioners after 1/1/55 - $4.43 per thousand
Hospital and surgical - $7.84 per employee through 3/31/1956
$8.84 per employee from 4/1/1956
Funding of life insurance of pensioners after 1/1/55 - $.94 per employee.

The Company's cost toward the premium cost of this group insurance for this period continued at 4½¢ per hour actually worked by bargaining employees. The employee's contribution remained at the fixed rates shown in the 1955 Annual Report.

A new program of group insurance became effective on September 1, 1956. An outline of benefits and contributions follows:

1. Life Insurance
   (a) $4000 to all employees
   (b) $1500 additional insurance at full cost to employee (optional).

2. Weekly Sickness & Accident Benefit - $46.50 for maximum of 26 weeks - First day accident - Eighth day sickness - Provision for make-up of workmen's compensation.

3. Hospitalization - Liberalized Blue Cross - semi-private service - 120 days - liberalized in-hospital incidental charges - certain diagnostic procedures (inpatient and outpatient) - $12 per day toward private room.

EMPLOYEES' INSURANCE AND COMPENSATION DEPARTMENT

ANNUAL REPORT YEAR 1956

1.

b. GROUP INSURANCE - Bargaining Units (Continued)

4. Surgical - Blue Shield - as per schedule - $300 maximum.

5. Retired death benefit - $1375 if qualified for pension.

6. Provision has been made for continuing modified coverage to laid-off employees and for conversion privilege of hospital and surgical insurance for retired employees.

7. New employees will become insured on the first day of the month following the month in which employed.

Schedule of benefits and contributions:

Benefits					Contributions	
Employee		Employee & Dependent				
Life Ins.	Weekly S & A Benefit	Daily Hosp. Benefit	Incidental Hospital Charges	Max. Surg.Fee Benefit	Emp. Without Dep..	Emp. With Dep.
$4000	$46.50	Semi-private	Unlimited on covered charges	$300	$8.20*	$9.75*

* $1500 optional life insurance available at additional premium cost of $1.26.

Premium rates beginning September 1, 1956 follow:

Life - .84 per thousand
Sickness and accident - .073 per dollar
Retired life insurance
Pensioners before 1/1/55 - $5.37 per thousand
Pensioners after 1/1/55 - $3.71 per thousand
Hospital and surgical - $12.00 per employee
Funding of life insurance of pensioners after 1/1/55 - $1.03 per employee.

The Company is contractually obligated to share the cost of this program by matching the basic employee contributions of $8.20 or $9.75 for those employees who are on an actively-employed status as outlined by the contract and group insurance booklet.

A favorable balance in the insurance benefits account resulted in a complete waiver of premium to all employees in July 1956. Similar circumstances in the optional life account brought waivers of the optional life premiums in December 1956 and January 1957.

Reference is made to the Annual Reports of 1936 and 1937 for the details of the Company's original group insurance plan which provided only life and disability coverage and to 1947 when hospitalization and surgical benefits were added.

EMPLOYEES' INSURANCE AND COMPENSATION DEPARTMENT

ANNUAL REPORT YEAR 1956

1.

b. GROUP INSURANCE - Salaried and Non-bargaining

Salaried and non-bargaining employees were covered during 1956 by a group life, disability, hospital and surgical plan underwritten completely by The Aetna Life Insurance Company of Hartford, Connecticut. The basic plan as outlined in the Annual Report of 1954 and premium rates shown in the Annual Report of 1955 were unchanged through August 31, 1956.

On May 1, 1956 major medical expense coverage, also underwritten by The Aetna Life Insurance Company, was added to the program. This new feature covers practically all types of medical expense and supplements the basic hospital and surgical insurance. It is a $100 deductible plan providing for payment of 75% of the excess of medical expense for non-occupational accident and illness over and above the benefits paid by the basic plan and the deductible of $100. This deductible applies in each calendar year and to the employee and dependent individually. A maximum of $10,000 during the life of the policy is provided but is renewable upon approval of the insurance company. The overall premium rate for the major medical expense insurance is $.99 for single and $1.55 for family coverage. As a result of this addition employee contributions were increased by $.60 for the single employee and $1.20 for the employee with dependents.

On September 1, 1956 the basic program was revised. An outline of the revised plan and employee contributions follows:

		Employee		Employee and Dependents
Class	Basic Annual Earnings Rate	Life Ins.	Weekly Sickness and Accident Benefit	Hospitalization, Surgical and Diagnostic Benefits
1.	Less than $3,600	$4000	$46.50	Hospitalization
2.	$3,600 but less than $4800	5000	"	Benefits for 120
3.	4,800 but less than 6000	6250	"	days in Semi-Private
4.	6,000 but less than 7500	7500	"	Accommodations, $12 per
5.	7,500 but less than 10,000	10,000	"	day toward private room,
6.	10,000 but less than 12,500	12,500	"	$300 Max. Surg. Schedule,
7.	12,500 but less than 15,000	15,000	"	Anesthesia Services, X-Ray
8.	15,000 but less than 17,500	17,500	"	& Lab. Services & X-Ray &
9.	17,500 and over	20,000	"	Radium Therapy Benefits, & Major Medical Expense Benefits.

