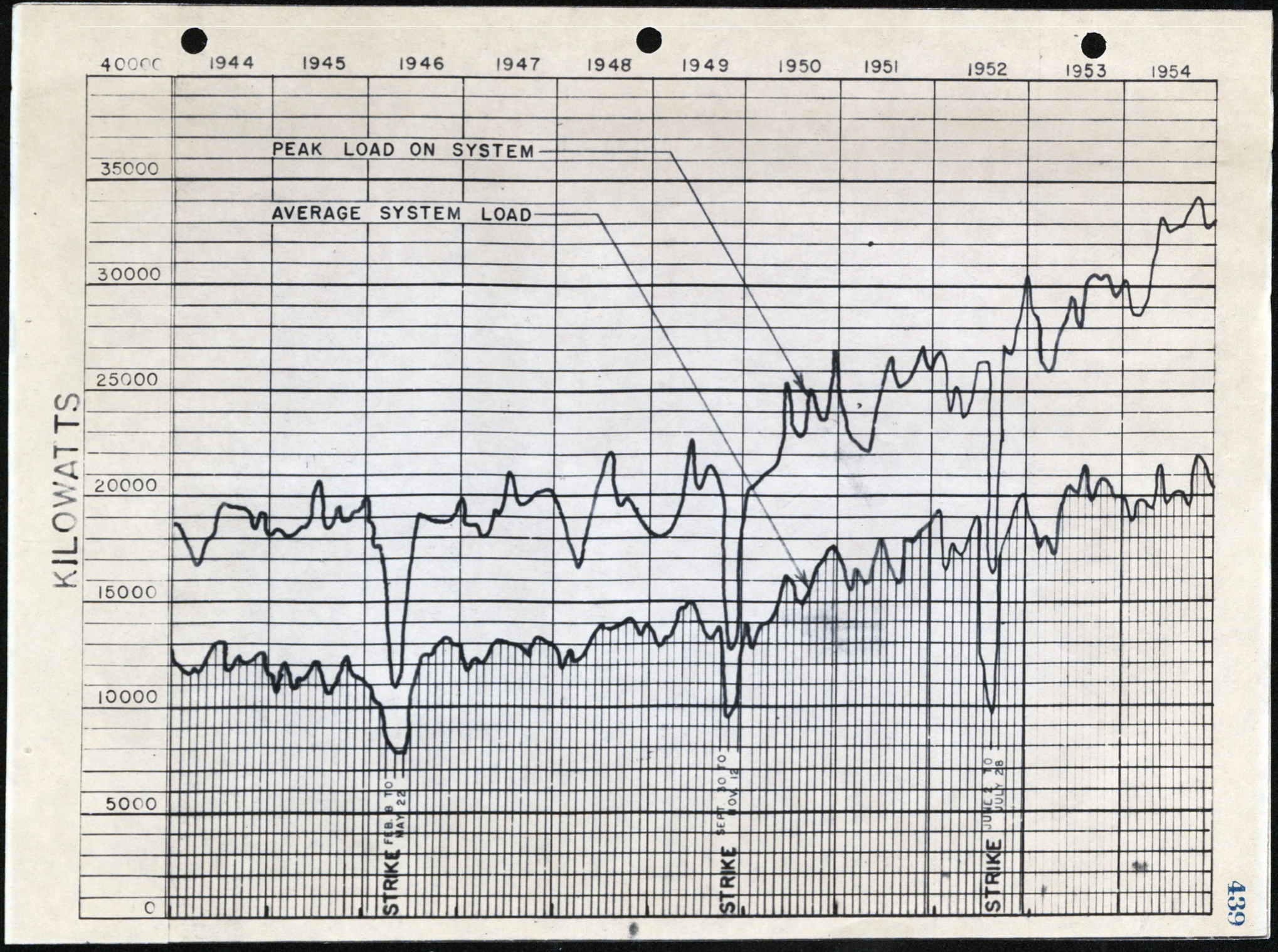
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1953
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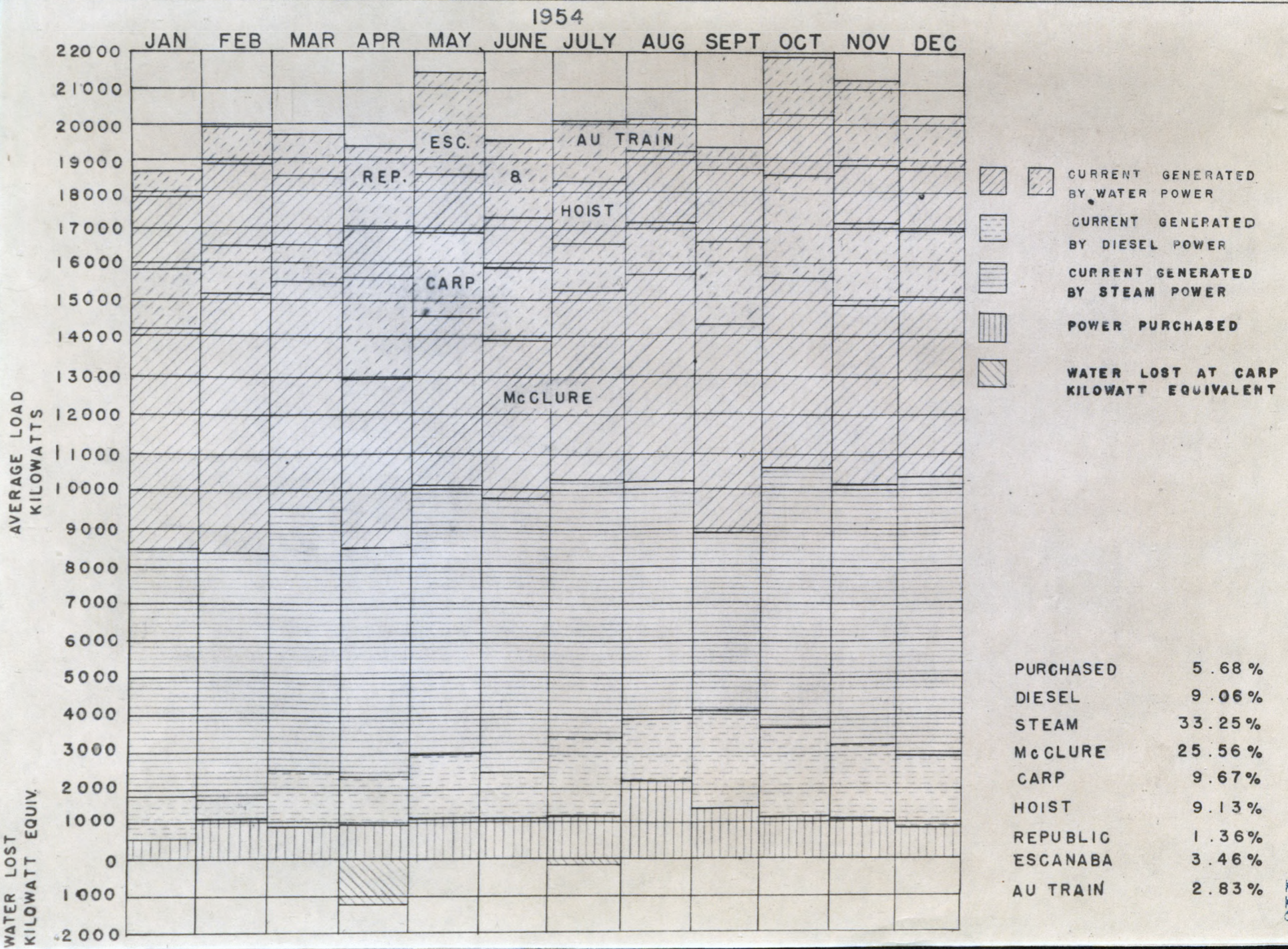
PEAK LOAD ON SYSTEM
AVERAGE SYSTEM LOAD
STRIKE FEB. 8 TO MAY 22
STRIKE SEPT. 30 TO NOV. 12
STRIKE JUNE 2 TO JULY 28



PURCHASED	5.68%
DIESEL	9.06%
STEAM	33.25%
McCLURE	25.56%
CARP	9.67%
HOIST	9.13%
REPUBLIC	1.36%
ESCANABA	3.46%
AU TRAIN	2.83%

WELFARE DEPT. ANNUAL REPORT YEAR 1954

The Annual Report of the Welfare Department for the year 1954 is presented herewith.

Throughout the year 1954 this Department carried on its usual scope of activities. These activities cover the welfare of employees of our Company and our association with the general welfare of the entire community.

The major functions of the Welfare Department include general employee welfare. For years the Department would direct relief work but in recent years this activity has been reduced to but a few persons. Workmen's compensation, group insurance, pensions, safety, publication of the "Cliffs News", public relations and Company-sponsored employee activities, police and plant protection are all activities carried on in a greater or lesser degree in the Welfare Department. We also participate in activities of a civic, community and public health nature.

As pointed out in previous Annual Reports, we submit for the record that the Department was first known as the Pension Department under the supervision of Mr. W. H. Moulton, whose title at one time was Secretary. Mr. Moulton retired on July 1, 1938 and the name of the Department was then established as the Welfare Department. Mr. Walter F. Gries was placed in charge under the title of Superintendent. In discussions at the end of the year 1954, it was thought best to change the name of the Department to The Department of Compensation, Insurance and Pensions. The reason for this suggested change is due to the fact that the term Welfare connotes something different today than it did in years past and moreover the activities of the Department are largely in the fields of compensation, insurance, pensions and such public relations activities as have been developed in recent years.

Mr. A. J. Stromquist, our Director of Safety, and the employees of the Safety Department have cooperated fully with this Department. For a good many years the Company and its employees have reaped the benefits of a combined welfare and safety program and it is felt that our safety program is one of the best in iron mining activities.

Mr. W. E. Johnson, who is directly in charge of the Compensation Bureau of the Department as well as the Insurance Bureau, has been with the Company since 1911. He is thoroughly familiar with compensation rules and regulations in Michigan and Minnesota and his experience over the years, together with his efficiency and his loyal service, have proved to be invaluable to the entire Department, to the Company and to its employees. Because of the development in recent years of an over-all Company insurance program, Mr. Johnson is required to spend at least 50% of his time, if not more, in matters dealing with the carrying out of the insurance program.

The detail work in the insurance program and the pensions, donation and retirement payrolls is handled by Mr. Lowell C. Holmgren, whose service with the Company goes back to 1936. Mr. Holmgren, because of his background of experience, his capacity for service, has contributed much to the proper functioning, particularly of the insurance program, since he has charge of the transfers, additions and corrections involving employees in the insurance program.

WELFARE DEPARTMENT

MAY 20 1955

WELFARE DEPT. ANNUAL REPORT YEAR 1954

Mrs. Ann Sundblad Kauppila, who served as Secretary to the Superintendent of the Welfare Department, resigned as of November 1, 1954. On that date Mrs. Shirley O. Mattson became the Secretary to the Superintendent. She came to this Department with nine years experience in the Purchasing Department and we wish to record that she has undertaken the numerous duties as Secretary with the degree of efficiency and cooperation that we had anticipated. We wish to acknowledge the loyal service to this Department both of Mrs. Kauppila and Mrs. Mattson. Miss Rita Chapman, who was employed as a clerk in the Department was disengaged from her job in June of 1954. There has been no replacement. Miss Chapman was released in the program in our effort to reduce costs of the Department. Miss Chapman's release has created somewhat of a problem since at times the number of applications for insurance benefits cannot be handled in a reasonable length of time. On May 1, 1953 Miss Martha Roine, now Mrs. Robert Saari, continues her service in the Department as a Stenographer in matters concerning compensation and insurance. Mrs. Saari is a very reliable and efficient person and she has cooperated splendidly in the efforts we are making to keep our applications for insurance flowing as rapidly as possible.

Mr. Emil Hoff, our Chief of Police, confers with the Superintendent of the Department almost daily and keeps a close check of the officers in the field. Mr. Hoff is formerly Captain of Police at Mather Mine "A" Shaft and for six months was associated with our previous Police Chief, Mr. R. J. Veale, who has retired. Mr. Hoff has an excellent record of achievements in police work and we are fortunate to have him as our Chief of Police. We wish to record here that he is highly regarded by all the officers in our Police Department, by the Michigan State Police and the local Police authorities. He works cooperatively with them in a quiet and efficient manner.

The personnel of the Welfare Department is as follows:

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

WELFARE DEPT. ANNUAL REPORT YEAR 1954

11.

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.

FRANK BOLLERO - MAAS MINE

On February 8, 1952, Bollero, with others, were unloading timber with a hydrocrane. In the process he was turning the bucket when a swinging timber balanced on the edge of the car and swung and struck him on the back. He was paid compensation intermittently until March 30, 1953 and subsequent to that time made no complaint until June of 1954. As it happened, he was one of the men laid off during the May 15th lay-off period and after he had exhausted his unemployment he apparently began looking for some other source of income and decided to file a claim. Incidently, he operates a tavern near Gwinn on a tourist license which is effective from May 1 to January 1. This case will undoubtedly come up for hearing some time in 1955.

CARL R. AUSTIN - CAMBRIA-JACKSON MINE

On December 30, 1953 Austin was struck on the leg by a chunk which rolled from the pile and sustained a fracture of the right leg just above the ankle. In May of 1954 he suffered a heart attack and was hospitalized and subsequently an embolus developed which necessitated the amputation of the injured leg. There had been two previous emboli but these had dissolved. He filed a claim requesting that compensation be paid for the loss of the leg on the ground that he had not recovered from the fracture, however, our medical opinion indicates that the embolus did not originate at the site of the fracture, but rather was carried from the heart through the circulatory system and that it was a direct result of high blood pressure from which the records indicate he has suffered for several years. This case will also be heard in 1955.

EINO ISAACSON - MAAS MINE

Isaacson has been employed at several of our mines, including the Princeton, Athens and lastly, at the Maas. He was always seeking favored employment which he requested because of a back condition which he claimed occurred while in our employ. However, he continued work except for minor periods of disability until May of 1954 when he, with the others, were separated during the general lay-off.

11.

a. WORKMEN'S COMPENSATION (Continued)

He subsequently filed a claim for compensation listing ten different incidents which occurred over the period from 1949 to September of 1953. He has consulted an attorney and this case will probably be scheduled for hearing early in 1955. However, it is our feeling that if a reasonable settlement can be made in this case that we should accept it as he will continue to be a troublesome individual and if the matter is not met now, and he is reemployed, it would mean that he would probably file a claim at some future date.

LEANDER SAYRING - CAMBRIA-JACKSON MINE

Mr. Sayring last worked on September 21, 1953, at which time he was disabled due to a lung condition which Dr. Acocks of Morgan Heights Sanitarium described as an inflamatory process of the left upper lung. He drew insurance benefits for a time and then filed claim for benefits under the Occupational Disease Law as a silicotic. The findings by our doctors indicate that he had no X-ray evidence of silicosis and this has been confirmed by Dr. O. E. Sander of Milwaukee. However, he does have some pathology in the lung and as he has consulted an attorney there undoubtedly will be a hearing in this case early in 1955.

WELFARE DEPT. ANNUAL REPORT YEAR 1954

11.

a. WORKMEN'S COMPENSATION (Continued)

ANNUAL STATEMENT OF COMPENSATION PAYMENTS
FROM JANUARY 1st, 1954 TO DECEMBER 31, 1954

Compensation paid on 1954 cases	34,739.91	
Estimated compensation still pending	153,212.10	
Cost of medical and hospital service and special expenses	56,851.38	
		244,803.39
Less pending for years 1944 to 1953 inclusive	125,791.32	
Less medical and special expense on accidents occurring prior to January 1, 1954.	9,986.40	
		135,777.72
		109,025.67
Less compensation paid on 1954 occupational disease cases		3,779.22
Estimated cost of 1954 accidents		105,246.45
Percentage of payrolls on accidents		.00585
Percentage of payrolls including Occupational Disease cases		.00602
Number of fatal accidents		0
Number of compensable accidents		103
Number of lost-time accidents - non-compensable		114
Number of slight accidents		921

The following occupational disease cases occurred during 1954. 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	12

During 1954 a total of $19,093.89 was paid on occupational disease cases and it is estimated it will cost $29,001.78 to complete payments in the seven cases still active on December 31, 1954. Of these one originated in 1949, one in 1950, one in 1951, one in 1952, one in 1953 and two in 1954.

WELFARE DEPARTMENT

11.

a. WORKMEN'S COMPENSATION (Continued)

Settlements on a partial disability basis were made in the following cases during 1954. The table below indicates the percentage of permanent disability and the member involved.

Lee Jackson	Sargent	33% left leg	2,346.67
Joseph Bertnick	Agnew	75% left little finger	480.00
Allyn Clark	Hawkins	15% right foot	792.00
Carl Forsberg	Hawkins	33% left middle finger	408.33
John Simonovich	Agnew	10% left leg and ankle	528.00
William Lehto	Agnew	15% right foot and ankle	792.00
George Cayanovich	Sargent	60% right arm	4,416.00
John Bozicevich	Wanless	10% leg	770.00
Ralph Trout	Canisteo	5% right thumb	113.75
John Vuyovich	Hawkins	17 1/2% of back	1,848.00
Earl Barsness	Hawkins	15% right great toe	183.75
Carl Torkelson	Hill-Trumbull	15% right arm	1,207.50
Donald Wilson	Hill-Trumbull	Neurosis	3,232.00
Everett C. Danielson	Hill-Trumbull	15% of back	1,584.00
Vincent J. Soleture	Hill-Trumbull	40% left ring finger	350.00

ANNUAL REPORT - 1954
STATEMENT OF COMPENSATION PAYMENTS FROM
JANUARY 1, 1954 TO DECEMBER 31, 1954

	Average No. of Employees	No. of Fatal Accs.	No. of Non-Fatal Accidents			Actual Comp. Paid in 1954	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	Estimated Compensation Still Pending	Medical & Special Expense	Cases Pending		
																				Fatal	Acc.	O. D.
Bunker Hill	325		8	58	14	3,087.66											3,087.66	706.00	3,651.82		3	
Cambria-Jackson	182		1	24	5	5,669.33				1,404.00	1,196.00	834.00	1,248.00			840.00	147.33	5,908.00	2,064.98	3	1	
Cliffs Shaft	486		13	115	17	7,502.34	350.00			988.00			782.67			1,796.00	3,585.67	2,646.00	7,280.91		3	
E & A cc 345 - Negaunee Shaft						1,546.67										1,546.67		9,240.00		1		
General Storehouse	165			22															1,210.55			
Ishpeming Office	261																		1,878.20			
Lloyd	117		6	27	7	8,001.88	588.00				1,304.00			1,352.00		1,620.00	3,137.88	25,468.78	1,662.12	1	3	2
Maas	319		5	46	12	12,587.34				2,288.00		1,976.00	2,890.00		1,317.00	1,832.00	2,284.34	17,875.50	4,325.59	5	3	1
Ohio	40			5		1,560.00										1,560.00		1,525.00	304.20		1	
Princeton						753.48		753.48										137.66			1	
Spies	97		2	11	2	3,431.33								1,352.00	1,352.00		727.33	1,632.00	899.20		1	1
Tilden																			11.80			
Cliffs Shaft Lab.Sample Crusher						1,456.00									1,456.00			2,464.00	7.50		1	
General Shops						90.00										90.00			68.25			
Research Laboratory				7															42.88			
Miscellaneous	38			7															279.00			
Cleveland Roll	32																		229.80			
E & A cc 522			1			90.67											90.67		60.68			
Electric Power Dept.	46			6															354.65			
Humboldt	93		4	36	1	1,292.00											1,292.00	432.00	1,195.89		1	
Negaunee						8,458.00		1,029.00	1,092.00		204.00	2,031.00	1,152.00				2,950.00	5,523.00	297.47		2	
Mather Mine "A" Shaft	587		19	144	22	23,943.01				2,226.00	988.00		1,352.00	1,456.00	5,512.00	4,134.99	8,274.02	29,092.74	8,728.53	3	8	
Mather Mine "B" Shaft	542		31	195	18	9,213.65					1,130.67		1,248.00			1,473.33	5,361.65	5,704.00	7,500.99	2	1	
Athens Iron Mining Company						6,180.00			300.00			684.00			2,392.00	2,804.00		9,520.00	1,538.89		2	2
Total - Michigan Mines	3,330		90	703	98	94,863.36	938.00	1,782.48	1,392.00	6,906.00	4,822.67	5,525.00	8,672.67	4,160.00	12,029.00	17,696.99	30,938.55	117,874.68	43,593.90	15	31	6
Hibbing Office	66																		600.00			
Miscellaneous - Hibbing	28			1															253.50			
Agnew	124			76	5	2,776.95													1,731.20			
Canisteo	136		6	37		1,317.58								587.97	538.56	1,650.42			1,283.75			
Hawkins	144		4	36	5	10,526.81											1,317.58					
Hill-Trumbull	108		2	27	4	10,677.82								4,292.96	1,664.00	2,884.07	1,685.78	5,310.20	2,198.44	1	1	
Holman-Cliffs	117			34		3,741.31									3,764.24	6,500.58	413.00	7,120.00	2,550.22	1		
Sargent	14		1	6	1	8,049.92								3,262.98	373.33		105.00	3,169.02	1,494.55		1	
Wanless	2			1	1	1,750.00							1,560.00	2,393.60	3,816.32		280.00	19,482.00	3,046.32	1	3	
																1,750.00		256.20	99.50		1	
Total - Minnesota Mines	739		13	218	16	38,840.39							1,560.00	10,537.51	10,156.45	12,785.07	3,801.36	35,337.42	13,257.48	3	6	
Total - All Mines	4,069		103	921	114	133,703.75	938.00	1,782.48	1,392.00	6,906.00	4,822.67	5,525.00	10,232.67	14,697.51	22,185.45	30,482.06	34,739.91	153,212.10	56,851.38	18	37	6

11.

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 Pr. & Light Co.	Mesaba-C. Mining Co.	CCI Co. Opt. Agt. Atkins	Humboldt Mng. Co.	Miscellaneous Companies	TOTAL
1912 to 1944	1,531,822.45	263,634.57	171,295.12	21,260.67	116,417.13			10,282.71	2,114,712.65
1945	85,558.58	32,400.22	7,152.70	1,468.50	5,630.00				132,210.00
1946	84,009.42	25,391.20	5,373.63	1,528.50	7,693.03	174.50			124,170.28
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
	2,505,491.73	662,074.19	281,664.35	30,365.84	232,972.63	9,906.96	2,887.74	10,282.71	3,735,646.15

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

WELFARE DEPT. ANNUAL REPORT YEAR 1954

11.

a. WORKMEN'S COMPENSATION (Continued)

Following is a list of the more serious cases other than fatalities which occurred in 1954:

Mine and Report No.	Name	Nature of Injury	Compensation Paid to 12/31/54
Cliffs-Shaft 1312	William Collins	Fracture and severe laceration great toe.	972.00
Cliffs-Shaft 1317	Arvid Anderson	Fracture both bones of left leg.	612.00*
Maas 781	Jack Lintula	Loss of right eye	1,472.00*
Lloyd 919	Louis H. Mayotte	Amputation 2nd & 3rd fingers left hand.	1,512.00*
Bunker-Hill 6	Alfred Denofrio	Severe laceration left hand.	747.33
Bunker-Hill 7	Joseph J. Pepin	Fractured left heel	288.00*
Mather "A" Shaft 254	Frithiof Peterson	Amputation 1st,2nd,3rd & 4th fingers left hand.	900.00*
Mather "A" Shaft 256	Arvo Lammi	Fracture right ankle.	730.67
Humboldt 4	Ernest Anderson	Fracture both bones of left arm	216.00*
Hawkins 42	Earl Barsness	Fracture right great toe	971.78

*Payments still being made.

WELFARE DEPARTMENT

11.

c. GROUP INSURANCE (Continued)

The following death claims were paid during the period from March 1, 1954 through December 31, 1954.

