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PROVINCE OF ONTARIO

DEPARTMENT OF MINES

HON. PHILIP T. KELLY, *Minister of Mines* H. C. RICKABY, *Deputy Minister*

SIXTY-FOURTH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. LXIV, PART 1, 1955

Statistical Review of the Mineral Industry for 1954 - - - - 1-66
Mining Accidents in 1954 - - - - - - - - - - 67-84
Classes for Prospectors, 1954-55 - - - - - - - - 85-89

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO
Printed and Published by Baptist Johnston, Printer to the Queen's Most Excellent Majesty
1956

TABLE OF CONTENTS
Vol. LXIV, Part 1

PAGE

Introductory Letter ii

STATISTICAL REVIEW OF THE MINERAL INDUSTRY FOR 1954

General Summary 1
Mineral Production 1
Metal Production 7
Metal Prices and Exchange 7
Prospecting 8
Metallic Minerals 10
Gold 10
General 10
Production 10
Dividends 29
Gold-Milling Plants 37
Labour Statistics 38
World Output 38
Nickel-Copper and Platinum Metals 40
Dividends 40
General Statistics 40
Production of Precious Metals 42
Operations at the Mines 42
Silver-Cobalt 43
Iron Ore, Pig Iron, and Steel 45
Lead and Zinc 46
Calcium and Magnesium 46
Non-Metallic Minerals 46
Arsenic 46
Asbestos 46
Feldspar 47
Fluorspar 47
Graphite 47
Gypsum 47
Mica 48
Mineral Waters 48
Natural Gas and Petroleum 48
Natural Gas 49
Petroleum 49
Drilling and Exploration 50
Nepheline Syenite 50
Peat 51
Quartzite, Quartz, and Silica Brick 51
Salt 51
Sulphur 52
Talc 52
Structural Materials 52
Construction Contracts 52
Cement 53
Lime 53
Sand and Gravel 54
Sand-Lime Brick 54
Stone 55
Clay Products 55
Miscellaneous Statistics 56
Mining Company Incorporations 56
Mining Revenue and Expenditure 62
Provincial Assay Office 64
Special Work 64
Summary 66

MINING ACCIDENTS IN 1954

Statistical Review 67
Introduction 67
Summary of Fatal and Non-Fatal Accidents 69
Fatal Accidents 69

PAGE

Statistical Review—*Continued*
Non-Fatal Accidents 72
Mines 72
Metallurgical Works 73
Quarries 73
Clay, Shale, Sand, and Gravel Pits 73
Contract Diamond-Drilling 73
Infection 74
Electrical Accidents 74
Explosives 74
Fires 74
274. Coniarum Mines, Ltd. 74
275. Steep Rock Iron Mines, Ltd. 75
276. Hollinger Consolidated Gold Mines, Ltd. 75
277. Pamour Porcupine Mines, Ltd. 76
278. Hollinger Consolidated Gold Mines, Ltd. 76
279. Upper Canada Mines, Ltd. 76
280. Hollinger Consolidated Gold Mines, Ltd. 77
281. Hollinger Consolidated Gold Mines, Ltd. 77
282. Steep Rock Iron Mines, Ltd. 77
283. McIntyre Porcupine Mines, Ltd. 78
284. Cobalt Consolidated Mining Corp., Ltd. 78
285 Pamour Porcupine Mines, Ltd. 79
286. Algoma Ore Properties, Ltd. 79
287. Madsen Red Lake Gold Mines, Ltd. 79
288. Sylvanite Gold Mines, Ltd. 79
289. Hollinger Consolidated Gold Mines, Ltd. 80
290. Lake Shore Mines, Ltd. 81
291. Falconbridge Nickel Mines, Ltd. 81
292. McIntyre Porcupine Mines, Ltd. 81
293. Hollinger Consolidated Gold Mines, Ltd. 81
294. Castle-Trethewey Mines, Ltd. 82
Prosecutions 83
Regina *vs.* Donat Morin 83
Regina *vs.* William Sylvestre 83
Mine Rescue Stations 84
Ontario Government Cable-Testing Laboratories 84

CLASSES FOR PROSPECTORS, 1954–55

Interest in Classes Now Widespread 85
Classes Held 85
Particulars of Classes Held 85
Huntsville 85
Timmins 86
Geraldton 86
Port Arthur 86
Marathon 86
White River 87
Sudbury 87
Marmora 87
Toronto 89
Kenora 89