EMPLOYEES' INSURANCE AND COMPENSATION DEPARTMENT

ANNUAL REPORT YEAR 1956

1.

b. GROUP INSURANCE - Salaried and Non-bargaining (Continued)

EMPLOYEE'S MONTHLY CONTRIBUTION

Class	Employee Without Dependents	Employee With Dependents
1.	$ 4.94	$ 8.36
2.	5.69	9.11
3.	6.32	9.74
4.	7.69	11.11
5.	9.19	12.61
6.	10.69	14.11
7.	12.19	15.61
8.	13.69	17.11
9.	15.19	18.61

A table of overall premium rates as they apply beginning September 1, 1956 follows:

Life - $1.01 per thousand
Disability - $.097 per dollar
Retired life insurance - $6.13 per thousand
Basic employee hospital and surgical - $3.92 per employee
Basic dependent hospital and surgical - $9.48 per employee
Major medical expense - employee - $.99 per employee
Major medical expense - dependent - $1.55 per employee

1.
b. GROUP INSURANCE (Continued)

The following statement shows the amount of Salaried and Non-Bargaining Unit claims paid during the year December 1, 1955 to August 31, 1956.

	Hospitalization	Health & Accident	Comp. Make-up	Death Claims	Total
Bunker Hill	1,645.78	177.14	86.33		1,909.25
Cambria-Jackson	865.02	668.58			1,533.60
Cliffs-Shaft	3,837.92	1,164.71			5,002.63
Cleveland Roll	1,720.24	240.00			1,960.24
General Roll	18,875.25	2,697.15		7,500.00	29,072.40
Elec. Power Dept.	41.00				41.00
General Storehouse	49.50				49.50
Lloyd	1,772.21	857.14			2,629.35
Maas	1,644.75	1,788.57	39.96		3,473.28
Ohio		22.86			22.86
Inactive	759.28			1,875.00	2,634.28
Total-C.C.I. Company	31,210.95	7,616.15	126.29	9,375.00	48,328.39
Mather Mine "A" Shaft	3,783.85	731.43	74.86		4,590.14
Mather Mine "B" Shaft	3,634.32	308.57			3,942.89
Total-Negaunee Mine Co.	7,418.17	1,040.00	74.86		8,533.03
Humboldt Mining Company	17.50				17.50
Republic	5.00				5.00
Total-Michigan District	38,651.62	8,656.15	201.15	9,375.00	56,883.92
Number of Claims	274	52	6	2	334

WELFARE DEPARTMENT

WELFARE DEPT. ANNUAL REPORT YEAR 1956

1.

b. GROUP INSURANCE (Continued)

The following statement shows the amount of Bargaining Unit claims paid during the 10-month period from November 1, 1955 to August 31, 1956.

	Hospitalization	Health & Accident	Comp. Make-up	Death Claims	Total
Bunker Hill	114.50	13,112.86	1,045.91	5,000.00	19,273.27
Cambria-Jackson		4,097.16	125.00		4,222.16
Cliffs-Shaft	115.00	18,091.42	572.33	15,000.00	33,778.75
Elec. Power Dept.		57.14			57.14
General Storehouse		3,868.58	211.47		4,080.05
Lloyd	115.00	3,062.86	212.65		3,390.51
Maas		13,194.31	646.91		13,841.22
Miscellaneous		85.72			85.72
Ohio	65.00	222.86	13.33		301.19
Spies		160.00	40.00		200.00
Republic		1,788.56	131.66		1,920.22
Pensioner before 1/1/55				16,250.00	16,250.00
Total-C.C.I. Company	409.50	57,741.47	2,999.26	36,250.00	97,400.23
Mather Mine "A" Shaft	230.00	15,937.56	1,026.84	10,000.00	27,194.40
Mather Mine "B" Shaft	570.70	24,379.41	1,149.28	30,000.00	56,099.39
Total-Negaunee Mine Co.	800.70	40,316.97	2,176.12	40,000.00	83,293.79
Pelletizing Plant			6.67		6.67
Humboldt Mining Company	230.00	1,034.28			1,264.28
Total-Michigan District	1,440.20	99,092.72	5,182.05	76,250.00	181,964.97
Number of Claims	17	378	123	28	546

WELFARE DEPARTMENT

WELFARE DEPT. ANNUAL REPORT YEAR 1956

1.

b. GROUP INSURANCE (Continued)

The following death claims were paid during the period from November 1, 1955 through August 31, 1956.