Name	Mine	Date of Death	Amount of Insurance
Werner R. Lukkonen	Bunker-Hill Mine	3-13-54	5000.00
Max M. Roy	Bunker-Hill Mine	9-23-54	2500.00
Lawrence LaParche	Cambria-Jackson Mine	3-27-54	5000.00
Theodore Palomaki	Cambria-Jackson Mine	5-31-54	5000.00
Eiler Anderson	Cambria-Jackson Mine	9-18-54	5000.00
Alfred Fredin	Cliffs-Shaft Mine	10-18-54	5000.00
Rudolph Franson	Cliffs-Shaft Mine	11-14-54	5000.00
Stanley Corlett	Cliffs-Shaft Mine	12-1-54	2500.00
William Hebert	Cliffs-Shaft Mine	11-30-54	5000.00
Conrad W. Rosendale	General Roll	5-1-54	5000.00
Henry Wheeler	General Storehouse	8-22-54	5000.00
Gordon Cornish	General Storehouse	10-22-54	5000.00
Joseph Perrault	Lloyd Mine	11-15-54	2500.00
Percy Evans, Sr.	Maas Mine	7-5-54	5000.00
Julius Hedstrom	Maas Mine	11-18-54	5000.00
Eino A. Syrjala	Mather Mine "A" Shaft	5-30-54	5000.00
Andrew J. Filizetti	Mather Mine "B" Shaft	6-5-54	5000.00
Walter Tuominen	Mather Mine "B" Shaft	4-10-54	7500.00
Ernest G. Harris	Inactive	3-1-54	2500.00
Herbert Blomquist	Inactive	3-7-54	5000.00
John C. Whitford	Inactive	3-2-54	1250.00
John W. Carlson	Inactive	3-3-54	750.00
Beatrice A. Pryor	Inactive	5-1-54	1250.00
August Jokinen	Inactive	5-6-54	2500.00
Fred Staples	Inactive	5-16-54	2500.00
William H. Kennaugh	Inactive	5-31-54	750.00
Frank Arrieri	Inactive	6-6-54	750.00
Thomas Atwell	Inactive	5-26-54	500.00
Henry R. Carter	Inactive	6-24-54	500.00
Martin Anderson	Inactive	7-13-54	500.00
Henry C. Scarffe	Inactive	7-25-54	6250.00
Victor Lindberg	Inactive	6-23-54	500.00
William Jenkin	Inactive	8-23-54	1250.00
Jacob Korpi	Inactive	6-30-54	500.00
Gust E. Kuisti	Inactive	9-15-54	1250.00
Nels Luoma	Inactive	10-9-54	1250.00
Andrew E. Elgland	Inactive	11-5-54	500.00
Wilfred J. Manning	Inactive	11-19-54	1250.00
Sam Kivisto	Inactive	11-14-54	2500.00
Anthony Lavelle	Inactive	11-19-54	750.00

11.

c. GROUP INSURANCE (Continued)

The following statement shows the amount of claims paid under the group insurance and hospitalization plan during the 10-month period from March 1, 1954 to December 31, 1954.

	Hospitalization	Health & Accident	Death Claims	Total
Bunker-Hill	20,026.16	6,355.73	7,500.00	33,881.89
Cambria-Jackson	9,117.25	2,340.02	15,000.00	26,457.27
Cliffs-Shaft	24,982.38	12,241.27	17,500.00	54,723.65
Cleveland Roll	1,528.51	55.71		1,584.22
General Roll	14,830.29	3,595.73	5,000.00	23,426.02
Electric Power Dept.	2,657.68	304.29		2,961.97
General Storehouse	10,587.01	4,443.28	10,000.00	25,030.29
Inactive			34,750.00	34,750.00
Lloyd	6,381.86	2,065.71	2,500.00	10,947.57
Maas	16,771.76	8,738.57	10,000.00	35,510.33
Miscellaneous	1,663.12	38.57		1,701.69
Ohio	2,928.75	4.29		2,933.04
Spies	3,252.18	955.71		4,207.89
Total - C.C.I. Co.	114,726.95	41,138.88	102,250.00	258,115.83
Mather Mine "A" Shaft	32,039.67	13,055.96	5,000.00	50,095.63
Mather Mine "B" Shaft	28,343.14	7,395.70	12,500.00	48,238.84
Total-Negaunee Mine Co.	60,382.81	20,451.66	17,500.00	98,334.47
Humboldt Mining Co.	4,747.14	1,332.85		6,079.99
Total-Michigan Dist.	179,856.90	62,923.39	119,750.00	362,530.29
Bargaining Unit	153,688.61	58,127.68	96,500.00	308,316.29
Sal. & Non-Barg.Unit	26,168.29	4,795.71	23,250.00	54,214.00
	179,856.90	62,923.39	119,750.00	362,530.29
Number of Claims				
Bargaining Unit	1,458	280	34	1,772
Salaried & Non-Barg.Unit	247	49	6	302
	1,705	329	40	2,074

WELFARE DEPARTMENT

11.

c. GROUP INSURANCE - Bargaining Units

A group insurance plan providing life, disability, hospitalization and surgical fee coverage was carried during the year without change with The Aetna Life Insurance Company of Hartford, Connecticut under policies 14,440, GS 14,440, and H 14,440. This plan was terminated on 12/31/1954. Originating on September 1, 1947 the benefits of the plan were liberalized on March 1, 1950 and June 1, 1952. Details of the plan may be found in the Annual Reports of 1947, 1950, 1952 and 1953.

Since March 1, 1950 separate accounting has been maintained for bargaining unit personnel in both premium computation and payment of claims. Premium rates for the period from March 1, 1954 through December 31, 1954 follow:

		Premium Rate
Life	Per month per thousand	$ 1.24
Disability	Per month per $1.00	.088
Employee Hospitalization Benefit	Per month per $1.00	.17
Employee Surgical Benefit	Per month per employee	.45
Dependent Hospitalization Benefit	Per month per $1.00	.374
Dependent Surgical Benefit	Per month per employee	1.66

The Company's contribution toward the premium cost of this group insurance is on a contractual basis of 2½¢ per hour actually worked by bargaining unit employees. The employees' contribution is at a fixed rate according to schedule.

Because of the reduction in working hours during the year, and poor experience with the hospitalization coverage, there was a deficit in the fund from which premiums were paid to the insurance company. To make up the deficit bargaining unit employees were assessed $4.00 per month from May through September.

Reference is made to the Annual Reports of 1936 and 1937 for a description of the Company's first group insurance plan which provided only life and disability coverage.

11.

c. GROUP INSURANCE - Non-bargaining Units

A group insurance plan providing life, disability, hospitalization and surgical coverage was carried for non-bargaining personnel with the Aetna Life Insurance Company of Hartford, Connecticut through November 30, 1954 under policies 14,440, GS 14,440 and H 14,440. Benefits and premium rates for this plan are detailed in the Annual Report of 1953.

A new group insurance plan for non-bargaining employees became effective December 1, 1954. It is carried with the Aetna Life Insurance Company under policy numbers 55,951, GS 55,951 and H 55,951 and provides life, disability, hospitalization and surgical coverage.

The benefits of the plan are as follows:

1. Life Insurance - From $3500 to $20,000 according to schedule based on annual earnings.
2. Disability from sickness or accident - Weekly benefit of $40.00 for maximum period of 26 weeks with provision for workmen's compensation make-up.
3. Hospitalization for employee and dependent - Semi-private service for maximum of 120 days with $10 per day private room benefit. Unlimited incidentals. $100 maximum maternity benefit.
4. Surgical Fee benefits for employee and dependent - According to schedule with maximum of $200.

The schedule of life insurance and employee contributions follows:

Class	Life Insurance	Employee Contributions	
		Without Dependents	With Dependents
1	$3500	4.34	7.16
2	5000	5.09	7.91
3	6250	5.72	8.54
4	7500	7.09	9.91
5	10,000	8.59	11.41
6	12,500	10.09	12.91
7	15,000	11.59	14.41
8	17,500	13.09	15.91
9	20,000	14.59	17.41

11.

c. GROUP INSURANCE - Non-Bargaining Units (Cont'd.)

The annual earnings schedule governing the class of life insurance carried follows:

Class	Basic Annual Earnings Rate
1.	Less than $3,600
2.	$3,600 but less than $4,800
3.	4,800 but less than 6,000
4.	6,000 but less than 7,500
5.	7,500 but less than 10,000
6.	10,000 but less than 12,500
7.	12,500 but less than 15,000
8.	15,000 but less than 17,500
9.	$17,500 and over.

The rates charged by the Insurance Company for computing the total premium charge are as follows:

Life	Per month per $1,000	$1.01
Life-retired	Per month per $1,000	6.12
Disability	Per month per Employee	3.88
Employee Hospitalization and surgical	Per month per Employee	2.98
Dependent Hospitalization and Surgical	Per month per Employee	7.525

Upon retirement the non-bargaining employee may carry fifty percent of his life insurance without further contribution on his part. He may also carry the hospitalization and surgical coverage by paying the total premium cost.

11.

c. GROUP INSURANCE (Continued)

The following table shows a tabulation from the group insurance premium statements prepared by this office of the total premium cost units of our group insurance plan. The tabulation for the bargaining units covers the period from March 1, 1954 through December 31, 1954 and that for the non-bargaining units covers the period from March 1, 1954 through November 30, 1954. The ending dates of these two periods resulted from major revisions in both the bargaining and non-bargaining plans whereby new policy years have been established.

Unit	Premium Cost Bargaining Units	Non-Bargaining Units
Bunker-Hill	41,937.87	4,368.46
Cambria-Jackson	23,755.85	2,207.73
Cliffs-Shaft	64,697.36	5,397.34
General Storehouse & Shops	21,672.85	777.43
Electric Power Department	5,774.95	798.92
General Payroll-Ishpeming Office	-	41,814.67
Inactive	5,091.86	1,892.30
Lloyd	14,810.13	1,435.23
Maas	42,368.03	3,247.52
Miscellaneous Payroll-Cliffs Shaft Laboratory	4,644.74	-
Ohio	5,830.96	634.81
Spies	11,782.33	1,342.26
Tilden	54.96	-
Mather Mine "A" Shaft	74,782.65	7,907.72
Mather Mine "B"Shaft	65,243.62	6,908.32
Humboldt	10,614.26	822.30
TOTALS	393,062.42	79,555.01

WELFARE DEPARTMENT

23.

a. PENSION SYSTEM (Continued)

Retirement Payrolls

The purpose of the Retirement Payrolls was to supplement Social Security benefits being paid to our retired employees under that program. The payrolls were initiated on March 16, 1939 and were the major retirement plan of the Company through February 1950 when the Pension Plan of March 1, 1950 came into being. This latter Pension Plan has all but eliminated additions to the Retirement Payrolls, and any additions now are in the nature of special cases.

A retired employee's Social Security benefit was originally supplemented by $10.00 per month over The Retirement Payrolls. Beginning with July 1948 this amount was increased by $10.00 per month in all cases so that the usual allowance over the payroll was $20.00 per month. Our retired employees carry fifty per cent of the life insurance in force on their lives at the time of their retirement. Since March 1, 1950 this is done without cost to the employee.

There were no additions to the Mining Department Retirement Payroll during 1954.

Fourteen retired employees being paid over this Payroll were dropped during 1954:

John Rosten	Number 343	25.00	Transferred to Pension Plan 2/1/54
August Norell	187	20.00	Died 2/6/54
John W. Carlson	200	20.00	" 3/3/54
William Kennaugh	48	20.00	" 5/31/54
Thomas Atwell	85	20.00	" 5/27/54
Frank Arrieri	139	20.00	" 6/6/54
Victor Lindberg	109	20.00	" 6/23/54
Jacob Korpi	176	20.00	" 6/30/54
Elias Maki	240	20.00	Dropped from Payroll 6/30/54
Martin Anderson	183	20.00	Died 7/12/54
William Jenkin	280	20.00	" 8/23/54
Andrew Elgland	292	20.00	" 11/5/54
Anthony Lavelle	90	20.00	" 11/19/54
James Blee	133	20.00	" 12/15/54

Two Retirement Payrolls are prepared in this office to handle payments to Minnesota retired employees, one for the Canisteo Mine and the other for the Mesaba-Cliffs Mining Company - Mining Department.

There were no additions or deaths on the Canisteo Mine Retirement Payroll during the year.

WELFARE DEPT. ANNUAL REPORT YEAR 1954

23.

a. PENSION SYSTEM (Continued)

Retirement Payrolls (Cont'd.)

There were no additions to the Retirement Payroll of The Mesaba-Cliffs Mining Company - Mining Department during 1954. There were four deaths as follows:

Frank Marcella	Number 10	$20.00	Died 1/31/54
Peter Hecimovich	12	20.00	" 2/18/54
Frank Cook	20	20.00	" 4/9/54
William Saw	7	20.00	" 12/2/54

A resume of the 1954 Retirement Payrolls follows:

Number of Mining Department Retired Employees 12/31/1953	151
Number of Mining Department Retired Employees 12/31/1954	137
Total Expenditure to above employees for year 1954	37,888.84
Number of Canisteo Mine Retired Employees 12/31/1953	3
Number of Canisteo Mine Retired Employees 12/31/1954	3
Total Expenditure to above employees for year 1954	720.00
Number of Mesaba-Cliffs Mng. Co. Retired Employees 12/31/53	21
Number of Mesaba-Cliffs Mng. Co. Retired Employees 12/31/54	17
Total Expenditure to above employees for year 1954	4,440.00
Total Number of Retired Employees 12/31/1953	175
Total Number of Retired Employees 12/31/1954	157
Total Expenditure to retired employees for year 1954	43,048.84

WELFARE DEPARTMENT

WELFARE DEPT. ANNUAL REPORT YEAR 1954

23.

a. PENSION SYSTEMS (Continued)

Pension Plan for Salaried Employees

The Pension Plan for Salaried Employees which became effective on 1/1/1951 was revised effective November 1, 1954, to correspond with the hourly-rate Pension Plan of 3/1/1950. The revisions may be found in this report under the heading "Pension Plan of March 1, 1950."

This Department handles the initial processing of all pension applications under this Plan and submits them to the Pension Committee in Cleveland for final disposition.

During the year the following pensions were granted under the Plan:

Name	Former Occupation	Eff.Date	Gross	Deductions		Net
George Quick (Age)	Mining Captain Agnew Mine	1-1-54	96.00	SS CR	$5.00 35.85	-
William H. Thomas (Age)	Mine Clerk Cliffs Shaft Mine	5-1-54	209.15	SS CR	$5.00 82.02	42.00
Edwin R. Jacka (Age)	Diamond Drill Foreman Geological Dept.	5-1-54	189.67	SS CR	$5.00 10.91	94.00
Robert J. Veale (Age)	Chief of Police	6-1-54	173.20	SS CR	$5.00 65.77	22.00
Thomas J. Roberts (Age)	Assistant Chemist Cliffs-Shaft Lab.	5-1-54	124.15	SS CR	$5.00 48.33	-
Albert H. Decaire (Age)	Surface Foreman Cliffs-Shaft Mine	6-1-54	185.65	SS CR	$5.00 65.43	35.00
Julien Payen (Age)	Landscape Foreman	5-1-54	100.00	SS CR	$2.80 32.88	-
John George Johnson (Age)	Senior Clerk Electric Power Dept.	7-1-54	182.88	SS CR	$5.00 77.55	21.00
George S. Bowden (Age)	Mine Clerk Negaunee Shaft	7-1-54	167.91	SS CR	$5.00 84.99	-
Archie V. Minnear (Age)	Draftsman Geological Dept.	7-1-54	100.00	SS CR	$0.80 43.01	-
Arthur E. Johnson (Age)	Inventory Clerk General Storehouse	7-1-54	100.00	SS CR	$5.00 26.33	-
Peter Bessola, Sr. (Age)	Timber Foreman Maas Mine	6-15-54	143.77	SS CR	$5.00 66.59	-

WELFARE DEPT. ANNUAL REPORT YEAR 1954

23.

a. PENSION SYSTEMS (Continued)

Pension Plan for Salaried Employees (Cont'd.)

Name	Former Occupation	Eff.Date	Gross	Deductions		Net
Jethro Collins (Age)	Shift Boss Maas Mine	6-15-54	96.67	SS CR	85.00 69.60	-
John W. Hult (Age)	Janitor General Storehouse	7-1-54	72.33	SS CR	85.00 7.47	-
Matthew C. Renowden (Age)	Mining Captain Cliffs-Shaft Mine	9-1-54	235.53	SS CR	85.00 90.15	60.00
Charles W. Urquhart (Age)	Equipment Inventory Clerk General Storehouse	9-1-54	68.33	SS CR	85.00 31.28*	-
Kaarle Koski (Age)	Watchman McClure Dam	9-1-54	100.00	SS CR	85.00 44.55*	-
Henry C. Endahl (Age)	Chief Operator AuTrain Plant	9-1-54	106.31	SS CR	85.00 52.46*	-
Robert P. Stanaway (Age)	Assistant Chemist Cliffs-Shaft Lab.	9-1-54	76.33	SS CR	85.00 11.17*	-
John Glanville (Age)	Underground Foreman Cliffs-Shaft Mine	11-1-54	188.94	SS CR	85.00 79.39	25.00
John R. Nicholls (Age)	Assistant Chemist Cliffs-Shaft Lab.	12-1-54	141.01	SS CR	85.00 52.03	4.00
W. Arthur Bennett (Age)	Analysis Clerk Shipping Dept.	12-1-54	140.00	SS CR	85.00 71.79*	-

Code letters for deductions: SS - Social Security
CR - Contributory Retirement-Company proportion
* Represents total annuity payment - Company proportion not known.

The following pensions were discontinued during the year:

Henry C. Scarffe (Disability)	Ret.#S-4D	Died 7/25/54
Fred Staples (Age)	Ret.#-Not known	Died 5/16/54

WELFARE DEPARTMENT

WELFARE DEPT. ANNUAL REPORT YEAR 1954

23.

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-sixth year of its operation was completed in 1954.

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 1954. This includes Frank Vierela who was formerly on the Republic Mine Department Pension Payroll. Total expenditure over the payroll for 1954 was $936.00.

WELFARE DEPARTMENT

23.

a. PENSION SYSTEM (Continued)

The table below shows the pension payments for the Mining Department and Holmes Mine Department combined for the years 1908 through 1954. The Holmes Mine Department payroll became inactive with the death of its last pensioner on April 23, 1949.

Year	Old Age	Widows and Orphans	Total
1908 thru 1943	776,130.14	22,547.00	798,677.14
1944	8,485.25	-	8,485.25
1945	7,446.32	-	7,446.32
1946	5,648.60	-	5,648.60
1947	4,156.68	-	4,156.68
1948	3,840.68	-	3,840.68
1949	3,260.68	-	3,260.68
1950	2,400.68	-	2,400.68
1951	1,438.78	-	1,438.78
1952	1,076.00	-	1,076.00
1953	796.00	-	796.00
1954	936.00	-	936.00
	$815,615.81	22,547.00	$838,162.81

Includes payment of $2,500.00 made by the Cleveland Office in 1930.

Republic Mine Department

This payroll is inactive. During its active years - 1920 through June 1953 - a total of $149,689.04 was expended over the Republic Mine Department Pension Payroll.

Land Department

This payroll is inactive. During its active years - 1927 through June 1953 - a total of $6,836.88 was expended over the Land Department Pension Payroll.

Furnace Department

This payroll became inactive in 1948. During the years when it was active - 1910 through 1948 - a total of $66,155.22 was expended over the Furnace Department Pension Payroll.

23.

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 effective November 1, 1954. It provides for an age pension for retiring bargaining unit employees who are at least 65 years of age with a minimum of 15 years of continuous service. The formula for computing the gross pension is as follows: one per cent of the average monthly wage (as 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.

23.

a. PENSION SYSTEMS (Continued)

Pension Plan of 3/1/1950 (Con't.)

During the year the following age pensions were granted:

Name	Mine	Eff.Date	Gross Pension	Soc. Sec.	Net Pens.
Louis Royea	General Sthse.	2-1-54	100.00	82.00	18.00
Charles H. Collycott	Bunker-Hill	3-1-54	106.92	85.00	22.00
Nestor Sarkela	Maas	3-1-54	100.00	85.00	15.00
Godfrey Anderson	Negaunee Shaft	1-1-54	90.68	85.00	6.00
John E. Kenney	General Shops	4-1-54	147.97	85.00	63.00
John Koski	Lloyd	2-1-54	157.46	85.00	72.00
Edward L.Jackse	Agnew	4-1-54	97.00	85.00	12.00
Alfonso Langmead	Bunker-Hill	5-1-54	108.11	85.00	23.00
John Macario	Cambria-Jackson	5-1-54	100.00	85.00	15.00
John Chiri	Maas	5-1-54	108.77	85.00	24.00
Joseph LaBeau	Cliffs-Shaft	8-1-54	69.67	76.50	-
Gust E. Kuisti	General Sthse.	5-1-54	100.00	85.00	15.00
Antti Wesa	Cliffs-Shaft	5-1-54	138.83	85.00	54.00
John Tamminen	Bunker-Hill	6-1-54	116.38	85.00	31.00
John A. Kutchie	Maas	6-1-54	128.34	85.00	43.00
Chester Weinberg	General Sthse.	6-1-54	150.87	85.00	66.00
John Kujala	Bunker-Hill	6-1-54	153.05	85.00	68.00
John Alrick Johnson	Bunker-Hill	5-1-54	104.37	85.00	19.00
Richard Yelland,Sr.	Cambria-Jackson	5-1-54	131.35	85.00	46.00
Christian L.Peterson	Bunker-Hill	6-1-54	100.00	85.00	15.00
Frank A. Mattson	Cambria-Jackson	6-1-54	135.85	85.00	51.00
Mike Zekovich	Hawkins	8-1-54	68.34	76.00	-
Steve Niksich	Hawkins	8-1-54	69.00	74.20	-
Gust J.Leaf,Sr.	Bunker-Hill	7-1-54	100.00	85.00	15.00
David Hanninen	General Sthse.	5-1-54	71.68	82.90	-
John A.Williams	General Sthse.	6-1-54	68.32	67.20	1.00
Frank Lind	Maas	6-1-54	82.00	85.00	-
Jacob Piirainen	Maas	6-1-54	68.00	85.00	-
George Coyanovich	Sargent	3-1-54	96.68	80.50	16.00
John Rokola	Hawkins	7-1-54	98.00	85.00	13.00
Mike Cvitkovich	Sargent	9-1-54	82.00	62.30	20.00
Charles Olson	Hawkins	3-1-54	96.68	85.00	12.00
Richard Lucas	Lloyd	9-1-54	71.00	84.10	-
John W. Larson	Bunker-Hill	11-1-54	145.00	85.00	60.00
Gustav Anderson	Bunker-Hill	11-1-54	140.00	85.00	55.00
Harry Johns	Maas	11-1-54	140.00	85.00	55.00
William H. Palmer	Cliffs-Shaft	12-1-54	140.00	85.00	55.00
Peter J. Audette	Hawkins	11-1-54	129.65	85.00	45.00
John Johnson	Hawkins	12-1-54	129.83	85.00	45.00
John S. McIntyre	Cliffs-Shaft	12-1-54	140.00	85.00	55.00
Louis Sarasin	Electric Power	12-1-54	140.00	85.00	55.00
David Terzaghi	Bunker-Hill	12-1-54	131.83	85.00	47.00
Ambrogio Migliarini	Bunker-Hill	12-1-54	140.00	85.00	55.00

WELFARE DEPT. ANNUAL REPORT YEAR 1954

23.

a. PENSION SYSTEMS (Continued)

Pension Plan of 3/1/1950 (Cont'd.)

Name	Mine	Eff.Date	Gross Pension	Soc.Sec.	Net Pens.
Garfield Rice	Bunker-Hill	12-1-54	140.00	85.00	55.00
Richard Pascoe	Maas	12-1-54	140.00	85.00	55.00
Jalmer Pirkola	Cliffs-Shaft	12-1-54	140.00	85.00	55.00
George Jandron	Cliffs-Shaft	12-1-54	140.00	85.00	55.00
Viktor L. Salonen	Hawkins	12-1-54	129.83	85.00	45.00
Joseph Holman	Negaunee Mine	11-1-53	100.00	68.80	31.00
Frank B. Jarvi,Sr.	Negaunee Mine	11-1-53	100.00	68.70	31.00
Charles Koski	Negaunee Mine	3-1-54	100.00	62.30	38.00
Edmund Nault	Mather "A" Shaft	11-1-54	114.33	85.00	29.00
James Hansen	Mather "A" Shaft	11-1-54	140.00	85.00	55.00
Otto Korhonen	Negaunee Mine	11-1-54	140.00	85.00	55.00
George Flack	Mather "A" Shaft	11-1-54	140.00	85.00	55.00
Guido Della Corte	Athens	1-1-54	104.13	85.00	19.00
John W. Kurikkala	Athens	11-1-54	128.66	85.00	44.00
Tom Knudson	Holman-Cliffs	1-1-54	81.32	85.00	-
George A. Apitz	Hill-Trumbull	4-1-54	100.00	85.00	15.00
John Trembath	Hill-Trumbull	11-1-54	143.55	85.00	59.00
Morten Mortenson	Hill-Trumbull	11-1-54	114.83	85.00	30.00
Grant Hess	Holman-Cliffs	12-1-54	131.00	85.00	46.00

The following disability pensions were approved during the year:

Name	Mine	Eff.Date	Gross Pension	Net Pension
Earl Rule	Negaunee Shaft	7-1-53	101.10	101.00
Joseph E. LaBeau	Cliffs-Shaft	5-1-54	50.00	50.00
Harry Johns	Maas	6-1-54	117.14	117.00
Mike Zehovich	Hawkins	5-1-54	50.00	50.00
Steve Niksich	Hawkins	3-1-54	50.00	50.00
Gustaf E.Sundberg	Cliffs-Shaft	9-1-54	135.37	135.00
Sam Latkovich	Canisteo	9-1-54	57.22	57.00
William M. Lund	Gen. Storehouse	9-1-54	91.35	91.00
John Bakkala	Athens	5-1-54	104.00	104.00

WELFARE DEPARTMENT

WELFARE DEPT. ANNUAL REPORT YEAR 1954

23.

a. PENSION SYSTEMS (Continued)

Pension Plan of 3/1/1950 (Cont'd.)