INDEX 91

Statistical Review of the Mineral Industry for 1954

By M. G. Arnoldi

GENERAL SUMMARY

Mineral Production

A total of over $500,000,000 was the production value of the mineral industry of Ontario in 1954. Specifically, this amounted to $503,757,221, or a gain of 6.16 percent over the 1953 value of $474,510,226. Metals, with a total value of $395,185,129 and being over 78 percent of the total mineral production, showed a gain of 6.54 percent over last year's figure of $370,926,750. The Sudbury nickel-copper industry, with its huge expansion projects, was mostly responsible for this. The production value of the nickel-copper ores and their by-products from this source was 72 percent of the total value of all metals produced in Ontario. The industry produced 315,795,468 pounds of nickel, which is the highest since 1943, when 287,963,545 was reported; and 279,959,195 pounds of copper, which has not yet reached the previous high of 347,845,369 in 1940. Values of these metals, of course, have increased considerably as the prices have risen year by year. Gold showed an increase for the year of 6.72 percent in value, mainly because the labour strikes in the Porcupine camp were settled early in the year. The iron-ore picture was not as bright this year owing to less demand from the American steel mills. In the non-metallic group, natural gas, petroleum, nepheline syenite, salt, sulphur, and talc all made advances, but the rest of the list was down slightly. Construction materials show a gain of 3.41 percent when their value of $65,116,199 is compared with the previous year's total of $62,968,946. Clay products made the greatest advance; their total value of $17,230,231 was 16.19 percent greater than the 1953 production total of $14,829,222. This is indicative of the tremendous building boom that the country is enjoying.

That exploration and development of new properties is going on at a feverish pace is shown by the number of claims recorded, which reached a high of 50,176 during the year as compared with 29,019 in 1953, which was in itself a record. Nickel-copper properties in the Sudbury district, base metals in the Manitouwadge Lake area of the Port Arthur district, uranium at Blind River and in Eastern Ontario, and the iron-ore property of Bethlehem Mines Corporation in southeastern Ontario are some of the prospects for early production.

The Emergency Gold Mining Assistance Act is still in force, but only a very few of the gold mines receive much advantage from it. Any mine selling its gold on premium markets is not eligible to receive assistance under the Act.

SUMMARY OF MINERAL STATISTICS, 1954

Product	Quantity	Value[1]	Wage-earners	Wages
METALLIC				
Gold ..... oz.	2,361,387	$ 80,460,251	10,459	$ 33,846,099
Silver ..... oz.	5,443,721	4,530,484	([2])	
Copper in matte exported[3] ..... lb.	25,566,373	6,698,390		
Copper, metallic and in concentrates, exported ..... lb.	255,985,988	74,645,146		
Nickel in matte,[3] in speiss, and in ore exported; metallic nickel; and nickel content of oxides and salts ..... lb.	316,019,050	176,556,296	18,125	71,882,208
Platinum metals ..... oz.	343,706	20,906,556		
Selenium ..... lb.	94,826	474,130		
Tellurium ..... lb.	7,195	12,591		
Cobalt in metal, oxides, salts, ores, and residues ..... lb.	2,252,965	5,912,997	[4] 1,037	3,182,826
Iron ore[5] ..... tons	2,416,434	20,341,203	1,711	7,043,032
Calcium and magnesium	.....	4,101,642	180	529,584
Lead ..... lb.	2,815,611	375,321	85	243,485
Zinc ..... lb.	1,420,048	170,122		
Total	.....	$395,185,129	31,597	$116,727,234
NON-METALLIC				
Arsenic[6] ..... lb.	1,180,350	$ 48,333	.....	.....
Asbestos ..... tons	21,389	3,497,824	214	$ 721,968
Feldspar, crude and ground ..... tons	1,791	22,052	4	1,240
Fluorspar ..... tons	904	40,130	14	15,469
Graphite, crude and refined ..... tons	2,452	253,441	31	59,947
Gypsum ..... tons	357,432	822,094	113	487,064
Mica, amber ..... lb.	137,208	4,195	5	1,060
Mineral waters ..... gals.	2,000	750	.....	.....
Natural gas ..... M cu. ft.	10,015,818	11,758,549	1,180	4,152,279
Nepheline syenite ..... tons	123,669	1,770,528	118	444,911
Peat fuel ..... tons	6	60	3	24
Peat moss ..... lb.	1,279,250	19,809	13	35,827
Petroleum crude ..... bbls.	412,474	1,390,000	135	301,379
Quartzite and quartz ..... tons	1,476,745	1,270,731	89	282,062
Silica brick ..... M	2,370	221,117	36	96,672