Name	Mine	Date of Death	Amount of Insurance
Clifford P. DeChambeau	Bunker Hill	11-28-55	5000.00
James Willey	Cliffs-Shaft	10-10-55	5000.00
William Johns	Cliffs-Shaft	2-25-56	5000.00
Phil Pepin, Jr.	Cliffs-Shaft	3-8-56	5000.00
William J. Smith	General Roll	5-31-56	7500.00
Henry Anderson	Mather Mine "A" Shaft	10-10-55	5000.00
George Miljour	Mather Mine "A" Shaft	2-22-56	5000.00
Floyd Erickson	Mather Mine "B" Shaft	1-28-56	5000.00
Nels Anderson	Mather Mine "B" Shaft	3-6-56	5000.00
John Wiig	Mather Mine "B" Shaft	4-2-56	5000.00
Leo Johns	Mather Mine "B" Shaft	4-5-56	5000.00
Alphonse J. Michell	Mather Mine "B" Shaft	5-4-56	5000.00
Edward J. Girard	Mather Mine "B" Shaft	7-26-56	5000.00
Albert J. Lehmann	Inactive	11-7-55	750.00
Russell H. Hill	Inactive	11-13-55	1250.00
Herbert Skewis	Inactive	11-14-55	1250.00
Ludwig A. Lee	Inactive	7-31-55	1250.00
Clyde E. Legacy	Inactive	12-22-55	1250.00
Albin Hamalainen	Inactive	1-28-56	750.00
Charles Kirschner	Inactive	1-9-56	1250.00
Jacob Koski	Inactive	2-9-56	750.00
Otto Korhonen	Inactive	2-12-56	1250.00
Joseph Saari	Inactive	6-26-55	1250.00
John O. Jokela	Inactive	3-1-56	750.00
John Johnson	Inactive	3-24-56	750.00
Otto G. Franson	Inactive	3-25-56	500.00
John Juhola	Inactive	6-14-56	1250.00
James Hansen	Inactive	6-20-56	1250.00
Carl F. Swanson	Inactive	6-27-56	750.00
Cliff LaMer	Inactive	6-4-56	1875.00

WELFARE DEPARTMENT

EMPLOYEES' INSURANCE AND COMPENSATION DEPARTMENT

ANNUAL REPORT YEAR 1956

2.

a. PENSION SYSTEM

Pension Plan of 1/1/1909

The Company's original pension system went into effect on January 1, 1909 and the forty-eighth year of its operation was completed in 1956.

No changes in the rates of pensions were made during the year. On January 1, 1933 pensions being paid were reduced by fifty per cent, those under $20.00 remaining the same and those over $20.00 having a minimum rate of $20.00. There have been no additions to these payrolls since January 1, 1932.

During the time the Plan was active individual payrolls were written for the following Departments:

Mining Department
Holmes Mine Department
Republic Mine Department
Land Department
Furnace Department.

Of these only the Mining Department payroll was active during the year. There are four pensioners being paid over the Mining Department Pension Payroll at the close of 1956. This includes Frank Vierela who was formerly on the Republic Mine Department Pension Payroll. Total expenditure over the payroll for 1956 was $936.00.

EMPLOYEES' INSURANCE AND COMPENSATION DEPARTMENT

ANNUAL REPORT YEAR 1956

2.

a. PENSION SYSTEMS (Continued)

Contributory Retirement Plan for Salaried Employees

For the purpose of Record it is here mentioned that the Company has had in effect for its salaried employees, since December 31, 1940, a Contributory Retirement Plan to which both the Company and the employees contribute. This Plan is carried with the Aetna Life Insurance Company of Hartford, Connecticut under group policy GA-228, and it is administered completely by the Cleveland Office. Participation upon meeting certain eligibility requirements is optional.

Pension Plan of 3/1/1950

The Pension Plan of 3/1/1950 remained in force without change through October 31, 1954. The details of the plan may be found in the Annual Report of 1950. This department handles the taking and initial processing of all pension applications. The applications are submitted to the Pension Committee in Cleveland for final action.

The Plan was revised on November 1, 1954 and remained in force, as revised, during 1956. It provides for an age pension for retiring bargaining unit employees who are 65 years of age and have a minimum of 15 years of continuous service. The formula for computing the gross pension follows: one per cent of the average monthly wage (computed over the ten year period immediately preceding the month of retirement) times the years of continuous service. Minimum gross pensions are stipulated as follows: $140.00 for thirty or more years of service with a reduction of $2.00 per year for each year less than thirty. The gross pension thus established is reduced by a standard social security deduction of $85.00, by that portion of any other pension which Company contributions have purchased, and certain other types of pensions and workmen's compensation benefits. The Company pays a net pension (adjusted to the nearest dollar) which is the difference between the gross pension and the total deductions.

The Plan provides a disability pension for the retiring bargaining unit employee with fifteen or more years of continuous service who prior to age 65 becomes totally and permanently incapacitated for gainful employment of any kind. Total and permanent incapacity for employment must have existed for a period of six months before the employee is eligible to apply for a disability pension. The formula for computing the gross disability pension is the same as that for an age pension with the minimum pension being $75.00 per month. A disability pension is reducible by certain types of other pensions and also by workmen's compensation or occupational disease benefits which are not payments for disability in the nature of a permanent disability.