Pensions as follows were discontinued:

Name	Mine	Pension No.	
Joseph E. LaBeau	Cliffs-Shaft	CC-166D	Converted to age pension effective 8/1/54.
Gust E. Kuisti	General Storehouse	CC-167	Died 9/15/54
Harry Johns	Maas	CC-171D	Converted to age pension effective 11/1/54.
Mike Zekovich	Hawkins	CC-178D	Converted to age pension effective 8/1/54
Steve Niksich	Hawkins	CC-179D	Converted to age pension effective 8/1/54
Nels Luoma	Cliffs-Shaft	CC-115	Died 10/9/54
Beatrice A. Pryor	Misc. Payroll	CC-121	" 5/1/54
Ernest Palola	Cambria-Jackson	CC-93	" 6/24/54
Oscar E. Engstrom	Canisteo	CC-104	" 6/9/54
Ernest G. Harris	Cliffs-Shaft	CC-106D	" 3/1/54
Mike Cvitkovich	Sargent	CC-76D	Converted to age pension effective 9/1/54
Wilfred J. Manning	Mather "A" Shaft	NM-15	Died 11/19/54
Sam Kivisto	Mather "A" Shaft	NM-18	" 11/14/54
Herbert J. Blomquist	Mather "A" Shaft	NM-21D	" 3/7/54
John Bakkala	Athens	AM-28D	Converted to age pension effective 1/1/55.
John W. Kurikkala	Athens	AM-25D	Converted to age pension effective 11/1/54.
John G. Ranta	Hill-Trumbull	MC-3	Died 10/21/54
Dayton F. Scott	Hill-Trumbull	MC-12	" 7/11/54

WELFARE DEPARTMENT

23.
o. INCAPACITATED EMPLOYEES (DONATION PAYROLL)

During the year payments were continued to certain men who did not have sufficient service to bring them within the provisions of the Pension Plan of 1/1/1909 but whose cases had merit and to other men who retired under Social Security but had so little employment under that system that their benefits were inadequate. These payments were made over the Donation Payroll. Some of these men were totally disabled through mine accidents while others became incapacitated from illness or disease and required assistance because of large families. There have been very few additions to the payroll over the past few years, and the payroll is employed now only to take care of very unusual cases.

On February 1, 1947 direct relief in the form of grocery, clothing, and fuel orders was discontinued as a regular practice, and allowances over the Donation Payroll were granted in their place. At the close of 1954 only one such recipient - Mrs. Johanna Forstrom - remains on the payroll.

The Mining Department Donation Payroll included 14 people on January 1, 1954 and on December 31, 1954 there were 13 payees, a net loss of one. The total expenditure over this payroll for the year was $5,008.80.

There were no additions to the Mining Department Donation Payroll during the year.

There was one death on the Mining Department Donation Payroll during 1954:

Joseph Thomas Monthly allowance - $75.00 Died 12/15/54

The Holmes Mine Department Donation Payroll became inactive on June 30, 1953. During its active years - January 1932 through June 1953 - a total of $18,920.92 was expended over the Holmes Mine Department Donation Payroll.

After being granted, the Furnace Department donations were paid originally by the Furnace Department itself and later by the Cliffs-Dow Chemical Company. By direction from Cleveland on September 1, 1937 the donations were paid by this office over the Furnace Department Donation Payroll. The payroll became inactive in August 1950 with the death of its last payee, and it will remain inactive. During its active years - September 1937 through August 1950 - a total expenditure of $11,910.00 was made over the Furnace Department Donation Payroll.

The Mesaba-Cliffs Mining Company Donation Payroll remained inactive during the year. The last payment over this payroll was made in March 1948. From the date of origin, January 1, 1946, through March 1948 a total expenditure of $795.00 was made over The Mesaba-Cliffs Mining Company Donation Payroll.

23.

o. INCAPACITATED EMPLOYEES (DONATION PAYROLL) Con't.

There are four widows receiving Donation payments, all on the Mining Department Payroll. Two of these widows, Mrs. J. H. Tregoning and Mrs. Fiina Kampinen, have been granted regular donations; one, Mrs. Johanna Forstrom appears on the payroll because of the conversion of direct aid orders to monetary allowances; and one, Mrs. Lyda M. G. Turgeon, is being paid over this payroll rather than under the Pension Plan of 3/1/1950.

23.

b. REPUBLIC MINE FUNDS

Our annual report for 1949 should be consulted for any information desired as these funds are no longer in existance.

c. SUSPENSE FUNDS

Since this fund has been closed out, we recommend referring to our annual report of 1949 for any desired information.

d. VISITING NURSES

The visiting nurses services program which was established on May 1, 1908 in Ishpeming and in Negaunee during September, 1912, was discontinued June, 1954.

i. SAFETY WORK

The Central Safety Committee carried out its usual safety program throughout the year 1954. The Committee meets regularly and Mr. Stromquist, Safety Director, presents a review of our accidents previous to the meeting and each case is gone over carefully. A study of every accident is made and at the meeting suggestions are made to lessen or eliminate, if possible, the accidents in the future. Each accident is definitely classified.

Central Safety Meetings were held on the following dates in 1954:

January 22
February 26
March 19
April 15
May 13
June 17
July 22
August 26
September 30
October 12 and 26
November 1
December 10

The roster of the Central Safety Committee as of December 31, 1954 was as follows:

Grover J. Holt
J. S. Westwater
S. W. Sundeen
H. H. Korpinen
H. C. Swanson
T. A. Kauppila
W. R. Atkins
Onnie Marjama
C. R. Sundeen
G. A. Dawe
R. L. Tobie
K. C. Olson
J. M. Haivala
G. M. Waldie, M.D.
B. E. Moore, M.D.
H. W. Sundberg
J. D. Preston
E. D. Cory
R. G. Schaal
Grant Hollett
H. W. Rembold
L. J. Erck
Max Madsen
R. M. DeGabriele
O. E. Johnson
J. S. Bowen
W. F. Gries
W. E. Johnson
Arne Andelin
B. H. Peterson
Keith Busby
E. W. Lindroos
A. J. Stromquist
T. W. Hill
E. G. Bengry
R. H. Lukkarinen

23.

j. MEDICAL SERVICE

The contract is still in effect which the Company has with Doctors A. W. Erickson of Ishpeming and R. L. Paine of Negaunee, for the coverage and care of all occupational injuries and accidents. This system has proved to be satisfactory to the Company and its employees.

IRON RIVER HOSPITAL

During the year, several visits were made at the General Hospital of the Iron River District at Stambaugh, Michigan. The annual meeting was attended by Mr. John M. Haivala, Superintendent of the Spies Mine at Iron River, in the absence of the Superintendent of the Welfare Department. The Superintendent of the Welfare Department represents the Company on the Board of Trustees. The General Hospital of the Iron River District is managed by a Board of Trustees representing the various stockholding mining companies and provides medical and hospital services to our employees at the Spies Mine at Iron River, Michigan. Its administration and operation is very effective.

Dr. L. E. Irvine continues to furnish the necessary medical attention to our employees at the Spies Mine. Physical examinations, both pre-employment and periodical, are performed by Dr. Irvine. Dr. Addison at Crystal Falls, who is associated with the Hospital there, provides medical care for some of our employees who request his services.

PHYSICAL EXAMINATION OF EMPLOYEES

Dr. George McL. Waldie, Director of our Industrial Hygiene Department, continues to perform the physical examinations of our employees and to counsel with employees regarding physical deficiencies and in such special cases requiring consideration and study. Dr. Bert Moore assists Dr. Waldie.

INDUSTRIAL HYGIENE DEPARTMENT

This department was organized on April 1, 1939 and continues to be under the capable direction of Dr. George McL. Waldie, who is assisted by Dr. Bert Moore. As previously stated, the physical examinations of employees are performed in this department. A follow-up program is also carried on in cases where physical examinations reveal an employee to have some deficiency. The records of the Industrial Hygiene Department contain much valuable information regarding the physical condition of all employees.

The Industrial Hygiene Department furnishes the same services to employees of the Inland Steel Company and the North Range Mining Company on the Marquette and Menominee Ranges, as well as to employees of Jones & Laughlin Steel Company.

Dr. Waldie submits monthly reports and periodic reports covering the work in this department.

23.

j. INDUSTRIAL HYGIENE DEPARTMENT (CONT'D.)

Up until 1945, all x-ray films were sent to Saranac for reading and interpretation. The Saranac contract was not renewed at that time. Since the fall of 1945, x-ray films have been read and interpreted by Dr. Waldie.

The total of examinations made through December, 1954 is as follows:

	1954	Total
Cleveland-Cliffs Iron Company	1,785	22,915
Negaunee Mine		4,098
Mather Mine "A" Shaft	562	4,773
Mather Mine "B" Shaft	478	2,372
Athens Mine		4,408
Electric Power Department	53	1,014
Land Department	2	51
Inland Steel Company	198	5,230
Pickands Mather		149
Jones & Laughlin Steel Corp.	50	315
Oliver Iron Mining Company		725
Marquette County Road Commission		10
Hercules Powder Company		391
Humboldt Mine	76	128
Other Companies - Miscellaneous		3,118
TOTAL	3,204	49,697

k. COMMUNITY HEALTH

We are pleased to report that the general health conditions existing in Marquette County in 1954 were excellent. There were no serious epidemics or any loss of time at the mines because of illness. We wish to point out particularly the fine service rendered by the Morgan Heights Sanatorium and its Superintendent, Dr. James A. Acocks. Dr. Acocks has conducted a tuberculosis discovery program which is probably not matched anywhere in the State.

Each of the three cities in Marquette County employ a health officer and a full time school nurse. The City of Marquette also has a full time nurse whose services are available mostly to township districts. The townships also have health officers.

City health officers in Marquette County are:

W. A. Corcoran, M. D. - Ishpeming
R. L. Paine, M. D. - Negaunee
A. L. Swinton, M. D. - Marquette.

23.
k. COMMUNITY HEALTH (CONT'D.)

The Northern Michigan Children's Clinic at Marquette, now under the supervision of St. Luke's Hospital continues to serve children throughout the Northern Peninsula.

Bay Cliff Health Camp at Big Bay in Marquette County had another very successful summer camp season in 1954. This is the 20th year of the camp's service to children in Northern Michigan. This is a free camp and runs for approximately seven weeks during which time children requiring special attention in various deficiencies are cared for at the camp. In the group are convalescent poliomyelitis cases, cardiac and rheumatic heart, children having speech and hearing defects, diabetics, and children suffering from malnutrition. The Superintendent of the Welfare Department is Chairman of the Board of Directors of Bay Cliff Health Camp, which position he has occupied now for approximately twenty years.

23.
m. RELIEF WORK

Direct relief is extended only in emergency cases. There are no regular recipients of direct relief.

The following is a statement of assistance rendered in 1954. This statement does not include cash assistance.

	Ishpeming	Negaunee	Total
January		27.40	27.40
February	15.00	20.60	35.60
March		21.20	21.20
April		21.00	21.00
May		64.46	64.46
June		21.00	21.00
July		-	-
August	12.00		12.00
September	-	-	-
October	-	-	-
November		15.00	15.00
December	25.00	15.00	40.00
TOTAL	$ 52.00	$205.66	$257.66

n. EMPLOYMENT

The Welfare Department keeps in contact with the Employment Office which is under the supervision of Mr. H. W. Sundberg. When a question arises regarding the employment of a certain individual, the case is reviewed and discussed. Every attempt is made to protect the best interest of the Company in connection with employment.

23.

q. IMPROVEMENT WORK

Mr. Peter DeRoche succeeded Mr. Julian Payen who was in charge of our program of improvement of grounds. Mr. Payen retired on May 1, 1954. Mr. DeRoche has had several years of experience under the supervision of Mr. Payen and he has proved well qualified and capable of filling this position.

s. COMMUNITY SERVICE WORK

As mentioned in previous annual reports, the American Legion building in Negaunee is leased from our Company. We continue to keep the building in good condition and inspections are made regularly. Many community activities are held in the Negaunee Legion Clubhouse.

A large number of fraternal organizations are supported by the people of this community. Many of these fraternal orders maintain their own clubrooms and much of the activity of the community is centered around these organizations.

u. OUTDOOR ACTIVITIES

Outdoor activities remain to be of great interest to this community. The Winter Sports Club, which maintains a clubhouse and skiing area north of Ishpeming, is a popular organization. The activities which are carried on at this area each winter draw interest and support from local people as well as from people of other parts of the country. The Winter Sports Club area is also used as a picnic ground during the summer and many outdoor meetings are held there.

The city of Ishpeming observed its centennial during July of 1954. During centennial week a Centurama pageant was presented each evening and thousands of people attended. Scenes of former years were depicted and many special events were held during the entire week. The Centurama Committee closed its centennial series of activities with all bills paid and with a small balance which was turned over to the Francis A. Bell Memorial Hospital.

The 67th Annual Ski Tournament of the Ishpeming Ski Club was held on February 21, 1954. Each year the enthusiasm for our annual ski tournament seems to increase. Several of our employees participate in the ski jumping.

v. THE MATHER INN

The Mather Inn, the most popular hotel in the Northern Peninsula, continues to provide fine service to the public. Each year its popularity increases and during 1954 many more civic and community organizations held their meetings in the different lounges of The Mather Inn.

23.

w. VARIOUS DEPARTMENTS AND ACTIVITIES

The Superintendent of the Welfare Department is serving his second term as President of the Michigan Tuberculosis Association. This assignment will come to an end in June of 1955. He also served the past two years as President of The Michigan Society for Crippled Children and Adults, Inc. The term expires in October of this year. In April, 1953, the Superintendent of the Welfare Department was elected a member of the Michigan State Board of Education. This is a six-year term which started on July 1, 1953.

The Superintendent of the Welfare Department continues to serve as a member of the Advisory Consultant Staff to the State Department of Public Instruction on community planning and programming. During the year he served as a member of the Survey Study Committee known as the Federal Study Committee on Welfare Grants in Aid to The States. This Committee is a sub-committee of the Intergovernmental Relations Committee which is chairmaned by Meyer Kestnbaum who is President of The Hart-Schaffner-Marx Company. The Federal Committee held about six meetings during 1954.

The employees of the Central Office held their annual Christmas Party on December 23, 1954.

x. POLICE DEPARTMENT

The Police Department is under the supervision of the Superintendent of the Welfare Department and is in direct charge of Mr. Emil Hoff, Chief. Conferences regarding police work and plant protection are often held with Mr. Hoff. A monthly report is submitted by Mr. Hoff. We feel that our police force furnishes efficient service to the Company and its employees. New men are carefully selected for this Department.

APPRECIATION

As Superintendent of the Welfare Department, I wish to express my appreciation for the cooperation, the guidance, and the understanding which has been given this Department by Mr. C. W. Allen, Vice President, former General Manager; Mr. Grover J. Holt, General Manager; Mr. J. S. Westwater, Manager of Michigan Mines and Mr. Ogden E. Johnson, Director, Industrial Relations.

The fine cooperation from Mr. A. J. Stromquist, Safety Director, and his staff is also appreciated.

We shall make every effort to maintain cooperation and efficiency within this Department and with those departments closely associated with it.

Geological
REPORT OF EXPLORATION DEPARTMENT FOR YEAR ENDING DECEMBER 31, 1954

Geological
The following is a report of the Exploration Department for the year 1954:

CONTENTS

This report has been prepared through the cooperative efforts of each of the staff members. The geologist in charge of each project prepared the summary of his assignment. The editorial board consisted of Gerald J. Anderson, Eric J. Rex and Burton H. Boyum.

I. STAFF

A. Distribution

As in the past, Ishpeming continued to be the headquarters and base from which the Exploration Department operated, Minnesota Exploration headquarters at the Hibbing office, while Canada centered around our Canadian Cliffs office at Port Arthur, Ontario.

On March 1st, Mr. E. L. Derby, Jr. retired as Chief Geologist to become Geological Consultant, with particular emphasis on Federal Taxation. Mr. Derby has served a long and fruitful career having directed the Company's exploration since September 1, 1916.

The year 1954 was a turning point in the growth of the Department. Messrs. Edwin Jacka and Archie Minnear retired and were not replaced. Mr. H. Walter Rembold was transferred from the Drilling Division to Superintendent of the Ohio and Tilden Mines. The Drilling Department was reorganized as the Michigan Drilling Division of the Exploration Department.

February 25, 1955

Mr. Gerald J. Anderson became Michigan District Geologist coordinating Michigan Exploration and Drilling activities. Mr. Boyum succeeded Mr. E. L. Derby, Jr. as Chief Geologist. Mr. Eric J. Rex became General Exploration Geologist, with particular emphasis on exploration other than Michigan and Minnesota. He served as Project Supervisor during the field season on the Albanel-Sandspit project. He was transferred from The Cleveland-Cliffs roll to the Canadian Cliffs organization from June 1st to December 31st.

Near the mid-year, a number of lay-offs were made in the Company in both salaried and hourly rate personnel. At this time, Messrs. Harold Boback, Robert Mount, Geologists, Sidney Holman, Coreroom Technician and Ray Leverton, Assistant Diamond Drill Clerk, were laid off. We were able to employ these men as temporary field assistants in Michigan until September.

Professor W. A. Longacre, our Geophysical Consultant, was promoted to Head of the Physics Department at the Michigan College of Mining and Technology, and was able to work only a short time with us, principally on the establishment of our geophysical prime stations relative to the investigations in the East-Central part of Michigan's Upper Peninsula.

Dr. Melville W. Bartley continued as Resident Manager for Canadian Cliffs, Ltd. with headquarters at Port Arthur, Ontario. He was assisted during the summer by Dr. James M. Neilson, Geological Consultant.

TABLE I

EXPLORATION DEPARTMENT

E. L. Derby, Jr., Consultant (A)
Burton H. Boyum, Chief Geologist (B)

Gerald J. Anderson, Michigan District Geologist (C)
Eric J. Rex, General Exploration Geologist
Rolland L. Blake, Minnesota Geologist (D)

DRILLING DIVISION

H. Walter Rembold (E)
Kenneth G. Maikkula, Drilling Engineer
Edwin Jacka, Foreman (F)
Swante Merrila, Foreman
Carl Ostlund, Foreman
Eino O. Kujala, Diamond Drill Clerk
Raymond A. Leverton, Ass't. Clerk (G)

GEOLOGISTS

David M. Bennett
Layton C. Binon
Harold C. Boback (H)
Donald L. Gilbert
James P. Meyers
Robert H. Mount (I)
Charles R. Pace, Jr.
Joseph L. Patrick
E. Richard Randolph

MICROSCOPY

Tsu Ming Han (N)

TECHNICIANS

George M. Olson, Chief
Robert W. Ryan
Sidney T. Holman (J)

DRAFTSMEN

Archie Minnear (K)
Pat S. Johnson
John V. Larson
Donald Nankervis

SECRETARIAL

Mrs. Belle Bloch, Office Secretary
Miss Dora Swanson, Secretary to Messrs. Derby, Sundeen, and Campbell
Douglas K. Pohlman (L)
Betty Morris Herman (M)

TABLE I CONT'D

CANADIAN CLIFFS, LTD.

Dr. Melville W. Bartley, Resident Manager

MICHIGAN FIELD ASSISTANTS, TEMPORARY

Harold C. Boback, Geologist
Robert H. Mount, "
Sidney T. Holman, Notekeeper
Raymond A. Leverton "

CONSULTANTS

Prof. William A. Longacre, Geophysics
Dr. James M. Neilson, Geology, Canada

MINNESOTA FIELD ASSISTANTS, TEMPORARY

Leonard P. Larson, E. M. Operator
Rufus Rantala, " " "
Tony M. Spanish, " " "

(A) Retired March 1, became Geological Consultant
(B) Became Chief Geologist March 1
(C) Became Michigan District Geologist March 1
(D) Granted leave of absence December 31, 1954
(E) Became Superintendent for Ohio & Tilden Mines March 1
(F) Retired May 1, 1954
(G) Laid off June 15, 1954
(H) Laid off June 15, 1954
(I) Laid off June 15, 1954
(J) Laid off June 15, 1954
(K) Retired June 22, 1954
(L) Drafted in Armed Forces May 28, 1954
(M) Married October 2, 1954
(N) Shared with Metallurgical Department

B. Man-Hour Summary

The following Table II is the hourly rate personnel carried on the General Storehouse payroll as members of the Exploration Drilling Department:

TABLE II

DISPOSITION OF HOURLY RATE PERSONNEL
GENERAL STOREHOUSE PAYROLL

Total Days Worked (4 Day Week)	- 217
Fridays, Saturdays & Sundays	- 142
Holidays	- 6
Days Lost to Strike, etc.	- 0
	365

Description	Total No. of Men	New Hire	Separations	Total Hours Worked	Statistical Men	Labor Cost
Runners	16	2	4	28,195.50	16.4	$ 64,425.17
Helpers	17	8	20	29,843.50	17.1	57,407.16
Recorder	1	0	1	1,036.00	.6	2,258.50
	34	10	25	59,075.00	34.1	$124,090.83

Table III shown below is a recapitulation of the various components of the Exploration staff:

TABLE III

MAN-HOUR SUMMARY

MICHIGAN

Exploration Drilling Division*	Hours	Men
Labor	59,075	34
Supervisors & Clerks	7,958	5
Sub-Total	67,033	39
Exploration Department		
Permanent	38,238.50	22
Temporary	2,867.50	8
Sub-Total	41,106.00	30

*Exclusive of mine employed personnel and drill contractors

MINNESOTA

Permanent	1,976	1
Temporary	282	3
Sub-Total	2,258	4

The following tabulation, Table IV, shows the distribution of the professional members of the Exploration Department by projects, during part or all of 1954:

TABLE IV

DISTRIBUTION OF PROFESSIONAL EXPLORATION STAFF
DURING PART OR ALL OF 1954

MICHIGAN

Operating Mines

Bunker Hill----------Joseph L. Patrick
Cambria-Jackson----------Layton C. Binon
Cliffs-Shaft----------James P. Meyers
Lloyd----------David M. Bennett
Maas----------Layton C. Binon
Mather Mine "A" Shaft-------Donald L. Gilbert
Mather Mine "B" Shaft-------Charles R. Pace, Jr.
Humboldt----------Robert H. Mount
Ohio----------Harold C. Boback
Republic----------Harold C. Boback
Spies----------David M. Bennett

TABLE IV CONT'D

Exploration Projects

Allen Exploration	E. Richard Randolph
Cascade East-End	"
Empire	"
Perkins	"
Section 11, 47-27	"
Imperial	David M. Bennett
McDermott	"
Glocke	"
D. M. & M.	"
Delta	"
Skews	"
Pioneer-Arctic	Layton C. Binon
Titan	Harold C. Boback

MINNESOTA - GENERAL

Burton H. Boyum
Rolland L. Blake (Resident)

CANADIAN CLIFFS, LTD.

Dr. M. W. Bartley, Resident Manager
Eric J. Rex

C. GENERAL SUMMARY

The maximum number of professional geologists employed in Michigan and Minnesota totaled 14 including Messrs. Derby and Boyum. At the end of 1954, we had a net of 10 permanent staff members, a decrease of 4. In the Drilling Division, we had a total of 5 supervisory personnel maximum including Mr. H. W. Rembold. At the end of the year, we had a total of 3 for a decrease of two and a further reduction of one of the two drill clerks. We had a reduction of one core-room technician, one draftsman and one stenographer. This makes a grand total reduction of 10 members in the Exploration Department staff.

We had a reduction in the number of field parties. In Michigan, we had 2 two-man parties with the part time services of Prof. W. A. Longacre, making a maximum of 3 field parties at one time. In Minnesota, we had the part time service of 1 geophysical crew doing principally Electromagnetic Induction work. In Canada, we had 3 field parties and 3 prospecting teams.

Virtually no time was devoted to the examination of Land Offers in the United States General classification nor in Central and South America.

II. GEOLOGICAL & GEOPHYSICAL FIELD WORK

As in previous years, our field work has been done by two-man parties. One member acted as the geologist and the other as the compassman, or with one member as the geophysicist and the other as the notekeeper. In general, the reconnaissance work was done with sundial compass survey lines, together with the mapping of outcrops, dumps and pits, the sampling of iron-formation, and the collecting of representative hand specimens of various rock types encountered.

This Section II is subdivided into three principal areas in which geological and geophysical field work has been done.

A. Michigan

We employed 2 two-man field parties, together with part of our permanent

staff, conducting field work, briefly augmented by the services of Professor William A. Longacre, Geophysical Consultant.

1. Cascade District - E. Richard Randolph, Geologist

a. Cascade East-End - Only a brief amount of Electromagnetic Induction Prospecting was conducted to assist in the location of the drill holes.

E.M. - 1.0 miles of traverse ---------- $179.44

b. Empire Area - Field work consisted of cutting survey lines followed by E.M. prospecting. The experimental work proved valuable, detecting structural features such as faults and the footwall contact. Other conductor patterns were too complex for definite interpretations based upon present knowledge of the geology of the Empire Area.

E.M. - 7.56 miles of traverse ---------- $1,681.64

2. Eagle Mills Project - E. Richard Randolph, Geologist

The site of the new agglomerating plant in Section 36, 48-26 was surveyed for depth of overburden in order to assure proper grading estimates and study conditions for ground water supply. Professor L. O. Bacon was engaged and made 76 seismic determinations across the area. Indications of ample depth of uniform, sandy material have since been borne out by construction, grading and drilling. (5½ days $962.50).

3. Republic Townsite - E. Richard Randolph, Geologist

In order to gain knowledge of the amount of rock trenching necessary to lay sewer and waterlines in the new Republic townsite, a series of seismic profiles were made along the proposed streets. Professor Lloyal O. Bacon of Michigan College of Mining and Technology was engaged, and he spent one day in the field. Satisfactory results were obtained and no great amount of ledge was indicated above the sewer depths. ($175.00 for 1 day).

4. Cameo Project

During 1953 exploration commenced on the so-called Cameo Project. This project is directed towards finding new iron ranges and mines in the East-Central part of Michigan's Upper Peninsula. The name Cameo was a code name built up from the "Pre-CAMbrian PalEOzoic Cover.

Our initial effort was in T. 42 N., R. 22 W., Northeast of the town of Perkins centering around Clausen's Farm in Section 26. The project is subdivided into several phases as follows:

a. Geophysical Prime Stations - Figure 1 shows the location of these geophysical prime stations located in strategic positions throughout the Cameo Project area. The stations are permanent or semi-permanent reference locations for which good vertical and horizontal control has been secured. They are readily available being adjacent to main highways. Professor W. A. Longacre and Richard Randolph directed the installation of these prime stations, together with determining their magnetic and gravimetric values.

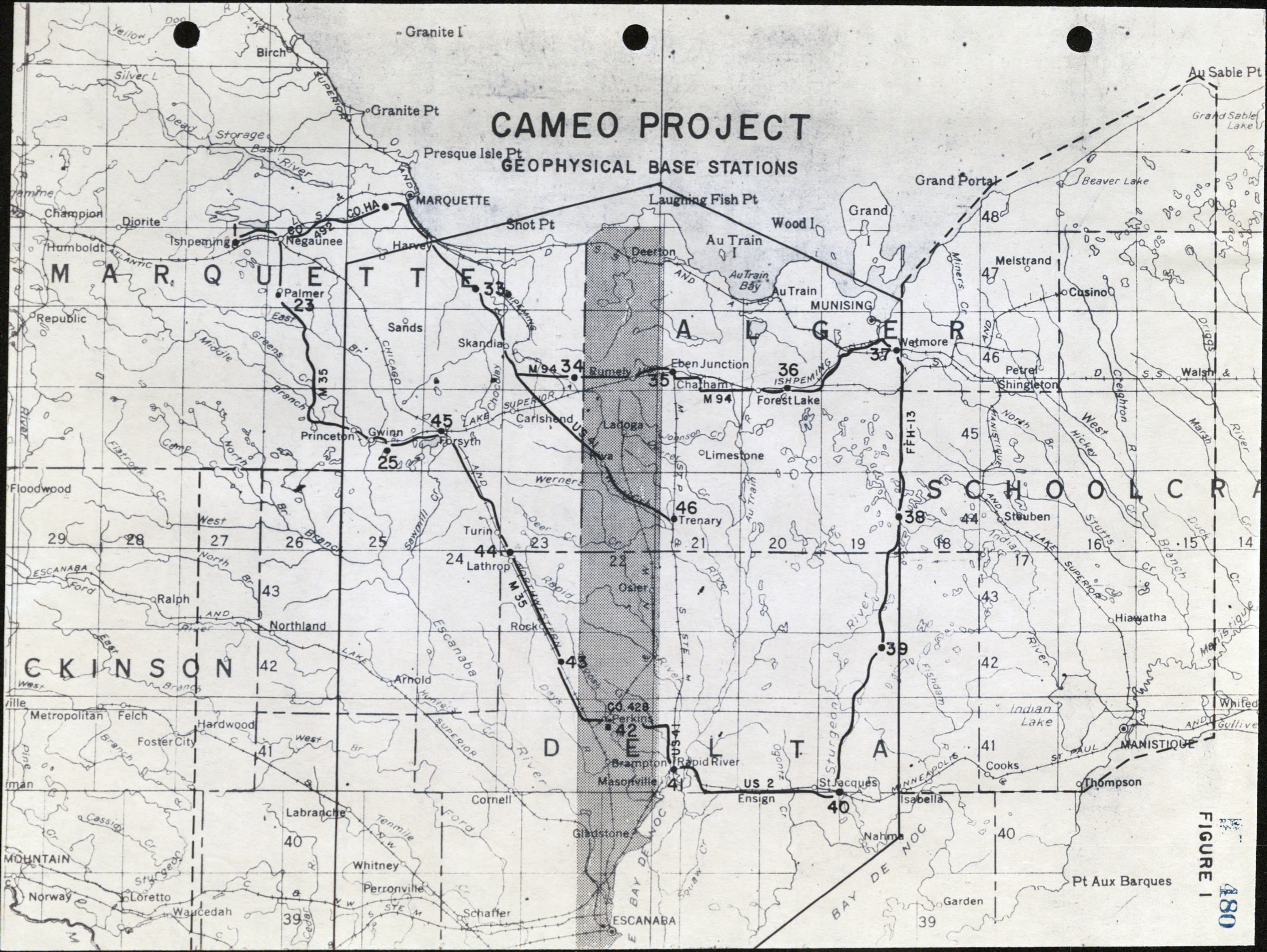

CAMEO PROJECT
GEOPHYSICAL BASE STATIONS
MARQUETTE
ALGER
SCHOOLCRA
DELTA
CKINSON
Granite I
Granite Pt
Presque Isle Pt
Laughing Fish Pt
Shot Pt
Grand Portal
Au Sable Pt
Grand Sable Lake
Beaver Lake
Grand I
Wood I
Au Train I
Au Train Bay
Au Train
MUNISING
Wetmore
Melstrand
Cusino
Champion
Diorite
Humboldt
Ishpeming
Negaunee
Harvey
Deerton
Republic
Palmer
Sands
Skandia
Rumely
Eben Junction
Chatham
Forest Lake
Petrel
Shingleton
Walsh
Princeton
Gwinn
Forsyth
Carlshend
Ladoga
Limestone
Floodwood
Trenary
Steuben
Turin
Lathrop
Osier
Ralph
Northland
Rock
Hiawatha
Arnold
Metropolitan
Felch
Hardwood
Foster City
Perkins
Brampton
Rapid River
Masonville
Ensign
St Jacques
Isabella
Cooks
MANISTIQUE
Thompson
Cornell
Labranche
Gladstone
Nahma
Whitney
Perronville
Schaffer
ESCANABA
Norway
Loretto
Waucedah
MOUNTAIN
Garden
Pt Aux Barques
Indian Lake
BAY DE NOC
M 35
M 94
US 41
US 2
FFH-13
CO. 428
23
25
33
34
35
36
37
38
39
40
41
42
43
44
45
46

FIGURE I

480

b. Air Magnetics - The Aero Service Corporation of Philadelphia, Pennsylvania was engaged to conduct an aeromagnetic reconnaissance of the Cameo Project area and used a flight pattern as shown in Figure 2. As a result of this airborne work, we were able to delineate other areas of major interest, also indicated on Figure 2, and designated them separate exploration numbers.

c. Perkins Exploration - During the summer of 1954 magnetic and gravimetric reconnaissance continued in the Perkins area on and adjacent to Section 26, 42-22. We were able to take advantage of the work done by Professor L. O. Bacon of Michigan College of Mining and Technology and that of his students. Later in the year, Mr. Randolph experimented with E.M. work and had gratifying results.

d. Rock-Osier Area - Following the preliminary work at Perkins, the field crews extended their reconnaissance to the north into the Rock-Osier anomaly area. The ground work showed a close correlation to the air magnetics, and a significant exploration area has been outlined.

e. Legal Matters - During the year 1954 much thought was given to the Option Form and to the methods of obtaining options. In December, the results were culminated by standardizing the new form which has many advantages. The Exploration Department worked closely with the Engineering and Mining Abstract Departments in obtaining options in critical areas at Perkins and at Rock-Osier.

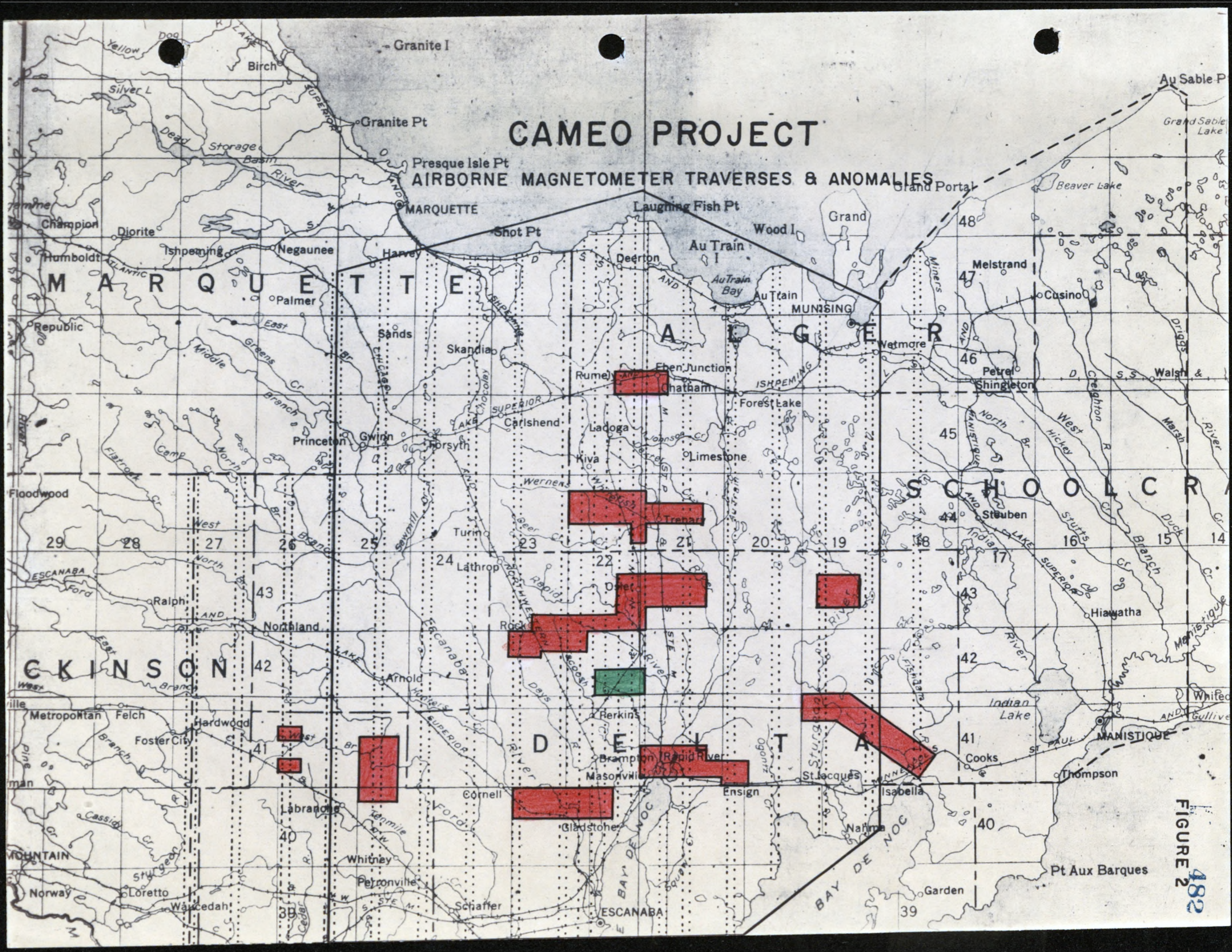
5. Iron River District - David M. Bennet, Geologist

a. D.M. & M. Company Lands (L.O. 2798), Cayia-Hollister Zone, T. 43 N., R. 32 W. - Field work was done in this area by Messrs. L. C. Binon and D. M. Bennett during the months of September and October. Specimens were gathered from available outcrops and samples were obtained from iron-formation outcrops and dumps at old properties. The sampling at the Bird property was the most encouraging and recommendations for E.M. work here has been submitted. In this area, however, the knowledge of the remaining reserves at the Armenia property is the most important feature.

b. Glocke, (L.O.3527), near Gibbs City - The trend of the iron-bearing formation at the McColeman property strikes northeasterly towards the Glocke Farm on which there are two drill holes reputedly ledged in iron-formation. E.M. traverses were run here and the resulting cross-overs outlined a formation strike which trends southwest toward the McColeman property. Mr. Glocke is scheduled to re-sample the two old holes already there. Depending on the results of the re-sampling, the Company may continue with more exploration.

c. Skews (O.E. 1170), West of Sagola, Sections 29 & 30, 43-30 - The Skews' drilling came to our attention late in the year. They have been drilling in their spare time over the past five years and have completed a total of 29 holes. With the assistance of the U.S.G.S., DDH #28 crossed what is thought to be the Negaunee Iron-Formation as it extends down from Michigamme mountain on the Amasa Oval. The iron-formation was rich, but loaded with quartz veining. More exploration could be done on this project by The Cleveland-Cliffs Iron Company if the proper agreement is reached with the Skews'.

d. Delta (L.O.2846), Section 25, 43-35 - The data concerning the W½, Section 25, 43-35, was compiled and studied. This included Jones & Laughlin drilling, Sinclair Mining Company drilling and workings, Riverton Mine data, and an examination of the open pit on the south end of the section. This


CAMEO PROJECT
AIRBORNE MAGNETOMETER TRAVERSES & ANOMALIES
Granite I
Granite Pt
Presque Isle Pt
MARQUETTE
Shot Pt
Laughing Fish Pt
Wood I
Grand I
Grand Portal
Au Train I
Au Train Bay
Au Train
MUNISING
Au Sable Pt
Grand Sable Lake
Beaver Lake
MARQUETTE
ALGER
SCHOOLCRA
CKINSON
DELTA
Birch
Champion
Diorite
Humboldt
Ishpeming
Negaunee
Harvey
Deerton
Palmer
Republic
Sands
Skandia
Rumely
Eben Junction
Chatham
Wetmore
Forest Lake
Melstrand
Cusino
Petrel
Shingleton
Walsh
Carlshend
Ladoga
Princeton
Gwinn
Forsyth
Kiva
Limestone
Floodwood
Steuben
Turin
Trenary
Lathrop
Ralph
Northland
Rock
Hiawatha
Arnold
Perkins
Indian Lake
MANISTIQUE
Metropolitan
Felch
Hardwood
Foster City
Brampton
Rapid River
Masonville
Ensign
St Jacques
Isabella
Cooks
Thompson
Cornell
Gladstone
Labranche
Nahma
Whitney
Perronville
Norway
Loretto
Waucedah
Schaffer
ESCANABA
Garden
Pt Aux Barques
BAY DE NOC
Bay de Noc
29
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24
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FIGURE 2

482

study was tied in with the McDermott forties to the east, but was dropped as it was found that the Inland Steel Company held the controlling minerals. Mr. R. C. Mahon of Iron River was handling the other interests in the Delta property.

B. Minnesota - Rolland L. Blake, Geologist

1. General - Minnesota exploration in 1954 was cut back considerably because of the decrease in ore sales. No summer crews were employed, and only a limited amount of field work was done. This was an excellent time to gather all available geologic data on Minnesota, especially in areas of our greatest interest.

Before the cut-back mentioned above, it was planned to take advantage of our exclusive right to use the electromagnetic induction equipment developed by McPhar Geophysics Limited of Toronto, Ontario, in cooperation with The Cleveland-Cliffs Iron Company, for use in iron ore exploration. To this end, E.M. equipment was purchased for Minnesota exploration during 1954. The equipment arrived in April, and was used on the Western Mesaba Range for several weeks during the year.

During the year, the latest topographic and aeromagnetic maps available were purchased, indexed, and added to our files. In addition, the highway maps folder was brought up to date by plotting geology and drilling data from various sources, such as the State Mine Office and the Minnesota Geological Survey. This data was also recorded and filed in the Township file drawer.

During the year, an index to Land Offers and Outside Explorations was developed, and a supplement was made to bring both the Ishpeming and Hibbing files up to date by the end of the year.

Much data was gathered and studied on the State Permits put up for bidding in August, 1954. No permits looked encouraging, and thus were not bid on by the Company. The data obtained was added to the Township file.

2. Vermilion Range

a. L.O. 2901 - Semer Land Company - In the fall of 1954, some office work was done on the E.M. contacts on L.O. 2901, Semer Land Company, four-forties in Section 5, 62-14. This consisted of preparing an inked tracing showing generalized geology, magnetics, and E.M. conductors which located a number of contacts of different types of rocks. In addition, a brief text accompanied the tracing. Both were used in the writing of the joint paper on E.M. with McPhar to be presented at the February, 1955, A.I.M.E. meeting in Chicago.

b. L.O. 2933 - Wahlsten - One day was spent on a geological reconnaissance of several forties in Sections 29 and 30, 61-15. No iron-formation was seen and all other geologic data indicated none was present. This land offer was declined.

c. L.O. 2942 - Brusell - One day was spent on a geological reconnaissance of two-forties, one each in Sections 32 and 33, 64-10. No iron-formation was found. Iron-formation was reported by the owner, and if it exists, it would be in small quantities, since greenstone and conglomerate outcrops are abundant. This Land Offer was also declined.

d. O.E 1107 - Westward Extension of Vermilion Range - In the fall of 1954, one day was spent on a geological reconnaissance of some State permits in Section 36, 60-23, to determine if we might be interested in obtaining

exploration permits on them. The area is interesting from its high magnetic anomaly and associated magnetite schists around a gabbro intrusive. Of greater interest, is an extensive anomaly 7 or 8 miles to the northwest. These two areas will be explored by a ground magnetic reconnaissance along roads and trails in 1955. Some preliminary work was done in December, 1954, as to planning the location of base stations, instructing crews in superdip work, and outlining the area to be covered.

3. Mesaba Range

a. Cushing Reserve - In April and May, 1954, fourteen days of field work was done on the Cushing Reserve. In 1954, both a preliminary and a detailed E.M. survey were performed on the Cushing Reserve, SW¼ and N½-SE¼ of Section 36, 56-25. This is the area on the Mesaba Range where McPhar performed initial test work used in designing the new E.M. gear. Four days in April and eight days in May were spent on the preliminary survey. Four days in September were spent on the detailed survey. Table A shows the rate and cost of the preliminary and the detailed surveys on the Cushing Reserve:

TABLE A

RATE AND TOTAL COST OF PRELIMINARY AND DETAILED E.M. SURVEYS ON CUSHING RESERVE
(100 Foot Station Interval)

	Total EM Distance	Total Time (2-Man Crew)	EM Rate Feet/Day	Total Cost	Cost per 1000'
Preliminary Survey (34% Repetition)	28,700'	12 Days	2400	$542.85	$18.92
Detailed Survey (63% Repetition)	9,500'	4 Days	2400	$200.56	$21.11

In Table I, there is indicated a repetition of 34% on the preliminary survey and 63% on the detailed survey. This results from the fact that some lines are surveyed more than once from different setups for better correlation. These rates and costs are based on the total amount of E.M. work done, and so includes the overlapping work. Figure 3 shows the location of E.M. lines in both surveys on the Cushing Reserve.

In April, 1954, three days were spent by Mr. Blake logging the hand wash samples of two drill holes on the Cushing Reserve, CU-3 and CU-17. This was an attempt to determine if any minerologic differences, occurring in the iron-formation or beneficiating material, could cause the E.M. conductor located between these holes. This location was also at the limit of the beneficiating material, and thus could mark the limits of the orebody. The study revealed no apparent difference in mineralogy, and no other apparent reason for a conductor here. It was surprising to learn that the iron oxide mineral was nearly always hard goethite (Fe_2O_3-H_2O).

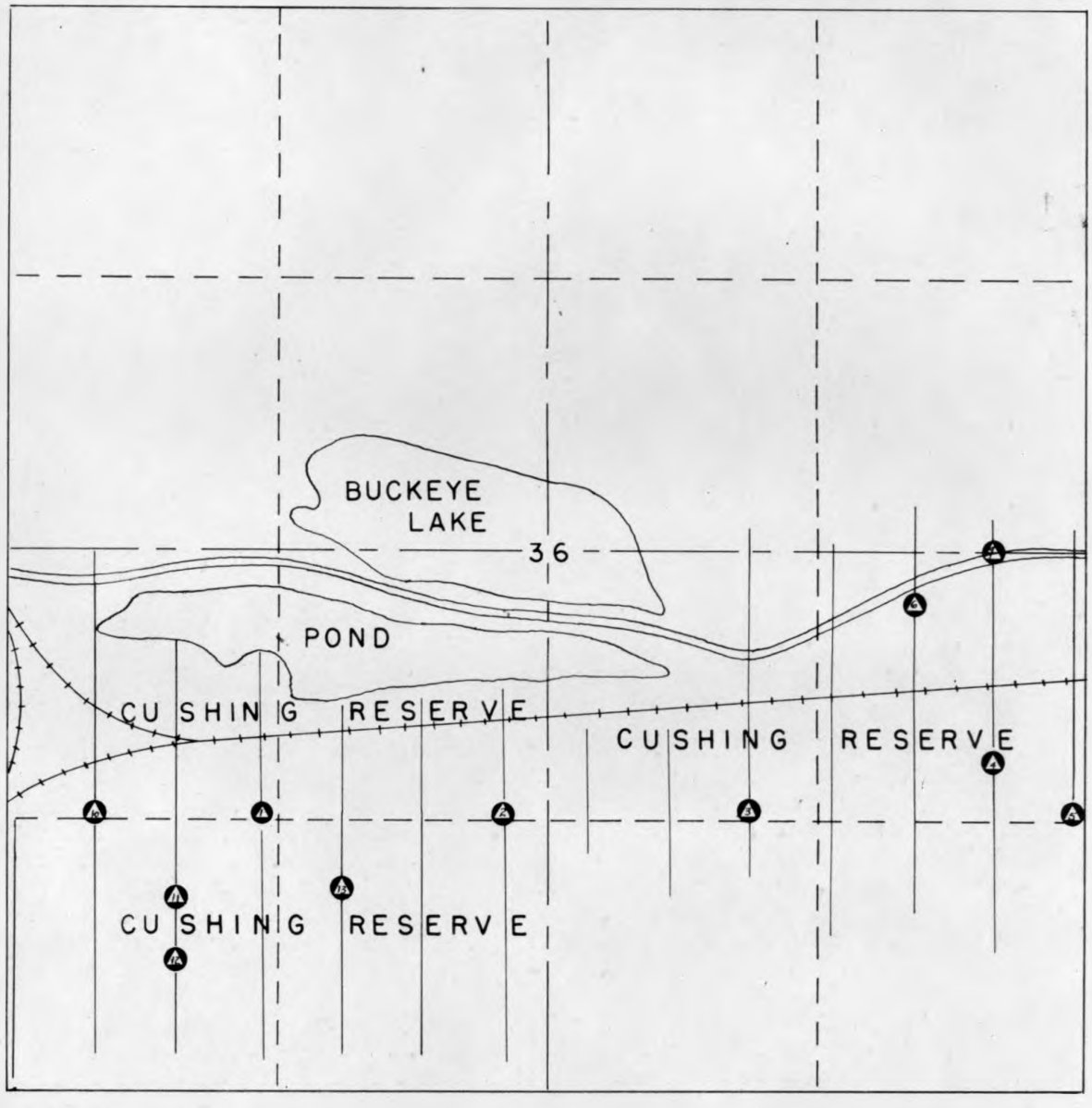
Office work during the year on the Cushing Reserve consisted of plotting data and interpreting results. In the course of this interpretation, it was brought out that possibly interstitial fluids may cause the conductors within iron-formation. An isopach map was made of the thickness of glacial drift, and a bedrock contour map was made on the SW¼ of Section 36. It was hoped these maps might indicate the cause of the E.M. conductors. At this time, we are not sure what is causing the conductors at the Cushing Reserve.

FIGURE 3

CUSHING RESERVE - S.W. 1/4 & N. 1/2 - S.E. 1/4, SEC. 36-56-25

E.M. PRELIMINARY & DETAILED SURVEYS

APRIL, MAY, AND SEPTEMBER - 1954



——— E.M. SURVEY LINES

▲ TRANSMITTER SET-UPS

(1-6, 9-10 PRELIMINARY SURVEY)
(11-13 DETAILED SURVEY)

b. Moore Option - L.O. 2929 - E & A, CC-610 - In May, 1954, two days were spent performing a preliminary E.M. survey on the Moore Option, W½-NW¼, Section 36, 56-25, just north of the Cushing Reserve. Figure 4 shows the E.M. survey lines run, and Table B shows the rate and cost of this survey.

TABLE B

RATE AND TOTAL COST OF PRELIMINARY E.M. SURVEY ON THE MOORE OPTION

	Total EM Distance	Total Time (2-Man Crew)	EM Rate Feet/Day	Total Cost	Cost per 1000'
Preliminary Survey (No Repetition)	4,050	2 Days	2000	$107.40	$26.52

A very strong conductor was located near the south limit of these two forties, but its significance is not known at this time.

4. Cuyuna Range

In 1953 plans were made to start a preliminary search of records and other sources for data on the Cuyuna Range, with the idea that we could first build up both our files and knowledge of Cuyuna Range exploration and its associated problems before spending much time and money on field work.

a. U.S.G.S. Conference - On February 1, 1954, the Minnesota Exploration Committee met with the U.S.G.S. men at Crosby, Minnesota, to discuss latest interpretation and get new ideas on the Cuyuna Range exploration. Dr. Carl Dutton and Mr. Robert Schmidt of the U.S.G.S. suggested that we explore areas which might be extensions of the known Cuyuna Range, and these were reduced to five outlying areas in which we had some lands offered.

In march, 1954, Messrs. W. J. Michels and L. K. Hanson of the Hibbing Engineering Department made an extensive ownership survey of these five areas. Much data was gathered from the State Mine office, publications, and old exploration data collected from various sources. The information was recorded and filed in the Township files and in the Highway map folder.

b. O.E. 1108 - Rice River Area - One of the five areas, O.E. 1108, Rice River Area, contains an old M. A. Hanna exploration with Messrs. Todd and Scalon. Much data was collected on this, a plan map was sketched in pencil, and the best structure drill holes were indicated. Further investigation disclosed that the best lands were still held as reserves by M. A. Hanna as State leases. Plans were made to search for more exploration data to determine if possible extensions of these reserves might occur in private lands, and if these lands were available. Before further search could be made, the decrease in ore sales put a halt on further Cuyuna exploration.

c. Minnesota Geological Survey - In March, 1954, a visit was made to the office of the Minnesota Geological Survey at the University of Minnesota to obtain the logs of the Great Northern Railway drilling done about 1929 between the Cuyuna and Mesaba Ranges. This data was filed as previously stated.

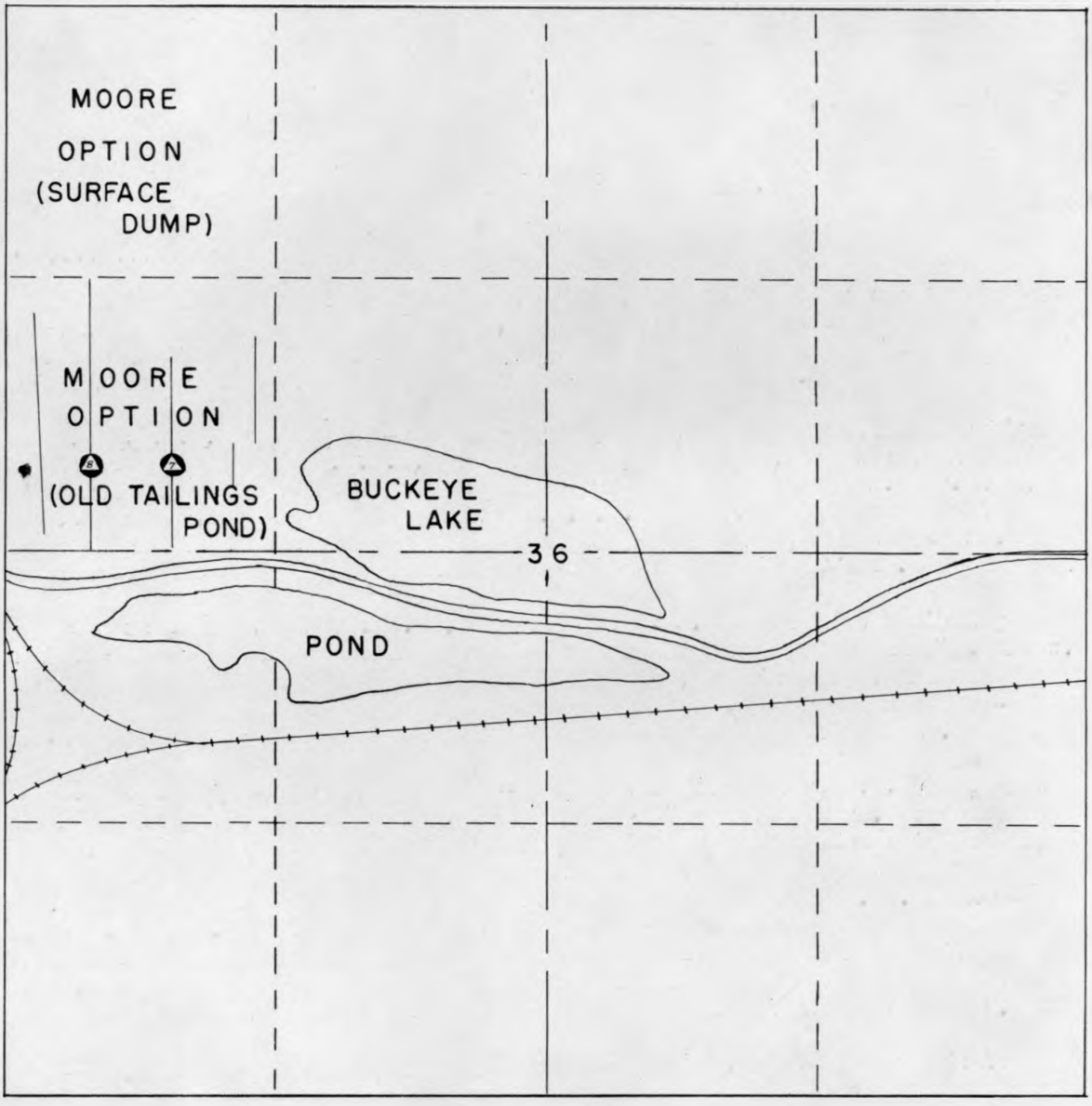
FIGURE 4

MOORE OPTION - L.O.2929 - E.&A. - C.C. 610

W.1/2 - N.W.1/4 SEC.36-56-25

E.M. PRELIMINARY SURVEY

MAY - 1954



——— E.M. SURVEY LINES

△ TRANSMITTER SET-UPS

d. O.E. 1105 - Huhn - While examining the drill record book early in 1954 for information in the Cuyuna Range Area, an old exploration (1913) in Sections 8 and 9, 45-28, Crow Wing County, was discovered. From the data available, it looked like a sizeable tonnage of iron ore might be found at this locality. Although it was not in one of the five areas previously mentioned, the Minnesota Exploration Committee decided further investigation was warranted. A plan map and several sections were drawn in pencil from the old data. An examination of tax receipts indicated that the Oliver Iron Mining Division is paying taxes on the best lands in this old exploration. The associated aeromagnetic anomaly gives some hope for an extension to the southwest where no mining companies are paying taxes yet, but further Cuyuna Range exploration was stopped by this time due to decrease in ore sales.

C. United States General - Eric J. Rex, General Exploration Geologist

Section VI of this Annual Report covers the general subject of Land Offers and Outside Explorations. During 1954, a total of ten mineral Land Offers originated in the United States, exclusive of Michigan and Minnesota. Locations are shown in Figure 5. None of these Land Offers were followed up by field examinations. However, three of them were visited previously by Messrs. Boyum and Rex while on a short reconnaissance of Wyoming iron deposits.

1. Idaho - L.O. 3461, Placer Mining Property in South-Central Idaho - Consisting of stream deposits of detrital magnetite, ilmenite and gold, these deposits are on the South Fork of the Payette River about 40 airmiles northeast of Boise. This offer was declined on the basis of the Company's policy of confining its interest to the ferrous field.

2. Montana - L.O. 3442, Titaniferous Magnetite in the Blackfeet Indian Reservation, Montana - In 1952 while Eric Rex was examining Land Offers in Montana, his attention was called to a group of about 30 claims of titaniferous magnetite in the Blackfeet Indian Reservation, several miles east of Glacier National Park. Although snow was on the ground, he made a visit to the property and picked a metallurgical sample and a series of specimens.

This property was again offered in 1954 with likely some later staked claims. It was again declined because of the financial demands of the owner and others involved.

3. Oregon - L.O. 3521, Black Sands Deposits near Coos Bay, Oregon - During the last war, black sands of the raised beach terraces on the Oregon coast were worked for their chrome and other mineral content. L.O. 3521 consists of about 2000 acres of beach sands containing the black sand concentrations. A study of the potential of these deposits is now being made by the Department.

4. South Dakota - L.O. 3519, Bentonite & Manganiferous Iron near Pierre, South Dakota - The Chicago and Northwestern Railroad indicated there were deposits of bentonite and manganiferous iron "in the same formations" in the vicinity of Pierre, South Dakota. Action on this Land Offer is still pending.

5. Washington - L.O. 3471, Iron Deposit near Colville, Washington

This offer consists of eleven lode claims on a limestone-porphyry contact called the "Big Iron Mine" in Stevens County, Washington. An examination of this property in 1954 had been considered, but had to be abandoned.

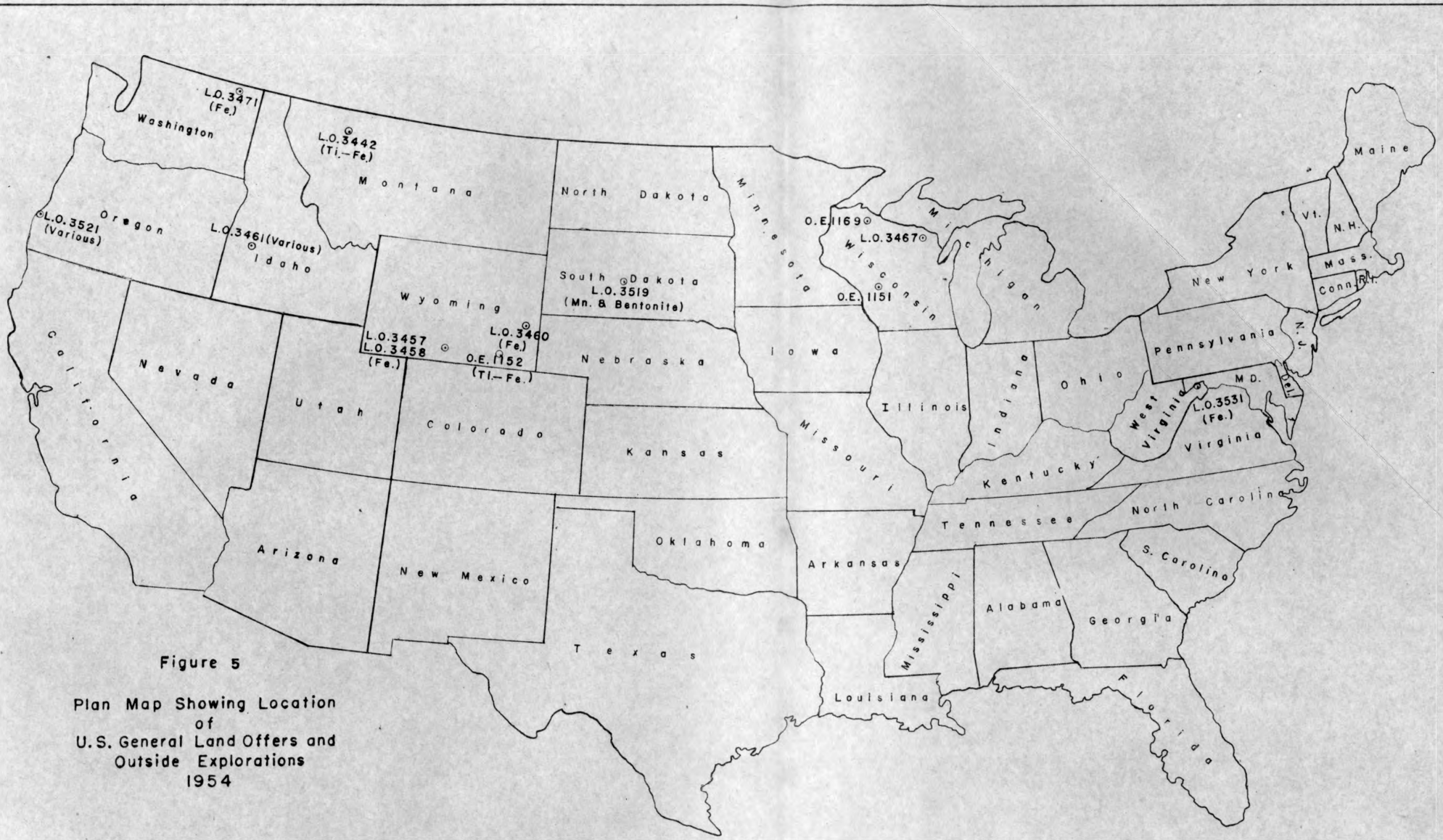


Figure 5

Plan Map Showing Location
of
U.S. General Land Offers and
Outside Explorations
1954

6. West Virginia - L.O. 3531, Iron Prospect near Keyser, West Virginia

Around 700 to 800 acres of mineral property in Mineral County, West Virginia is covered by this offer. The iron is contained in seams averaging two foot thickness in what is apparently an early Paleozoic sedimentary series. The Land Offer was declined on the basis of its low economic potential, shallow thickness, and a capping problem burdened by the necessity of concentration.

7. Wisconsin - L.O. 3467, Mineral Rights on 160 Acres in Florence County, Wisconsin - Mr. Allen Goodrich has offered mineral rights to 160 acres in Florence County, Wisconsin. The decision on this offer is still pending.

8. Wyoming - L.O. 3457, Iron Ore Property in Seminoe Mountains, Wyoming.- L.O. 3457 consists of 609 acres of iron-formation in the Seminoe Mountains, Carbon County, Wyoming. This property was offered by the Empire State Oil Company of Thermopolis, Wyoming. An examination of this Land Offer in 1954 had been considered, but had to be abandoned.

9. Wyoming - L.O. 3458, Iron Ore Property in Seminoe Mountains, Wyoming - L.O. 3458 consists of 517.6 acres of mineral claims in the Seminoe Mountains, Carbon County, Wyoming. These claims are owned by Thomas A. Yawkey of New York and his sister. An examination of this property in 1954 had been considered, but had to be abandoned.

10. Wyoming - L.O. 3460, Iron Ore Property Adjacent to the Sunrise Mine, Wyoming - This Land Offer was submitted on behalf of its owners by Mr. E. Christofferson of Duluth. It was declined after it had been determined that its acquisition would affect adversely Cliffs' relations with Colorado Fuel and Iron Company, who operate the neighboring Sunrise Mine.

D. Canada - Canadian Cliffs, Ltd.

In addition to the Resident Manager, Dr. M. W. Bartley and his Chief Clerk, Mr. Les Dack, who are retained on an annual basis, Canadian Cliffs, Ltd. engaged Dr. J. M. Neilson, Consulting Geologist, to work in the Province of Quebec and the Maritimes. Mr. Eric J. Rex was transferred to Canadian Cliffs, Ltd. payroll during the period of June 1st to December 31st, as Project Supervisor for the Albanel-Sandspit Exploration.

Canadian field exploration was centered in the Provinces of Ontario and Quebec. Examination of Land Offers were made in Quebec, Ontario, and British Columbia. Land Offers from the Maritime Provinces, Alberta, and Manitoba were considered, but not examined. During the twelve-month period, eleven Outside Explorations and fifty Land Offers were considered. Only five Outside Explorations were intensely pursued, and only twenty-four of the Land Offers given serious consideration. All the Outside Explorations have been abandoned. Sections covered by these explorations, deemed worthy of further consideration, have been reassigned as Land Offers. All but eleven of the Land Offers have been declined. The eleven Land Offers, plus the interesting areas developed by exploration, have been carried over to 1955 for consideration and action.

In addition to the Lake Albanel project, one two-man party prospected in Quebec near Lake Mistassini and Chibougamau. Two prospecting parties were in the field in the Province of Ontario attempting to discover valuable deposits on Crown Lands on behalf of Canadian Cliffs, Ltd. The prospecting programs were not immediately successful and should be continued in the future when finances are more readily available. The total cost of the Canadian Cliffs, Ltd. operation for the year 1955 amounted to $106,327.00.

Figure 6 shows the locations of the Land Offers and Outside Explorations originating in 1954.

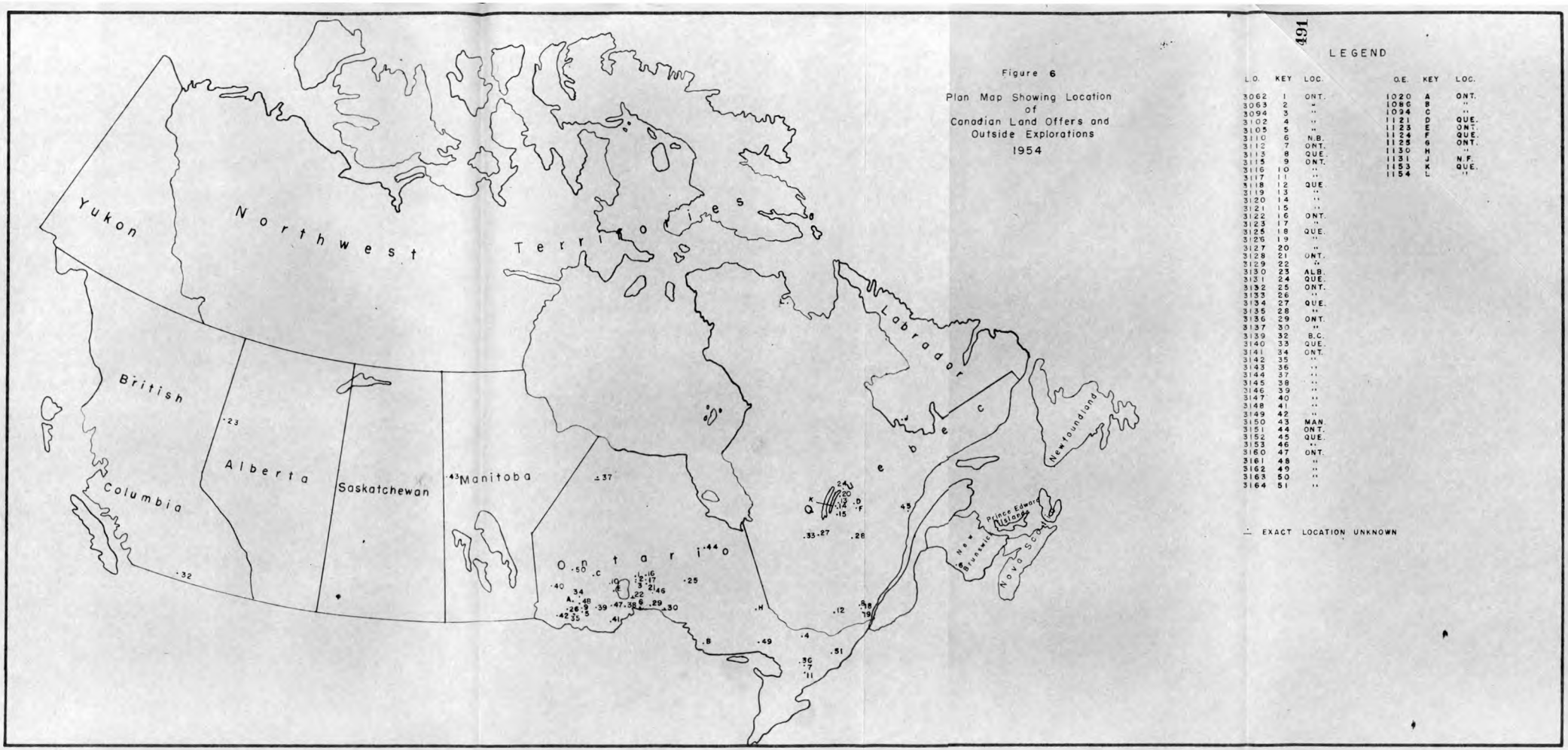


Figure 6

Plan Map Showing Location of Canadian Land Offers and Outside Explorations 1954

LEGEND

L.O.	KEY	LOC.
3062	1	ONT.
3063	2	"
3094	3	"
3102	4	"
3105	5	"
3110	6	N.B.
3112	7	ONT.
3113	8	QUE.
3115	9	ONT.
3116	10	"
3117	11	"
3118	12	QUE.
3119	13	"
3120	14	"
3121	15	"
3122	16	ONT.
3123	17	"
3125	18	QUE.
3126	19	"
3127	20	"
3128	21	ONT.
3129	22	"
3130	23	ALB.
3131	24	QUE.
3132	25	ONT.
3133	26	"
3134	27	QUE.
3135	28	"
3136	29	ONT.
3137	30	"
3139	32	B.C.
3140	33	QUE.
3141	34	ONT.
3142	35	"
3143	36	"
3144	37	"
3145	38	"
3146	39	"
3147	40	"
3148	41	"
3149	42	"
3150	43	MAN.
3151	44	ONT.
3152	45	QUE.
3153	46	"
3160	47	ONT.
3161	48	"
3162	49	"
3163	50	"
3164	51	"

O.E.	KEY	LOC.
1020	A	ONT.
1086	B	"
1094	C	"
1121	D	QUE.
1123	E	ONT.
1124	F	QUE.
1125	G	ONT.
1130	H	"
1131	J	N.F.
1153	K	QUE.
1154	L	"

± EXACT LOCATION UNKNOWN

III. EXPLORATION DRILLING DIVISION

Kenneth Maikkula, Drilling Engineer

In the year 1954, several detailed experiments were conducted and a review was made of the different practices in the Division in an attempt to reduce the cost of operation.

Experiments were conducted in the laboratory and in the field with several grades of bentonite for use in mud drilling.

A very detailed experiment was completed on oriented diamond core bits. As a result of this study 50% oriented bits and 50% random-set bits are ordered because it is felt from the experiment that oriented bits merit further investigation.

Presently, experiments are being made with scrap diamonds in bits. These are used diamonds that might be shattered or broken, but still retain enough of the physical properties to be used in bits. Formerly, a scrap credit was received from the bit companies. Thus far, the results are encouraging.

A study was made on the comparative time and cost of rigging up and down of the tripod rigs versus trailer rigs. This study proved the saving in having trailer rigs to drill the shallow holes.

A review of diamond drill equipment accounting was made with special attention on the year 1953. The equipment was classified into heavy, medium and light, and also included the inventory of the equipment necessary to drill an exploratory hole, for the purpose of substantiating a suggested increase in the per shift charge.

The designing and building of a shallow hole trailer rig was completed which is to be used in conjunction with open pit drilling. A sizeable saving was realized by having it made by Drilling Division personnel. Figure 7 shows this unit.

1. Diamond Cost

The following Table V represents an analysis of diamond bit costs at the various locations and the respective hole sizes.

TABLE V
PER FOOT COST OF DIAMOND BITS USED IN 1954
SURFACE

PROJECT Sec.	T&R	Hole	EX Ft.	EX Amt.	EX Per Ft.	AX Ft.	AX Amt.	AX Per Ft.	BX Ft.	BX Amt.	BX Per Ft.	NX Ft.	NX Amt.	NX Per Ft.	Total Footage	Total Bit Cost
19	47-26	3										400	$ 297.33	$ .74	400	$ 297.33
19	"	4							640	$ 756.22	$1.18				640	756.22
19	"	5							546	333.87	.61				546	333.87
19	"	6							500	965.77	1.93				500	965.77
19	"	7							485	412.38	.85				485	412.38
19	"	8							507	752.87	1.48				507	752.87
19	"	9							553	988.27	1.79				553	988.27
19	"	10							563	753.23	1.34				563	753.23
19	"	11							581	763.87	1.32				581	763.87
19	"	12							479	929.21	1.94				479	929.21
19	"	13							193	820.31	4.25				193	820.31
19	"	14							673	1,631.35	2.42				673	1,631.35
19	"	15							690	2,860.70	4.14				690	2,860.70
19	"	16							663	1,556.76	2.35				663	1,556.76
19	"	17							513	2,011.66	3.92				513	2,011.66
19	"	18							619	1,059.48	1.71				619	1,059.48

TABLE V CONT'D

PROJECT Sec.	T&R	Hole	EX Ft.	EX Amt.	EX Per Ft.	AX Ft.	AX Amt.	AX Per Ft.	BX Ft.	BX Amt.	BX Per Ft.	NX Ft.	NX Amt.	NX Per Ft.	Total Footage	Total Bit Cost
21	48-31	1				44	$ 44.88	$1.02	47	$ 332.03	$7.06				91	$ 376.91
25	48-31	20							138	355.53	2.58				138	355.53
26	42-22	1							112	70.53	.63	609	$ 587.71	$ .97	721	658.24
26	"	2				447	1,114.79	2.50	376	797.03	2.12	757	880.78	1.17	1,580	2,792.60
26	"	3										323	245.00	.75	323	245.00
27	47-26	32				318	800.14	2.52	1,312	7,011.00	5.42				1,630	7,811.14
27	"	33	665	$1,984.41	$2.98	75	410.65	5.57	866	4,052.76	4.68				1,606	6,447.82
TOTAL			665	$1,984.41	$2.98	884	$2,370.46	$2.68	11,056	$29,214.83	$2.70	2,089	$2,010.82	$1.00	14,694	$35,580.52

2. Diamond Inventory - Hand Setting

The following Table VI shows the distribution of carbon and ballas bortz for the year 1954:

TABLE VI

DIAMOND INVENTORY (Hand Setting), December 31, 1954

	CARBON (Hand Setting) Kts.	Amount	Per Kt.	BALLAS BORTZ (Hand Setting) Kts.	Amount	Per Kt.
On Hand 1/1/54	808.24	$63,629.89	$78.73	40.89	$4,077.47	$99.72
Purchased 1954	--	--	--	--	--	--
TOTAL	808.24	$63,629.89	$78.73	40.89	$4,077.47	$99.72
Used 1954	9.24	727.43	78.73	--	--	--
On Hand 12/31/54	799.00	$62,902.46	$78.73	40.89	$4,077.47	$99.72

DISTRIBUTION OF INVENTORY: Loose Carbon, Carbon set in bits, Loose Ballas (C. C. I. Co.)

3. Diamond Inventory - Mechanical Setting

The following tabulation shows the over-all distribution of all types of diamond used and on hand during the year 1954:

TABLE VII

DIAMOND INVENTORY (Mechanical Setting), December 31, 1954

	SCRAP CARBON		SCRAP BORTZ		CONGO		LONGYEAR		"R" GRADE		"G" GRADE		TOTAL	
	Kts.	Amount	Kts.	Amount	Kts.	Amount	Kts.	Amount	Kts.	Amount	Kts.	Amount	Kts.	Amount
On Hand 1/1/54	262.72	$4,049.27	--	--	322.29	$1,918.38	211.73	$2,329.03	29,335.77	$219,482.80	5,362.60	$48,872.09	35,495.11	$276,651.57
Purchased 1954	--	--	1,608.55	$2,883.57	9.38	56.28	--	--	1,222.22	11,000.00	5.31	7.56	6,027.57	40,859.93
									3,182.11	26,912.52				
TOTAL	262.72	$4,049.27	1,608.55	$2,883.57	331.67	$1,974.66	211.73	$2,329.03	33,740.10	$257,395.32	5,367.91	$48,879.65	41,522.68	$317,511.50
Used 1954 (loss)	9.78	234.30	--	--	59.25	367.50	--	--	8,032.09	75,607.64	1,000.00	11,000.00	9,374.54	90,217.06
											273.42	3,007.62		
Scrap Credit	--	--	--	--	--	21.89	--	--	--	6,135.48	--	125.35	--	6,282.72
On Hand 12/31/54	252.94	$3,814.97	1,608.55	$2,883.57	272.42	$1,585.27	211.73	$2,329.03	25,708.01	$175,652.20	4,094.49	$34,746.68	32,148.14	$221,011.72

Above includes $11,000.00 worth of "G" Grade Bortz exchanged for "R" Grade Bortz

DISTRIBUTION OF INVENTORY IN CARATS

	SCRAP CARBON	SCRAP BORTZ	CONGO	LONGYEAR	"R" NEW	"R" USED	TOTAL "R"	"G" NEW	"G" USED	TOTAL "G"	TOTAL INVENTORY
Loose (Mfr's Possession)	178.09	1,579.05	272.42		3,500.91	4,332.74	7,833.65	744.39	1,969.92	2,714.31	12,577.52
Loose (C.C.I.Co. Possession)						2.85	2.85				2.85
Salvage Reports Pending						1,078.58	1,078.58		25.75	25.75	1,104.33
Bits in Stock or Issued to Contracts	74.85	29.50		211.73		16,792.93	16,792.93		1,354.43	1,354.43	18,463.44
TOTAL	252.94	1,608.55	272.42	211.73	3,500.91	22,207.10	25,708.01	744.39	3,350.10	4,094.49	32,148.14

4. Plant Account

Table VIII shows our comparative status with reference to depreciation of the Department owned drilling equipment.

TABLE VIII

	Schedule "A"	Schedule "B"	Schedule "C"	Total
December 31, 1953	$23,241.78	$195,245.32	$186,076.97	$404,564.07
December 31, 1954	23,241.78	206,019.57	189,198.29	418,459.64
Net change	0	+$ 10,774.25	+$ 3,121.32	+$ 13,895.57

Income from "Per-Shift Charges"	
Total year 1953	$30,558.45
" " 1954	38,803.06
Expenses from "Per-Shift Charges"	
Depreciation 1954	$36,131.46
Maintenance & Repairs 1954	5,795.60
	$41,927.06
Net loss for year 1954	$ 3,124.00
Total equipment book value, 1954	$418,459.64
Total in Depreciation Reserve Fund, 1954 including the $36,131.46 above	169,755.39
Net	$248,704.25

Schedule "A" - Life not exceeding 2 years
Schedule "B" - Life not exceeding 10 years
Schedule "C" - Rods and Casing - depreciated on footage basis

The above tabulation shows that even with the increase in the "per-shift charge" made in 1954, a greater charge must be made to balance the anticipated repairs for 1955.

Figure 7

Shallow Hole Trailer Drill

View showing trailer-mounted diamond core drill and pump with tripod mast erected. Picture was taken at the time of the Ishpeming Centennial Parade and includes from left to right, Victor Nelson, Alvin Nelson and Swante Merrila

IV. SURFACE EXPLORATION

The projects discussed in this section of the Annual Report are those involving drilling in addition to geological and geophysical field work. The details of the geological and geophysical field work have been covered in Section II of this report.

A. Michigan

1. The following Table IX is a summary of the surface drilling including the cost analysis:

TABLE IX

SUMMARY OF SURFACE DRILLING - COST ANALYSIS

LOCATION	HOLES	RIGS	OVER-BURDEN	DIAMOND DRILLING	TOTAL	1st CLASS ORE FOOTAGE	%	MET. ORE FOOTAGE	%	TOTAL COST "A"	C/FT "A"	TOTAL COST "B"	COST/FT "B"
Perkins, Sec. 26, 42-22 (Shallow)	1,2,3	C.C.I.	24	2,600	2,624	--	--	--	--	$25,319.52	$ 9.649	$ 33,410.12	$12.732
Empire, Sec. 19, 47-26 (Met.)	3-19	C.C.I.	254	8,803	9,057	--	--	5491	60.6	97,423.47	10.757	117,126.91	12.932
Cascade, Sec. 27, 47-26 (Met.)	32, 33		37	1,163	1,200	--	--	--	--	19,257.74	16,048	21,245.65	17.705
Cascade, Sec. 27, 47-26 (Deep)	32, 33	C.C.I.	0	2,036	2,036	225	11	--	--	44,470.47	21,842	52,149.40	25.614
Sec. 11, 47-27 (Deep)	20C	C.C.I.	0	428	428	77	18	--	--	22,239.63	51.962	24,241.68	56.639
Sec. 11, 47-27 (Deep)	23B	E.J.L.	0	917	917	201	22	--	--	39,700.72	43.295	42,879.42	46.760
Sec. 11 (Total)	20C,23B	E.J.L. & C.C.I.	0	1,345	1,345	278	21	--	--	61,940.35	46.052	67,121.10	49.905
Titan, Sec. 21, 48-31 (Met.)	1	C.C.I.	30	61	91	--	--	0	--	2,321.28	25.509	2,774.24	30.486
Imperial, Sec. 25, 48-31 (Met.)	20	C.C.I.	38	100	138	0	--	45	33	4,811.71	34.868	5,524.26	40.031
Spies Surface, Sec. 24, 43-35 (Shallow)	88	Odgers	0	134	134	0	--	--	--	1,262.86	9.420	1,339.36	9.995
Allen, Sec. 25, 43-35 (Shallow)	89,90,91	Odgers	358	1,794	2,152	9	0.4	--	--	28,701.06	13.337	32,270.78	14.996
McDermott, Sec. 25, 43-35 (Shallow)	1A,2,3,4,5	Odgers	702	2,087	2,789	8	0.3	--	--	30,196.69	10.827	34,072.44	12.217

Note: Cost "A" is the direct drilling cost. Cost "B" is the total of the direct and indirect charges including overhead.

2. Recapitulation by Organization

TABLE X

	NO. RIGS	FOOTAGE	% OF TOTAL
DEEP HOLE DIRECT SHIPPING			
Department	1	2,464	69.5
Contract	1	917	30.5
TOTAL	2	3,381	100.0
SHALLOW HOLE DIRECT SHIPPING			
Department	3	2,624	34
Contract	2	5,075	66
TOTAL	5	7,699	100
METALLURGICAL DRILLING			
Department	3	10,486	100
Contract	0	0	0
TOTAL	3	10,486	100
TOTAL DEPARTMENT SURFACE	7	15,574	72.2
TOTAL CONTRACT SURFACE	3	5,992	27.8
GRAND TOTAL ALL SURFACE	10	21,566	100.0

Note: Cascade East End Holes 32 and 33 are counted for both met. and direct shipping.

3. Summary of Exploration Results - Marquette Range

a. Ohio Mine & Vicinity - Harold C. Boback, Geologist

1'. Ohio Mine - During the spring of 1954 in preparation for summer operation, Harold C. Boback fashioned a very comprehensive three dimensional diagram in color showing all diamond drilling, churn drilling and surface mapping of the Ohio East Pit, This diagram in conjunction with the pit mapping, brought out all the contacts and went a long way toward describing the horse of iron-formation within the concentrated ore. During the course of the season, this East Pit was mined out with exception of a prospective area on the west of the old Portland Pit. A final geological map of the Ohio East Pit was completed in the month of October. In the West Pit, stripping continued. The first mining from the West Pit was done in the 1954 season.

2'. Imperial Mine Land Offer - Most of the available ore on the Imperial property was thought to be in the shaft pillars, especially the timber shaft pillar to the east. DDH #20 was drilled in the timber shaft pillar during September and only 5 feet of ore was encountered. On the strength of this hole and the knowledge of the drilling from the previous year, the property was thereby declined.

3'. Titan Mine - Mine Lease 111 - On the basis of the 1953 field geology and geophysics, DDH #1 on the Titan was drilled. This hole went through the iron-formation to footwall sequence without cutting any concentrated ore.

b. Section 11, 47-27 - Deep Exploration - E. Richard Randolph, Geologist

In 1954, exploration for deep soft ore was completed in Section 11 with two rigs in the northwest portion of Section 11, termed Area II. The total cost of the Section 11 deep exploration was $1,101,766.87, conducted over a period of 8 years. Both holes #20-C and #23-B were started during the previous year and were 4401' and 3875' deep, respectively, at the start of 1954.

Hole #20-C entered high grade soft ore NX size at 4625' and advanced 27' before the hole was cased to BX size in order to regain circulation. Aquagel drilling mud was used and probably was responsible for the good ore recovery. Special techniques were employed in sludge collection from the aquagel, particularly in the use of a technician to remain at the drill and record drilling data as well as collect sludge. Seventy-seven feet of excellent ore was cored, and the hole was stopped at 4829'.

Hole #23-B cored 65' of soft ore from 4158' to 4250' in the so-called "Upper Orebody" which was also found in holes #20 and #20-C. At 4607', the main orebody was found and averaged 62.01% Fe for 136'. The same sampling procedure was used as on hole #20-C. Core recovery was excellent. The hole was stopped at 4792'. This hole entered the lower orebody approximately 415' northwest of hole #20, which, in turn, was 285' northwest of hole #20-C, for a total extent of 700' of high grade ore along the strike.

c. Empire Area - Section 19, 47-26 - E. Richard Randolph, Geologist

Exploration continued at an increased pace in Section 19 for magnetic beneficiating ore, employing two drill rigs. Drilling was conducted on 600 foot centers and was usually carried BX size to +900' sea level

elevation. This was an approximate average of 533' for each of 17 holes, for a total of 9057' of drilling in 1954. Considerable tonnages of Class I (percent weight recovery greater than 40%) and Class II (percent weight recovery between 30% and 40%) were proven. Several hitherto unsuspected oxidized areas were found which apparently are associated with faulting.

The trailer-mounted diamond drill was used to advantage in this area, reducing moving and set up time to an almost negligible amount. Carbon set bits were used on several holes, but the economy in diamond cost tends to be offset by increased labor costs since more care is needed in their use.

d. Cascade East-End - Section 27, 47-26 - E. Richard Randolph, Geologist

Exploration was conducted by drilling in the East End of the Cascade Basin two miles east of Palmer, Michigan. Diamond drilling was successful in locating two ore-bearing areas in Section 27 with holes #32 and #33, five hundred feet apart, coring 149' and 107' of ore, respectively. This presents the possibilities of an excellent high grade deposit at less than 1600' depth in an area owned in fee by Cliffs. Hole #32 was placed near the Palmer fault, which limits the basin on the north, on the basis of previous field mapping, magnetics, and E.M. Hole #33 was collared 500' to the south to gain more information about the footwall profile of the basin. Hole #32 was finished with good sampling and few difficulties while hole #33 transected many intrusives, which presumably represent faulted zones. Consequent casing and reduction to EX size impaired the sample recovery in the ore zone.

The footwall in this area is apparently very gradational, both holes encountering a very argillaceous, rich iron-formation. To date, no hole has crossed the Palmer Fault.

4. Summary of Exploration Results - Cameo Project

Perkins District - Diamond drilling was commenced in September on a vertical hole #1, Section 26, 42-22. This hole cut the limestone and sandstone of Ordovician Age comprising the Paleozoic Cover. A coarse angular iron-formation conglomerate was cut from 560' to 590'. The balance of the hole, from 590' to 721' was in hematitic quartzose mica garnet schist. Our second hole #2 was located approximately 900' North of hole #1 and inclined at -57° to the south towards hole #1. It ledged in the limestone cutting a similar section as that encountered in hole #1. The iron-formation conglomerate was cut from 650' to 695'. Pre-Cambrian schist was cut from 695' to 717', Hematitic cherty iron-formation was drilled from 717' to 1283'. Garnet biotite schist was cut from 1283' to 1345'. Magnetic cherty iron-formation was cut from 1345' to a depth of 1580' at which point the hole was abandoned, since the limits of the drill machine had been exceeded. The second or southerly iron-formation member is thought to have been the source of the magnetic anomaly. In December, a second drill rig was added and set up on the third hole, also in Section 26. It had reached a depth of 320' by the end of the year.

This exploration project is both interesting and significant. It represents successful team effort in pursuing an exploration idea of several years standing. We were able to take advantage of the work done by the Geophysics Department at Michigan College of Mining & Technology, and augmented it with work of our own. Over 500 magnetic observations were made and several gravimetric traverses completed. The E.M. technique appears to be successful on this project.

Splendid inter-departmental cooperation resulted in the leasing of hundreds of acres of land located in critical positions with reference to the magnetic anomaly. All of this was done including the drilling of the holes cited above for less than $40,000.00. Drilling costs approximated $31,000.00, engineering (surveying, legal and options) approximated $4,500.00, geology $1,800.00 and geophysics $1,100.00.

5. Summary of Exploration Results - Menominee Range - David M. Bennett, Geologist

a. Spies Mine Surface, Section 24, 43-35

During the year 1954, one Longyear contract drill completed the exploration on the Spies surface. DDH #88 was the last hole in this series and was stopped after passing through hangingwall graywacke and some argillite and an unoxidized iron-formation. This part of the program was drilled to intercept any enrichment between DDH #79 and the Spies East Deposit.

b. Allen Exploration NW¼ of SW¼, Section 24, 43-35

DDH's #89, #90 and #91 were aimed at a limb of an anticline which is believed to continue east from the Turosky and Sherwood drilling. DDH's #89, #90 and #91 cut this formation and further drilling from underground was designed to intercept this formation at depth. These three holes were contract holes drilled by Odgers Contract Drilling Company.

c. McDermott Exploration, Section 25, 43-35

The McDermott property lies in the W½ of the E½ of Section 25, 43-35. Extensive drilling was done on this row of forties. DDH's #1, #1-A, #2, #3, #4 and #5 were drilled by an Odgers contract rig out of Iron River. This drilling tended to show the iron-formation rolling and faulting to the south with oxidation wherever the iron-formation was cut. E.M. equipment was used to good advantage to locate all holes where the iron-formation could be cut near ledge.

A notice of surrender of this lease was sent out on December 1, 1954 and it will be officially terminated on April 1, 1955.

B. Minnesota

The details of the Minnesota Exploration are contained in the Annual Report from Mr. Hugh J. Leach, Manager. Briefly, it may be said that the principal exploration was done at the Holman Mine on the North Star Lease. Holes #420 through #429 inclusive, a total of 10 holes were drilled. A total of 204' of overburden was cut and 1538.5' of ledge material was drilled for a total of 1742.5'.

At the Cushing Mine, on the Moore Option, a total of 2 holes were drilled as follows:

CUSHING MINE - MOORE OPTION

Hole	Overburden	Ledge	Total
M-1	119'	144'	263
M-2	45'	162'	207
2 Holes	164'	306'	470'

Total drilling cost $7,686.80.
Cost per foot $16.35.

The test results indicate retreat material making a grade concentrate from 119' to 205'. A high silica retreat concentrate was cut from 45' to 135' in Hole M-2 and was classified as N.G. Mr. Magnuson believes that it would be possible to lay out a pit area containing approximately 1,000,000 tons of retreat concentrates. On the basis of this drilling, the Company exercised the option and had the State Lease assigned by Warren Moore to Cliffs.

C. Canada

The principal exploration project in Canada for 1954, conducted by the Canadian Cliffs, Ltd., was in the Mistassini Territory in the Province of Quebec. This exploration is divided into L.O. 3120, Albanel Claims, and L.O. 3121, Sandspit Claims. With the Temiscamie Group, L.O. 3119, explored in 1953, the number of claims currently held in the area are divided as follows:

L.O. 3119-C, Temiscamie---22 claims
L.O. 3120-C, Albanel------50 "
L.O. 3121-C, Sandspit-----36 "

During 1954, there was no exploration work carried on in the Temiscamie Claim Group.

Twenty-six diamond drill holes, for a total of 3682', were drilled in the Albanel-Sandspit Claim Groups, with the number of holes divided equally between them. Direct drilling costs for these holes, (E size), was $5.83 per foot. Drilling was carried on in two-12 hour shifts per day.

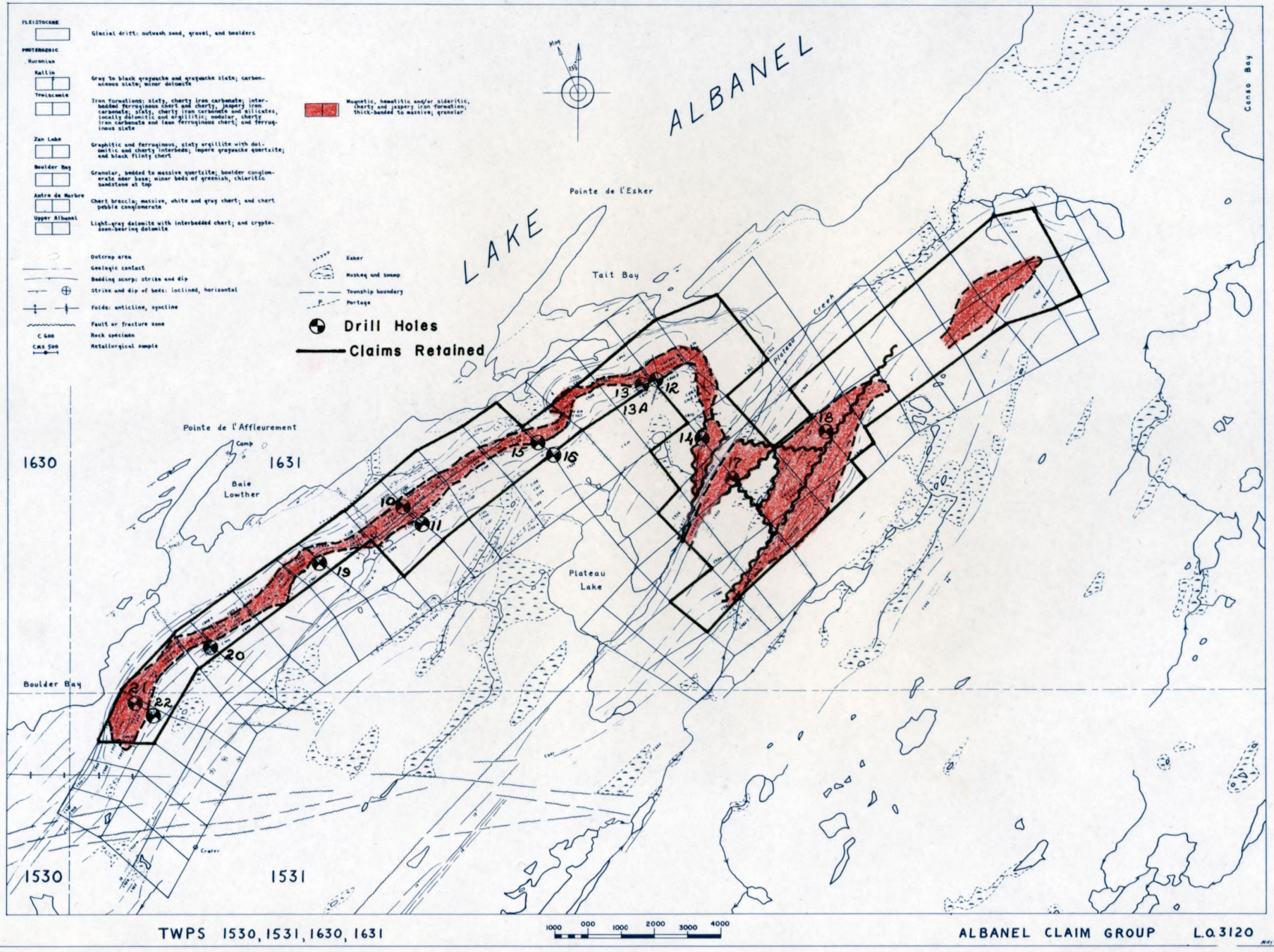
Field work consisted of about 32 miles of geologic traverses, 9 3/4 miles of magnetic traverses, 14.2 miles of chain survey, and 3.5 miles of stadia survey. Figure 8 shows the location of drill holes, claim boundaries and the surface extent of the principal member of the iron-formation in the Albanel Claim Group. Figure 9 is a similar treatment of the Sandspit Claim Group.

Exploration work in Ontario centered on the so-called "Steep Rock Gravels", L.O.'s 3105-C and 3115-C. In this area, the glacial drift contains an unusual amount of high grade specular hematite, apparently derived from the Atikokon deposits. Exploration was done by test-pitting and auger drilling to depths of as much as 94 feet. Unfortunately, the Land Offers had to be declined because the exploration indicated that insufficient hematite-bearing gravel was present to justify the capital expense necessary for a treating plant.

ALBANEL CLAIM GROUP

CANADIAN CLIFFS LIMITED

GEOLOGY L.O. 3120



TWPS 1530, 1531, 1630, 1631

ALBANEL CLAIM GROUP L.O. 3120

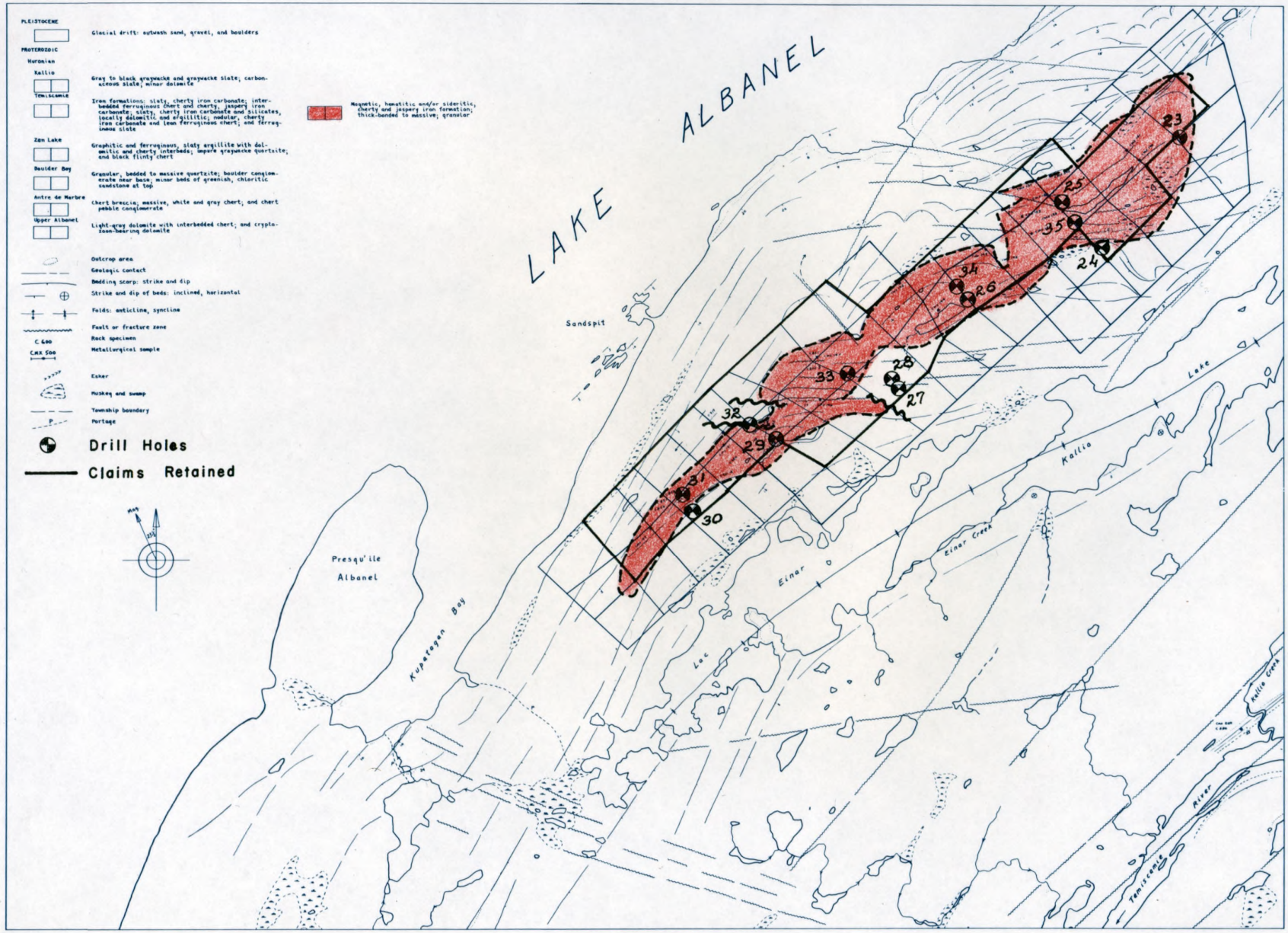
May 1984

Figure 8

SANDSPIT CLAIM GROUP

CANADIAN CLIFFS LIMITED

GEOLOGY L.O. 3121



TWP. 1531

SANDSPIT CLAIM GROUP L.O.3121

Figure 9

V. UNDERGROUND EXPLORATION

A. Michigan

1. Summary of Drilling

The following tabulation Table XI is the summary of underground drilling:

TABLE XI

LOCATION	HOLES	RIGS	DIAMOND DRILLING	1st CLASS ORE FOOTAGE	%	2nd CLASS ORE FOOTAGE	%	TOTAL COST "A"	C/FT "A"	TOTAL COST "B"	C/FT "B"	
Arctic Parcel	1-3		2,197'	526'	23.94	--	--	$17,769.43	$ 8.088	$17,909.07	$ 8.152	
Athens	54	C.C.I.	103'	90'	81.00	--	--	545.60	5.297	556.20	5.400	
Bunker Hill	15,32-34,36,37	C.C.I.	1,921'	483'	25.14	--	--	11,041.95	5.748	11,246.36	5.854	
" "	35	C.C.I.	207'	--	--	--	--	3,999.86	19.320	4,019.91	19.419	Water Drain Hole, RX.
Cambria-Jackson	217-219	C.C.I.	263'	40'	15.20	--	--	2,381.63	9.050	3,283.64	12.480	
Cliffs-Shaft	898-917	C.C.I. (Mine)	3,768'	281'	7.46	396	10.51	13,599.22	3.610	16,619.04	4.411	
Maas (Including Pioneer & Arctic)	77-81	C.C.I.	1,587'	420'	26.50	--	--	13,109.84	8.260	16,051.09	10.110	
Mather "A"		C.C.I. (Mine)	10,079'	2,406'	23.83	--	--	75,695.17	7.510	85,773.44	8.510	
Mather "B"	224,226,230,231,234, 235,238,239,245,247, 251-253,258-261,264-266,268,271,275	C.C.I. (Mine)	*6,266'	3,804'	60.00	--	--	47,499.38	7.580	61,403.16	9.790	
Spies Mine	75-86	Odgers	6,643'	233'	3.00	--	--	56,616.53	8.520	64,454.11	9.700	
Allen UG	87	Odgers	423'	0	0	--	--	3,306.81	7.820	3,659.67	8.660	

(* does not include 2,058' drilled for Mather Mine "A" Shaft)

2. Recap by Organization

The following tabulation Table XII is the recap of organization:

TABLE XII

ORGANIZATION	NO. OF RIGS	FOOTAGE	PER CENT
a. C.C.I. Co. 1. Department	3	6,278'	18.8
2. Mine	8	20,113'	60.1
b. Contract	2	7,066'	21.1
Total	13	33,457'	100.0

3. Summary by Properties - Marquette Range Underground

a. Athens-Bunker Hill Mine - Joseph L. Patrick, Geologist

1'. Athens Mine - Exploration in the Athens property was limited to exploration by drifting incidental with mining and development and one short diamond drill hole. Routine mapping of the mining places did not disclose any significant changes in the Athens structure.

Drifting on the 12th level main line proved the existence of a northwest-southeast fault, the north side being the down dropped side. The 14th level drift is being driven without support in hard black slate and dense graywacke. In some places support by roof bolting was necessary because of the intersecting joints. In another instance roof bolts were used at a lithological contact because separation occurred between the different rock types.

2'. Bunker Hill Mine - Drilling continued at the reduced rate established in the latter part of 1953. During 1954 one machine was used to explore for ore along the 2400 W. and the 2800 W. northsouth sections. The area along the south boundary of the Bunker Hill property was explored from the Arctic parcel along the 3850 S. eastwest section. Eight holes were drilled in the area between the 2200 W. and the 2800 W. With the exception of two holes drilled along the 2800 W., they explored the area above 10th level south of the Athens dike.

Two holes, #15 and #35, were drilled for other purposes than ore exploration; hole #15 was re-entered and extended to check the material in the vicinity of the proposed 14th level crusher; and hole #35 was drilled from the south end of the sumps on 14th level to the 12th level drift south of the plat as a water drain. Previously the mine water was carried to a pipe near the shaft in an open ditch and then piped to 14th level. Considerable leakage around the plat and into the trench was experienced. The 3 7/8" hole has alleviated the condition very successfully.

3'. Bunker Hill Surface Drainage Project - The Bunker Hill Mine embarked upon a study of the ground water in the overburden near the cave area. The purpose of the study was to determine if the surface water could be prevented from entering the cave area. The first step in the project was a geophysical study, by seismic method, of the ledge topography. The seismic study confirmed the existence of a northwest trending trough.

This trough was tested by five churn drill holes drilled on a northeast-southwest line. Tests indicated that four of the holes could be made into production wells. Pumping in the first well started on September 3, 1954, and shortly thereafter pumps were installed in the other three wells. The maximum production was 550 gal./min. With the continued drawdown, the rate of production has decreased. The drawdown in the observation well is continuing and it indicates that more water is being pumped than normally flows through the area.

b. Cambria-Jackson Mine - Layton C. Binon, Geologist

The diamond drilling program which commenced in April, 1952 was terminated in January with the completion of three holes. These holes were designed

to test for an extension of the "high country" orebody to 8th level elevation. Development of the ore which was indicated by these holes and by development work on the 7th level was started in March and is continuing at the present time.

Further testing of ore-bearing areas in the mine was done with a percussion drill capable of drilling holes to 70 feet. The machine was a standard design rock drill mounted on a jackleg. Seventy-four holes totaling 3880' were drilled during the year. The drilling was supervised by the mine supervisory force.

The total effect of the new information obtained from drilling and development work was to maintain reserves at approximately the same tonnage as last year.

c. Cliffs-Shaft Surface - James P. Meyers, Geologist

No drilling for hard ore was conducted upon the Cliffs-Shaft Mine surface in 1954.

Underground drilling during the year was guided by the 1952 "New Shaft" ore estimate and the 1954 revision of this estimate. Some drilling was done to facilitate development in conjunction with the new shaft project. Underground drilling was done in all areas of the mine except the "B" Shaft Far West workings. Some drilling was done from the "A" Shaft East area into the old Moro Mine area.

Drilling in the "A" Shaft, "A" Shaft South, "A" Shaft East, "A" Shaft North, "A" Shaft Northeast, and "B" Shaft areas may be considered complete except for occasional holes necessary to development. The old Moro Mine workings and "B" Shaft Far West workings remain to be drilled. Drilling of the old Moro Mine area has commenced and will continue throughout 1955. Significant tonnage additions of second class material were proven in the "A" Shaft North (Bancroft Lease) and "A" Shaft Northeast areas. Also the eastern extension of the orebody occurring on the upper levels of the Section 10 Lease was found. This structure will be outlined by further drilling during 1955.

In 1954, the mine's compliment of diamond drill rigs was reduced from three to one and the drilling program was equally reduced. In January, 1954, the use of one rig was discontinued and the use of a second rig was discontinued in August, 1954. Personnel laid off the rigs were absorbed in operations.

In May, 1954, an underground diamond drill incentive system was formulated and put into effect at Cliffs-Shaft Mine. The system to date has affected increased efficiency, greater advances per shift, and a sizable cost reduction. Ten holes were drilled under the incentive program. A bonus was paid on seven of the ten holes. Without the incentive system, a labor cost of $932.22 would have been incurred for the extra shifts necessary to complete the holes. Under the incentive system, the bonus for driller and helper amounted to $197.26. By deducting the amount of bonus paid from the labor cost of the extra shifts, a saving of $734.96 in direct labor costs is indicated. A total of 1393' was drilled for the seven holes. The saving per foot experienced then is $734.96 divided by 1393 or $0.53 per foot. Since the incentive system has proved quite effective, it will be continued in 1955.

Referring to Table XI, it is noted that the cost per foot for drilling in the mine decreased from $6.005/ft. in 1953 to $4.411/ft. in 1954. This decrease is due to two factors: (1) Longer holes and therefore somewhat reduced moving time and (2) Increased efficiency due to the new incentive program.

d. Lloyd Mine - David M. Bennett, Geologist

A review of the exploration possibilities for ore above 9th or 10th levels was considered during the year. The most interesting possible ore structure was indicated between U.H. #177, #178 and #182. The structure is roughly bounded by dikes and appears to be formed by the same footwall faulting which produced the present Lloyd orebody. It was decided that drifting to the south will be done to substantiate the ore between U.H. #177 and #178 which could be a mineable orebody with an upward pitch to the east. This pitch could possibly bring the enrichment structure above 9th level elevation. Some drifting was completed before the end of the year when the project was discontinued. Routine mapping and sampling was carried on throughout the year.

e. Maas Mine - Layton C. Binon, Geologist

The diamond drilling program to test the Maas-Mulvey and Pioneer & Arctic areas which commenced in 1953 was completed in June. Five holes totaling 1587' were drilled in 1954. Of this footage, 434' were drilled on Maas Mine property and 1153' were drilled on Pioneer & Arctic property. This work extended our knowledge of the orebody an additional 600' to the west.

The results of this work were:

1. Sufficient reserves were found on Maas Mine property to largely offset the loss in reserves by mining during the year.

2. Our estimate of Pioneer & Arctic proven reserves was increased from 991,251 tons to 1,960,862 tons.

3. The size of the orebody appears to diminish to the west.

4. The footwall pitches up to the west rather than down as was expected, thus more area is available for development from 7th level.

Testing by percussion drilling was used successfully to locate the footwall ore contact above the 700 drift on 7th level. This work was started in 1953 and was completed in January of 1954. The estimated cost of this drilling was $1.00 per foot.

f. Mather Mine

1'. "A" Shaft - Donald L. Gilbert, Geologist

The underground diamond drill program continued throughout the year at the Mather Mine "A" Shaft. The primary objective of this program was the preliminary outlining of reserves available to the 8th and 9th levels. The remainder of the program dealt with testing for additional reserves for 3rd and 7th level mining.

The net ore reserves reported to the Tax Commission on December 31, 1954 were 7,840,332 tons, an increase of 4,064,480 tons over the 1953 estimate. Preliminary drilling of 8th level reserves showed 4,001,510 tons by underground development and 164,933 tons by surface diamond drilling. Ore reserves below 8th level total 543,524 tons by underground development and 591,666 tons by surface diamond drilling.

3rd Level - Three diamond drill holes and six mining transfers were completed in the "ore-pipe" structure. Exploration was directed at testing for an anticipated flattening and northeast pitch above 3rd level elevation; however, a fault was uncovered on the -260' elevation and subsequent drilling on the east side of the fault proved it to be a limiting feature to the "ore-pipe" and that the structure was near vertical above 3rd level elevation.

6th Level - One vertical down hole was drilled from the 6700 Crosscut to outline the ore height and footwall position prior to mining development from above the 7th level.

7th Level - A total of 17 holes were drilled from 7th level, and of the total, 6 holes were down holes drilled to outline ore reserves and footwall position for 8th and 9th level development. Drilling was completed in the complicated structure west and above the 7100 Crosscut. Diamond drilling and test raising from the 7100 West Crosscut indicated the footwall to be displaced along a complicated intrusive pattern and to be turning and striking to the southwest. The orebody was also indicated to be pinching out to the west of the 7100 West Crosscut along the intrusives.

Of major significance to the geologic structure and future reserves at the Mather Mine "A" Shaft is the major east-west trending fault referred to as the Negaunee Shaft Fault. From the breast of the 7100 East Crosscut, U.H. #243 indicated the footwall to have flattened out above 8th level north of the fault and iron-formation on the south side. In order to further pinpoint the fault and to test for concentration available to lower levels, U.H. #210 was drilled. The hole indicated at least 1,000 feet of displacement and iron-formation between the 10th and 11th levels on the south side. East of the Mather Fault, drilling to locate the fault, has encountered an extensive and complicated intrusive pattern which has obscured the exact location of the fault in this area. Presently the 8910 Crosscut is being extended south to locate the fault and to provide drill stations to test on both sides of the fault, especially the south side, for reserves for lower level mining.

8th Level - Seven holes had been drilled by the end of the year from drill stations cut off the Main Haulage level east of the Mather Fault. The drilling has indicated a continuation of the main orebody down dip from 7th level and to plunge and extend eastward into Section 1, 47-27. The orebody, however, appears to decrease in thickness eastward from the Mather Fault to a minor fault previously uncovered in the 7th level, 7700 N. Crosscut. East of this minor fault and into Section 1, 47-27, the orebody averages 100 feet in thickness.

9th Level - Drilling from 7th and 8th levels has indicated a flattening of the footwall above 9th level elevation and due to the influence of the Negaunee Shaft Fault. One of the main objectives of the 1955

diamond drill program will be to locate and test for reserves south of the fault for 9th level mining.

During the year a Bureau of Mines microseismic recorder operated daily at DDH #65. Observations were made with a Model F recorder until September 1, when a Model E of latest design was installed. The geophone was positioned in the hole between the +560' and +650' elevations.

The records showed a comparatively low level of seismic activity, which appears to indicate the capping over the large stope area is not subjected, at the present, to sufficient stress to induce failure.

Dr. Obert, Chief Physicist of the U. S. Bureau of Mines and others of his staff visited the installation and discussed the project on May 10th and September 28th. Through Dr. Obert, Mr. Harold Schroeder was assigned to this area to keep the Bureau in close contact with our project. Mr. Schroeder has his office at Michigan Tech in Houghton.

2'. "B" Shaft - Charles R. Pace, Jr., Geologist

The diamond drill program carried out at Mather Mine "B" Shaft in 1954 totaled 8,319' which represents a reduction of 3,000' in comparison to the 1953 drilling program. The major portion of the drilling was carried out from 8th level with the remainder being distributed among 6th and 7th levels. Actually only a minor amount of drilling was carried out from the latter two levels as the emphasis was placed on 8th level testing. The program was planned to cover the following objectives:

1. Detailing 6th and 7th level ore.
2. Outlining and detailing 8th level ore.
3. Outlining 9th level ore.
4. Outlining 10th level ore.

In general, the ore reserves were increased during the year by approximately two million tons. This represents the net increase after the years production and the 10% allowed for mining loss and rock have been deducted. The increase was mainly in the reserves available to 8th, 9th and 10th levels. The upper levels, 5th, 6th and 7th, have been pretty well detailed and should require only minor amounts of testing in the future. Of major importance during the year was the drilling from 8th level to explore 9th and 10th levels. This drilling indicated an exceptionally large, high grade ore zone available to the two levels.

6th Level - Only one hole was drilled from 6th level during the year and this was to test for 5th level contacts. It was drilled from the 6400 Crosscut area and proved the large tonnage of sulfureous ore indicated in this area.

7th Level - A total of five holes were drilled from 7th level to test for 7th level outlines. The drilling was concentrated more on detailing ore outlines prior to the mining operation than on testing ore structures. No significant changes were noted as a result of this drilling.

8th Level - The main diamond drill activity was centered on 8th level during the year with a total of 22 holes being drilled. The

drilling for 8th level outlines included testing prior to block development and outlining from several of the Crosscut stubs. This drilling continued to prove the substantial tonnages available to 8th level mining. Of major importance on 8th level was the drilling carried out to test the 9th and 10th level ore zones. Six holes were drilled totaling 2,558' and showing 1,966' of first class ore. The drilling also proved the 9th and 10th level footwall contacts at enough points to permit accurate planning of the two levels. The ore proved to be of excellent grade showing high iron and low silica values.

Drilling was also carried out from the "A" Shaft side of 8th level with 5 holes being drilled. This information was needed in order that "A" Shaft could start development as soon as holing through operations took place. In general, a large ore zone was proven available to development in this portion of 8th level.

Pumping - Pumping operations were started in November in the program for dewatering the old underground workings of the Sand and North Shafts in the North Jackson Pit area. This area is of importance as it overlies a portion of the "B" Shaft underground workings. Although this water is several thousand feet above the "B" Shaft workings, it still represents a future danger zone since any cave intersecting this area would result in the unrestricted flow of a large volume of water. A churn drill hole (150 W) was put down and intersected the old stope at 155'. A Byron-Jackson pump rated at 500 gal/min was installed and pumping operations began on November 24th. By the end of the year, approximately 35,000,000 gallons had been pumped and indications were that a considerable volume remained to be pumped.

4. Spies Mine - David M. Bennett, Geologist

Extensive exploration drilling was done in the following areas at the Spies Mine:

6th Level - Searching for tonnage at 6th level elevation to the west of the Spies East Deposit in the NS fault zone.

8th Level - Deep ore program exploring for ore below the 8th level Spies East Deposit.

4th Level - Checking for any enrichment plunging down from the Spies 4th level deposit.

Virgil 6th Level - Exploration of the Allen at depth from the Virgil 6th level drift.

U.H.'s #76, #78 and #80 were part of a program which drilled a lens of ore west of the Spies East 6th level workings. The completed search indicated insufficient tonnage. This work did show an enriched iron-formation with ore to the west which increases our overall knowledge of the structure here for any future speculation below 8th level and to the west.

U.H.'s #75, #85 and #86 completed our survey of possible tonnage for mining below 8th level. A report concerning this tonnage has been submitted by Mr. J. M. Haivala. An estimate in the vicinity of 2,000,000 tons has been turned in for this area extending to a depth of 700' below 8th level.

U.H.'s. #77, #79, #81, #82, #83 and #84 were designed to test any possible extensions of the Spies 4th level deposit. These holes outlined the iron-formation containing some ore above 4th level and showed no enrichment below the 4th level and out to the northwest.

U.H.#87, which was in progress at the end of the year, is drilling from the 6th level Virgil drift and is aimed under the Allen Forty. This hole will test at depth, the iron-formation located on the Allen Forty. Because of the structure here, further testing appears to be less costly by underground drilling than by more surface drilling.

VI. LAND OFFERS AND OUTSIDE EXPLORATIONS

A. Land Offers

During the year 1954, the Exploration Department continued to process the various Land Offers submitted to the Company. A total of 77 mineral Land Offers were submitted by various owners in 1954. They may be divided into five geographical groups as follows:

Area	No.	Percent of Total
1. Michigan	24	31.2
2. Minnesota	9	11.7
3. Canada	29	37.6
4. U. S. General	10	13.0
5. South and Central America	5	6.5
	77	100.0

In addition to the mineral Land Offers, a total of 64 non-mineral Land Offers in Michigan originated during the year. These Land Offers are lots, houses, or auxiliary lands, and are processed jointly by the Recorders Tax, Engineering and Exploration Departments.

The trend of the greatest proportion of total Land Offers to be in Canada, which was begun in 1952, continued into 1954; however, it was diminished by gains in all other divisions except Minnesota whose proportion remained the same as in 1953.

During the year 1954, a total of $82,457.29 was spent by Canadian Cliffs, Ltd. for the investigation of Land Offers and metallurgical testing of samples from them. The Cleveland-Cliffs spent $536.16 on Minnesota Land Offers, $3,539.85 on those in Michigan and $1,316.33 on those classified under U. S. General. (The last group is all United States except Michigan and Minnesota). Figure 10 shows the 5 year trend on Land Offers.

B. Outside Explorations

The number of Outside Explorations considered in 1954 was the same as in 1953, but the proportional distribution has changed. Since 1951, Canada has had the greatest number of outside explorations. However, in 1954, Michigan surpassed Canada in the number considered. The distribution of Outside Explorations in 1954 is as follows:

Area	No.	Percent of Total
1. Michigan	14	45.2
2. Minnesota	4	12.9
3. Canada	10	32.2
4. U. S. General	3	9.7
5. South and Central America	0	0.0

Figure 11 shows the distribution of Outside Explorations for the last 5 years.

VII. MICROSCOPY

During the year 1954, our work in microscopy continued to be an important part of the Departmental activities. For the most part, this work was carried out by Mr. Tsu Ming Han, Mineralogist employed jointly by the Exploration and

Figure 10

GRAPH SHOWING RATE OF MINERAL LAND OFFERS 1950–1954 Incl.

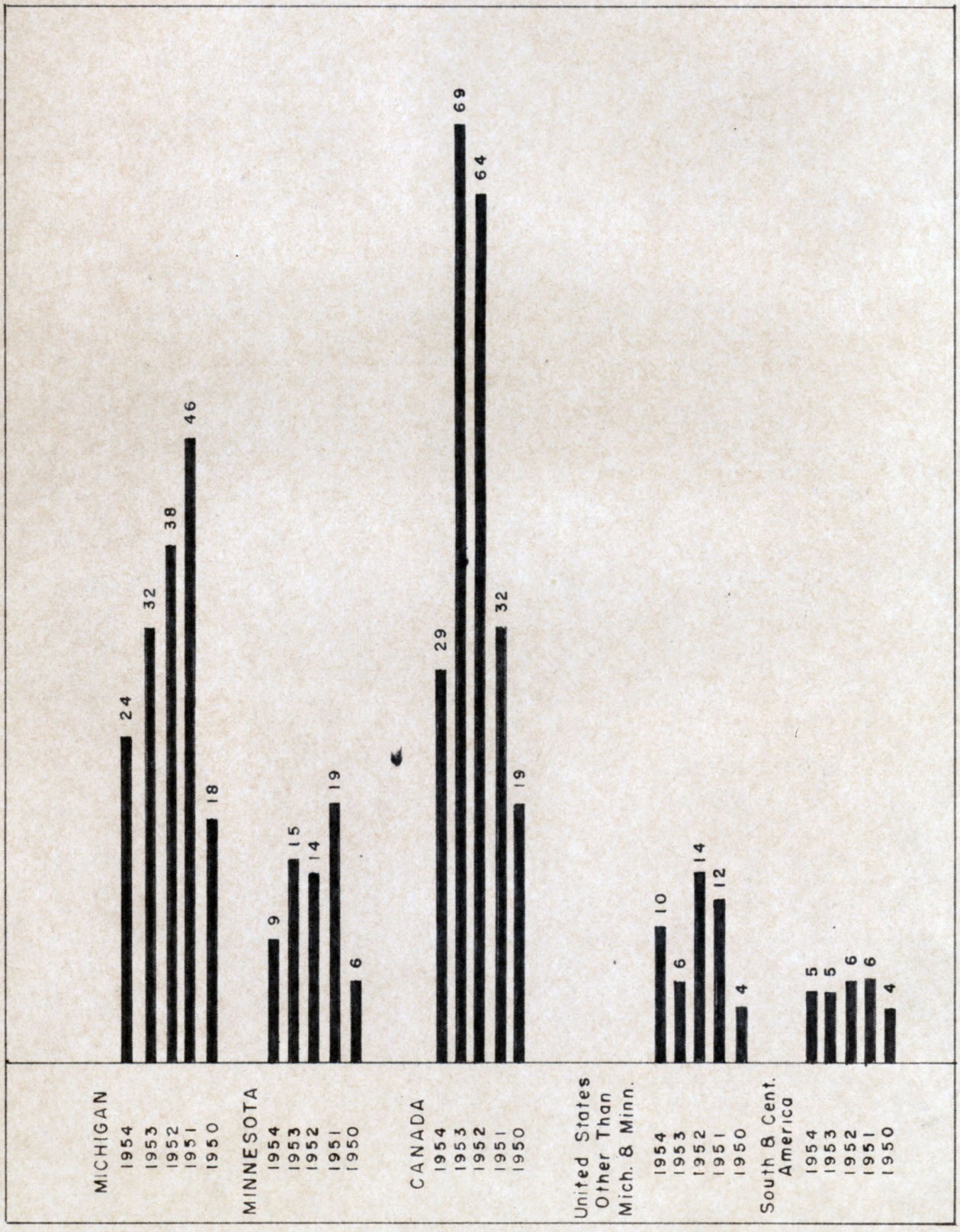
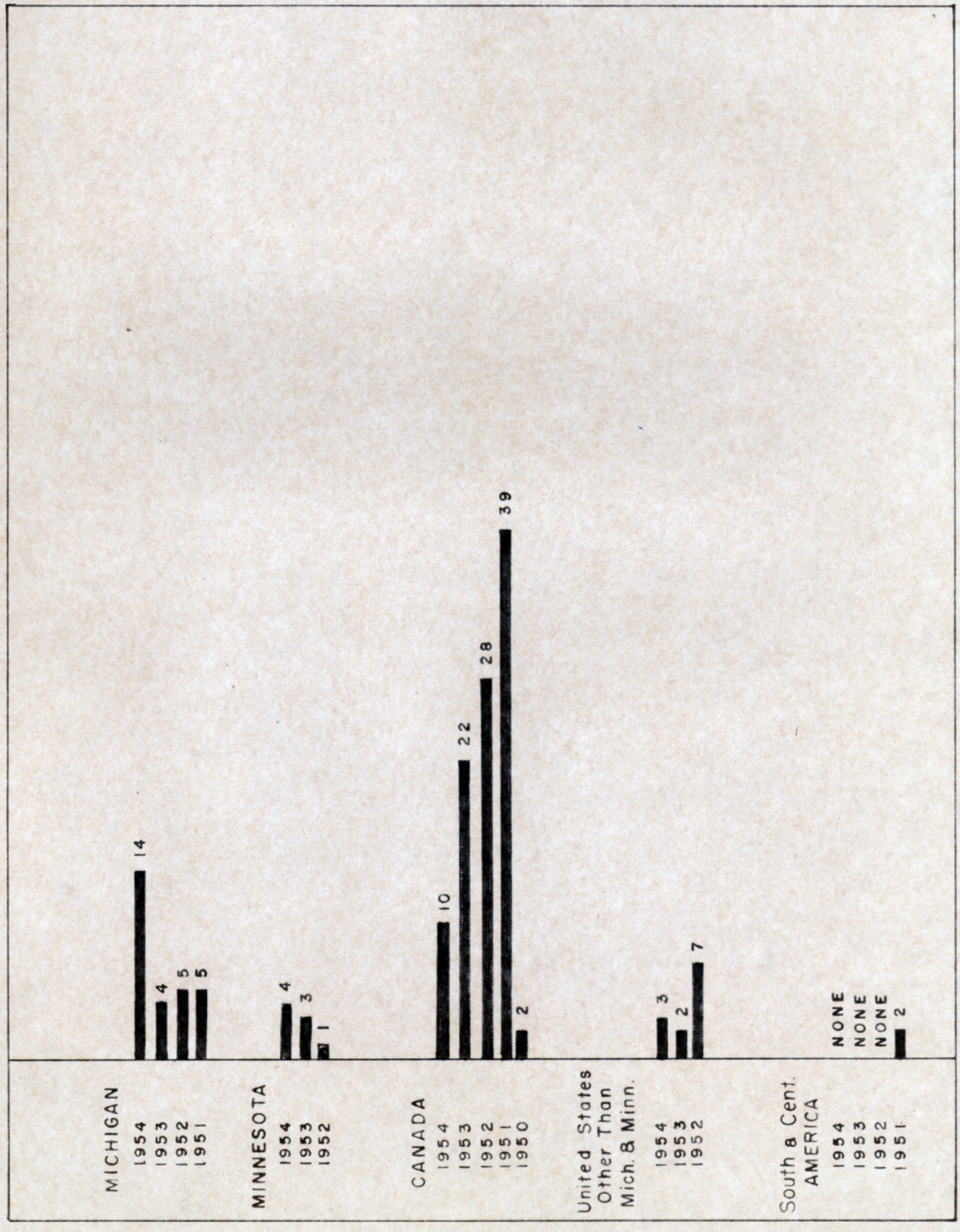


Figure 11

GRAPH SHOWING RATE OF OUTSIDE EXPLORATIONS 1950 - 1954 Incl.



Metallurgical Departments. In as much as possible, this microscopy work is coordinated with field work and core drilling. We are also interested in the beneficiating implications of these studies. The following areas have received attention during the year.

A. Michigan

1. Marquette District - The iron-formation of the Empire Area is composed of magnetite bearing rocks of carbonate chert (Plate 1), chert-carbonate-silicates (Plate 2); and clastics interbedded with chert-carbonate-silicates (Plate 3). Test work shows the magnetite to be economically concentratable.

The iron-formation of the Cascade Area is composed of martite-chert (Plate 4) and hematite-martite bearing clastics interbedded with hematite-martite-chert. Some test work has been done on the concentrating characteristics of the iron-formation with varying results while using the magnetic-oxide conversion process.

The iron-formation of the Tilden-Foster Lake Area is composed of goethite-hematite-martite bearing chert (Plate 5) and clastics. The iron minerals, on the basis of the samples tested to date, are not favorable for treatment, even after converting them to an artificial magnetite.

2. Perkins District - There are two iron-formation members present in the Perkins District, a south member and a north member. The north member is a well oxidized martitic iron-formation and the south member is a magnetite bearing silicate chert (Plate 6).

B. Minnesota

A microscopic study was made of a suite of specimens from our field work on the so-called Vermilion Range Extension, O.E. 1107. The polished section work indicated that three of the group were iron-formation rather than only one, as had been determined in the field suggesting a greater width. The study also showed that liberation could be achieved at -270 mesh (See Plate 7).

C. Canada

1. Albanel Area - A number of pieces of drill core and outcrop material were given to Mr. Han by Mr. Eric Rex for microscopic study. This suite constituted a typical section through the Albanel Area. The principal iron minerals are magnetite, hematite, siderite and some iron silicates. Of particular interest is the fact that some of the magnetic material is magnetite formed after hematite, shown in Plate 8.

2. Northwestern Alberta - Material from L.O. 3130, from the Peace River Area, Alberta, was representative of extensive low grade sideritic goethitic deposits. The oolitic nature of this material is shown by Plate 9. A satisfactory concentrate could not be made.

3. Lake St. John - Considerable interest was aroused from material obtained under L.O. 3135 near Dolbeau, Lake St. John Area, Quebec. This material was a coarse-grained basic intrusive containing ilmenite and magnitite shown in Plate 10. It was later learned that this preliminary sample was not representative.

4. British Columbia - Dr. Bartley visited a manganese prospect near Ollala, British Columbia. Mr. Han made a study of the suite of samples collected by Dr. Bartley of which Plate 11 shows typical rhodonite-braunite vein material.

VIII. OTHER DEPARTMENTAL HIGHLIGHTS

A. Report System

In July, the Department instituted a system of numbered reports classified into basic groups as follows:

1. General Exploration
2. Geology
3. Geophysics
4. Drilling
5. Reserves
6. Subsidence

The Mineral Reports prepared by Mr. Han in the microscopy section may also be given a Metallurgical Department number when the report deals with matters of interest to both departments.

By the end of the year, there were 5 reports in General Exploration, 3 in Geology, 2 in Geophysics, 3 in Drilling, 1 on Reserves and 1 on Subsidence. We believe that this is a definite improvement making for better organization and wider distribution of information. The reports are generally transmitted with with comment, by either the Michigan District Geologist or the Chief Geologist.

B. Reserves

During the year, the Department continued to be responsible for the Company's ore reserves and worked closely with the Engineering and Tax Departments. Three projects, in particular, are worthy of note.

1. In February, the Department brought out the so-called Special Reserve Study summarizing the individual property reserves in both Michigan and Minnesota. Of particular interest was the accompanying figure entited the Production Depletion Graph showing individual properties carried to exhaustion or the year 1970. Individual charts were prepared for each property showing the comparitive status of such features as reserves, annual production, capacity, grade of product and unusual expenditures required to make the ore available. It has been planned to make this an annual feature to appraise the Company's ore reserves.

During the year the Production Depletion Graph was modified to show depletion of proven and probable ore and a separate graph to show the depletion of proven, probable and prospective reserves.

In response to a request from Mr. Sterling, the Department prepared a report dated June 25th on the subject of the Marquette Range Low Grade Concentrating Reserves, with specific reference to what might be termed the Optimistic Potential. The intent of the study was to show maximum tonnages available to open pit mining in areas either owned, controlled or thought likely to be controlled by the Company. For the most part, these figures are optimistic and are prepared on fragmentary information. In fact, we introduced a new ore class termed speculative for use in this report. We believe that after surface sampling and core drilling is done, that such exploration will materially reduce the magnitude of these optimistic reserves.

2. During 1954 a special committee of Department members and former Department members completed a report known as the Ishpeming Deep Soft Ore Study. The purpose of this study was to organize all available information concerning deep soft ore reserves in the Ishpeming Area and to make an economic appraisal of the best means of mining these orebodies. This study is related to the future plans of the Mather Mine "A" Shaft, the Cliffs-Shaft "C" Shaft and the exploitation of the Section 11 reserves. We believe that this report has been a valuable contribution to the Company's planning for the best mining of these reserves.

C. Exploration Drilling

1. New Drill Rod and Casing Design -During the year, several meetings were held with representatives of the Joy Mfg. Co. of Michigan City, Indiana relative to the re-design of our diamond drill rods and casing. Our goal has been to design a three string assembly to replace the current four string or X series as it is known. The advantages of the new string would be greater strength in both rods and casing, the use of drill mud, better design of core barrels and application of wire line core barrels. We have forecasted experimental work of these new designs for 1955.

2. Accounting and Insurance - Considerable progress was made in improving our accounting with reference to the plant equipment account, particularly with reference to depreciation and repairs. A more realistic schedule of per shift charges was adopted. The insurance of the equipment was reviewed and more adequate coverage secured. A significant increase in insurance was made on our diamonds.

3. Diamond Bit Research - Diamond Drill Report No. 3, by Mr. Maikkula summarizes the progress made on the research of oriented diamonds and our coring bits. As a result, we are purchasing a number of oriented bits from our manufacturers to gather more factual information before reaching definite conclusions. Also during the year an intensive effort has been made to use our stock of black diamonds or carbons to decrease this inventory. Further, our study on diamonds has indicated the value of scrap set in bits on certain applications, particularly for projects such as the Cameo Exploration. Mr. Maikkula is to be congratulated for his efforts in this study.

4. Exploration Program - With the reduction in ore sales for the year 1954, corresponding reduction was made in the exploration program. In May, a review was made of various projects and certain cut-backs affected at that time. Our personnel was reduced at that time also. During October and November, numerous plans were made for the 1955 season. In November, the Cleveland Program Committee met in Ishpeming and reviewed the program as had been suggested. The following tabulation shows the distribution by areas:

1955 EXPLORATION
RECAP BY AREAS

	Total	Percent
1. Michigan----------$	436,380	78.7
2. Minnesota----------	53,000	9.6
3. Canada----------	50,000	9.0
4. U. S. General----------	15,000	2.7

The following table is a comparison to show the relative magnitude of the 1954 program with reference to the two years previous and for the coming year:

1955 EXPLORATION
COMPARATIVE PROGRAM

1. 1955 Program Total------$	554,380
2. 1954 Revised Program----	1,119,685
3. 1953 Program----------	1,757,400
4. 1952 Program----------	1,694,728

5. Budget - In the fall of 1954, the budget system was introduced. Considerable time was devoted to an analysis of our 1953 and 1954 overhead expenses. We found a considerable number of irregularities in the accounting. Separate budgets have been recommended for Michigan General Exploration, Michigan Drilling Division, Minnesota and U. S. General. It would also be well to have a separate clearing account for expenditures of United States origin with reference to Canadian Exploration. It has been determined that we will start with three budgets covering Michigan General, Michigan Drilling Division and Minnesota Exploration.

6. Land Offer Accounting - Through the office of the Chief Geologist, an effort has been made to review our Land Offer accounting. The review went back to 1952 and considered all Land Offers current in 1952 and since then. This study has been quite profitable. One surprising development was with reference to Canadian Land Offers. It had been assumed that the accounting on Canadian Land Offers included both United States and Canadian origin charges. We found that a dual system was being maintained. U. S. Charges totaling in excess of $26,000.00 had accumulated. It is planned to make a similar study of the Outside Exploration charges during 1955.

7. Subsidence - During the year, the Exploration Department continued to work with the Subsidence Committee on the matters of Mine Subsidence. Major conferences were held in May and October. This is a cooperative project with the U. S. Bureau of Mines. Principal activities in this work have been the continuation of our microseismic recording and the correlation of the geology of the actual subsidence noted.

8. Radiation - During 1954, the Department concluded its study on the possible occurrence of radioactive gases and particles in our mine air. We believe that no problem exists providing adequate ventilation is available.

9. Publications - During the year, the Department prepared a number of papers for publication. The first was the one on The Geology of the Marquette Range prepared by Burton Boyum for the Minnesota Geology Symposium given in Hibbing on April 9th. Mr. Maikkula prepared a paper on Drill Hole Cementing, and Mr. Boyum wrote a paper on The Rotary Drilling Technique used at El Trueno. Both of these papers were delivered at the University of Minnesota's Annual Diamond Drilling Symposium held on October 14th - 16th. Mr. Boyum also prepared a summary of the exploration activities in the Lake Superior Region for the A.I.M.E. magazine, Mining Engineering. Messrs. Gerald J. Anderson, E. Richard Randolph and Rolland L. Blake co-authored a paper on the Electromagnetic Induction Technique with Dr. Stanley Ward of the McPhar Geophysics Company. This paper was presented at the Chicago meeting of the A.I.M.E. in February, 1955.

MICROSCOPY

Empire Non-Oxidized Magnetic Iron-Formation

Plate 1
Empire

Magnetic carbonate chert. 125 x.
Magnetite, white; carbonate, grey; chert, dark grey; and pits, black
Magnetite grain size: -325 ;540 mesh
D.D.H. No. 4. Depth 195'
Polished Section No. 446. Photomicrograph No. 324

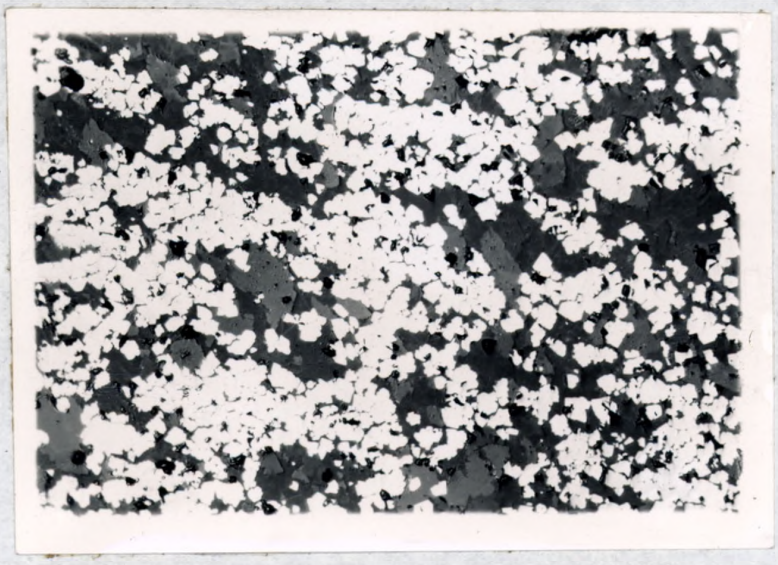


Plate 2
Empire

Magnetic chert-carbonate-silicate (carbonate-magnetite layer) 125 x.
Magnetite, white; gangue, grey; and pits, black
Magnetite Size: -400 +800 Mesh
D.D.H. No. 4 Depth 585'
Polished Section No. 466. Photomicrograph No. 327

Empire Non-Oxidized Magnetic Iron-Formation

Plate 3
Empire

Interbedded clastic rock (graywacke layer). 125 x.
Magnetite, white; gangue, grey; and pits, black.
Magnetite Size: -48 +200 Mesh and -540 +3200 mesh.
D.D.H. No. 3. Depth 144'.
Polished Section No. 421. Photomicrograph No. 325.

Cascade Oxidized Iron-Formation

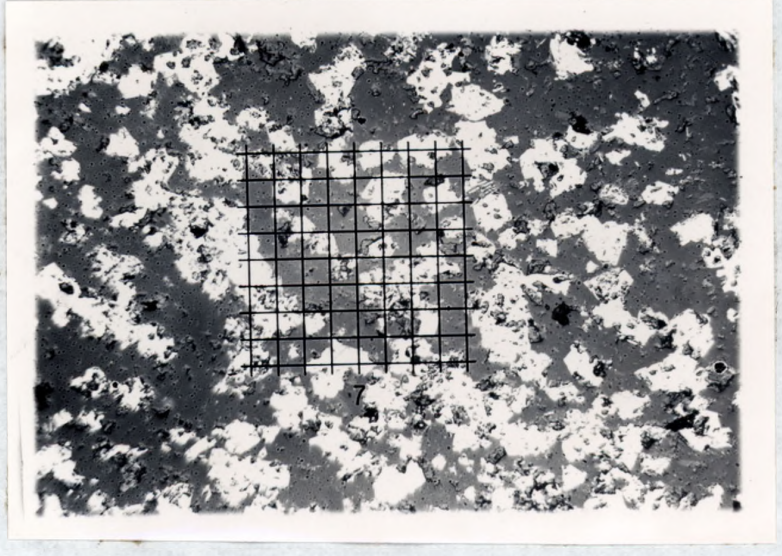


Plate 4
Cascade

Martitic chert.
Martite, white; gangue, grey; and pits, black.
Screen size: plus 400 mesh (800 grains per inch).
D.D.H. No. 32. Depth 410'.
Polished Section No. 547. Photomicrograph No. 356.

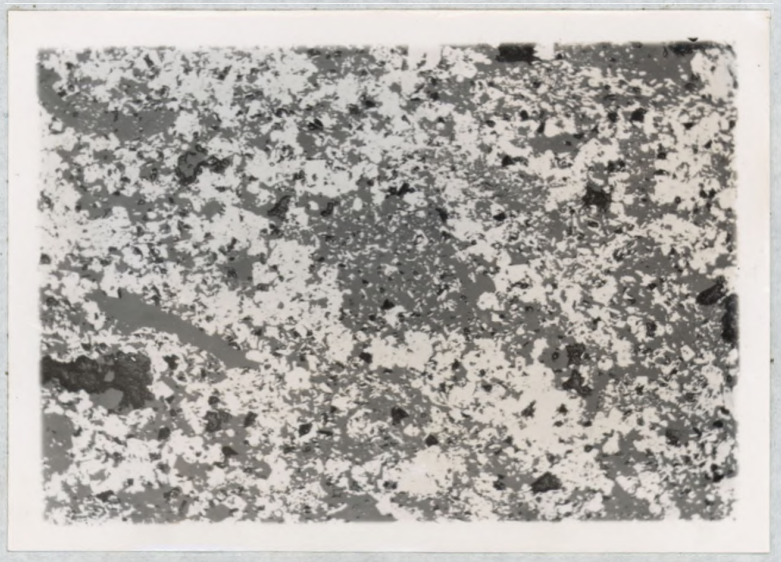


Plate 5
Tilden Area

Hematite-martite chert. 125 x.
Martite (granular), white; hematite (platy), white; gangue, grey; and pits, black
Martite size: 400 mesh, hematite size: 3200 mesh or finer
D.D.H. No. 1, Section 25. Depth 208'
Polished Section No. 586. Photomicrograph No. 387

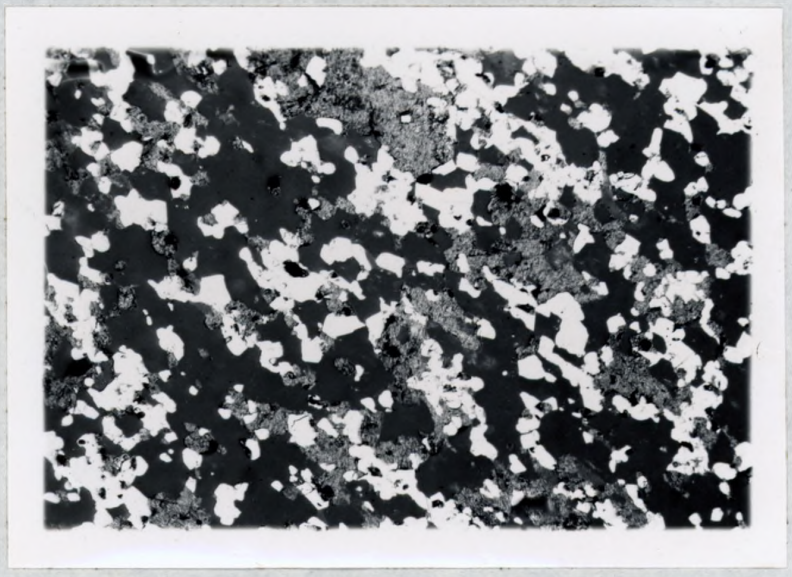


Plate 6
Perkins
South Member

Magnetic silicate chert. 125 x.
Magnetite, white; silicate, grey; chert, dark grey; and pits, black
Magnetite Size: -400 +540 mesh
D.D.H. No. 2. Depth 1390'
Polished Section No. 1162. Photomicrograph No. 3706

Vermilion Range West Extension

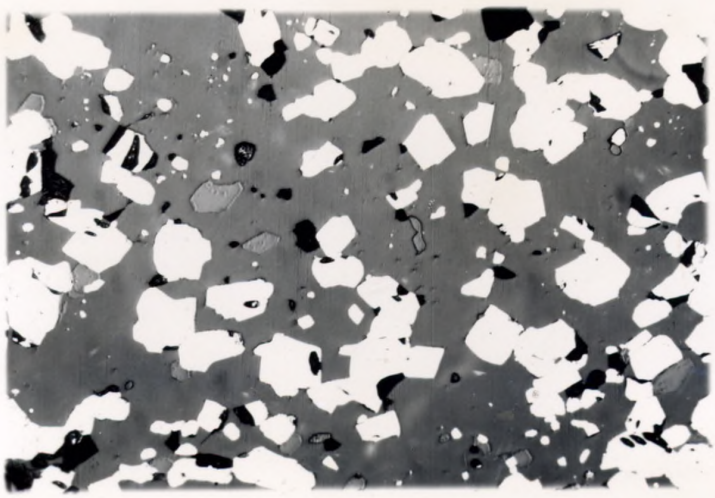


Plate 7
O.E. 1107

Magnetic silicate-chert. 125 x.
Magnetite, white; silicate, light grey; chert, grey; and pits, black
Magnetite size: 200 mesh to 325 mesh
Specimen No. 418
Polished Section No. 1150. Photomicrograph No. 3676

Albanel Oolitic Magnetic Iron-Formation

Plate 8
Albanel
L.O. 3120

Magnetic carbonate-chert. 125 x.
Magnetite, white; chert, dark grey; carbonate, grey; and pits, black
Magnetite size: -325 mesh (cross-section)
D.D.H. No. 20. Depth 50'
Polished Section No. 570. Photomicrograph No. 388

Alberta Oolitic Limonite-Siderite Iron-Formation

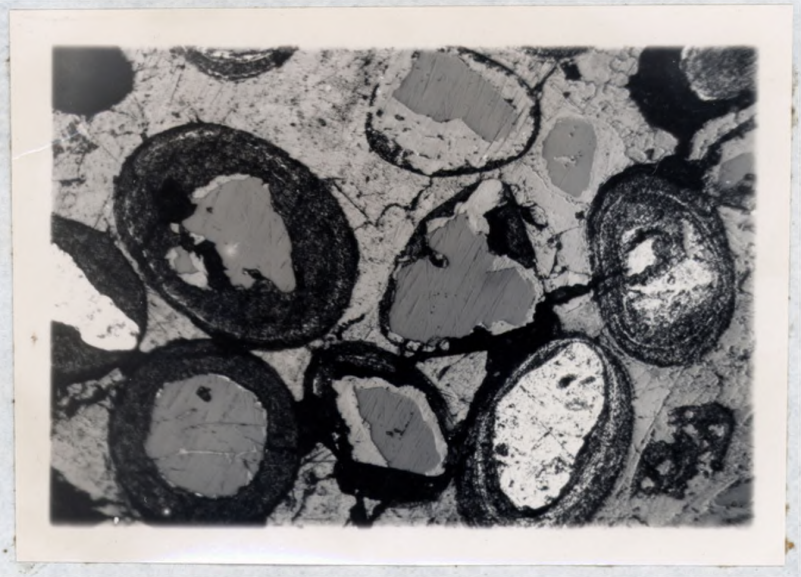


Plate 9
Alberta
L.O. 3130

Limonite-siderite oolites. 62 x.
Limonite, white; carbonate, light gray; quartz, gray; unpolished limonite-carbonate, black; and matrix, rough light, grey.
Drill Hole phil "C" No. 1. Depth 470'-610'
Polished Section No. 1080. Photomicrograph No. 276

Lake St. John Ilmenite-Magnetite-Bearing Basic Intrusive

Plate 10
L.O. 3135

Magnetite-Ilmenite bearing pyroxenite. 28 x.
Magnetite and ilmenite size: 14-65 mesh
Specimen No. C-324
Polished Section No. 1141. Photomicrograph No. 347

British Columbia Manganese Vein

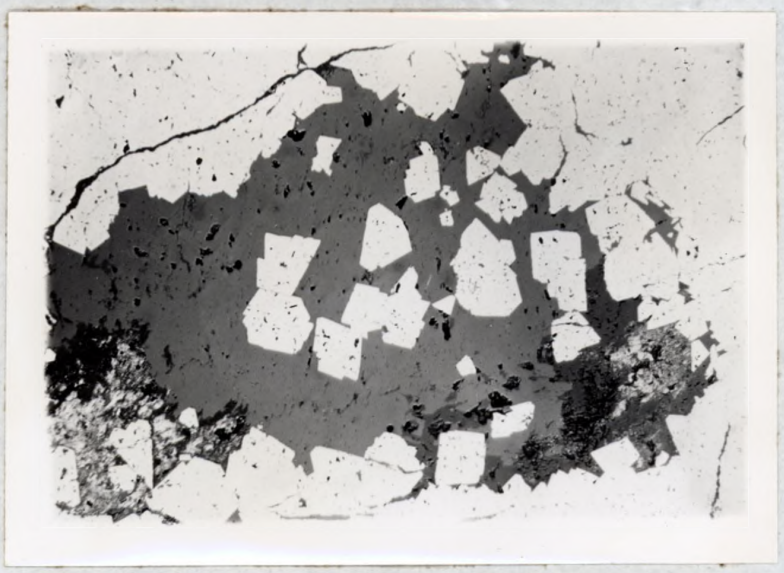


Plate 11
L.O. 3139

Euhedral Braunite. 125 x.
Braunite, white; gangue, grey; and pits, black
Sample No. MXC-698
Polished Section No. 1127. Photomicrograph No. 341