Salt ..... tons	733,066	4,440,418	234	779,802
Sulphur[7] ..... tons	49,598	495,980	.....	.....
Talc ..... tons	13,697	169,651	21	42,399
Total	.....	$ 26,225,662	2,210	$ 7,422,103
STRUCTURAL MATERIALS				
Cement, Portland ..... bbls.	7,208,061	$ 18,958,173	640	$ 2,449,391
Hydrated lime ..... tons	106,665	1,909,042	347	1,090,136
Quicklime ..... tons	503,926	5,771,697		
Sand and gravel ..... tons	46,433,191	25,577,612	1,652	4,421,883
Sand-lime products[8]	.....	267,377	29	83,898
Stone: limestone, marble, trap, granite, sandstone, slate ..... tons	10,142,056	12,632,298	1,059	3,198,379
Total	.....	$ 65,116,199	3,727	$ 11,243,687
CLAY PRODUCTS				
Brick, face ..... number	208,526,838	$ 11,041,413		
Brick, common ..... number	14,565,840	501,518		
Brick, fancy and ornamental ..... number	10,940	1,335		
Brick, sewer	.....	9,141		
Tile, drain ..... number	37,123,217	2,056,042	1,867	$ 5,471,015
Tile, stuctural, roofing, and floor	.....	1,442,927		
Sewer pipe, copings, flue-linings, etc.	.....	1,757,995		
Pottery and other products	.....	294,028		
Haydite and clay	.....	125,832		
Total	.....	$ 17,230,231	1,867	$ 5,471,015
GRAND TOTAL	.....	$503,757,221	39,401	$140,864,039

[1]Canadian funds.
[2]Wage-earners and wages included with figures for silver-cobalt smelters and refineries([4]).
[3]Copper in matte valued at 26.2 cents per pound, and nickel at 54 cents.
[4]Wage-earners and wages for silver-cobalt smelters and refineries.
[5]The production value of pig iron from Ontario iron ores is no longer included in the above table, but the record of domestic ore smelted in Ontario furnaces may be found on page 45.
[6]Shipments from Ontario sources and not actual production figures.
[7]Tonnage given in sulphur content of sulphuric acid.
[8]No deduction made for lime used in manufacturing.

COMPARATIVE VALUE OF MINERAL PRODUCTION, 1950–54

Product	1950	1951	1952	1953	1954
METALLIC					
Gold (Canadian value)	$ 94,216,874	$ 91,105,477	$ 87,540,620	$ 75,388,307	$ 80,460,251
Silver	3,561,005	4,273,241	5,416,647	4,331,199	4,530,484
Platinum metals	17,822,766	22,490,536	18,475,723	20,046,390	20,906,556
Cobalt[1]	964,003	1,999,612	3,226,903	4,013,077	5,912,997
Nickel[2]	112,292,202	151,217,865	151,666,687	160,491,126	176,556,296
Copper, metallic and in matte	54,411,033	70,861,788	70,981,618	77,587,440	81,343,536
Selenium	154,176	267,005	265,128	389,332	474,130
Tellurium	11,419	11,594	9,707	7,919	12,591
Iron ore	17,562,059	21,205,152	19,632,551	23,137,997	20,341,203
Lead, in ore	.....	.....	291,979	84,892	375,321
Magnesium Calcium	1,545,011	3,618,219	4,812,368	5,295,840	4,101,642
Bismuth	.....	34,048	.....	.....	.....
Zinc	.....	.....	130,630	20,546	170,122
Tungsten concentrates (WO_3)	.....	.....	164,886	132,685	.....
Total	$302,450,548	$367,084,537	$362,615,447	$370,926,750	$395,185,129
NON-METALLIC					
Arsenic, white	$ 16,220	$ 94,406	$ 71,477	$ 56,150	$ 48,333
Asbestos	1,493,039	3,773,069	3,862,653	3,965,299	3,497,824
Beryllium ore	7,882	.....	.....	.....	.....
Diatomite	.....	.....	.....	12,000	.....
Feldspar, crude and ground	49,619	125,727	37,628	28,018	22,052
Fluorspar	262,643	223,398	38,465	38,887	40,130
Garnet rock	240	.....	.....	.....	.....
Graphite, crude and refined	390,815	231,167	255,732	366,528	253,441
Gypsum	875,217	672,276	1,060,429	899,630	822,094
Mica, amber	28,299	3,904	4,618	7,687	4,195
Mica, white	128,161	310,530	106,943	51,481	.....
Mineral waters	440	450	440	150	750
Natural gas	8,890,532	9,962,553	9,946,024	11,694,595	11,758,549
Nepheline syenite	842,886	1,114,943	1,111,950	1,576,271	1,770,528
Peat fuel	580	300	300	.....	60

Peat moss	206,625	72,557	69,013	52,535	19,809
Petroleum, crude	892,335	677,905	641,400	1,005,535	1,390,000
Phosphate	712	94	.....	.....	.....
Quartz crystals	.....	1,407	11,287	.....	.....
Quartzite and quartz	1,027,791	1,496,404	1,495,245	1,301,048	1,270,731
Silica brick	174,372	204,831	246,108	313,175	221,117
Salt	4,639,867	4,789,990	4,401,780	3,919,810	4,440,418
Sulphur[3]	131,540	156,050	183,460	371,300	495,980
Talc and soapstone	182,048	160,540	149,711	125,209	169,651
Total	$ 20,241,863	$ 24,072,501	$ 23,694,663	$ 25,785,308	$ 26,225,662
STRUCTURAL MATERIALS					
Cement, Portland	$ 10,953,896	$ 12,494,677	$ 14,142,060	$ 18,497,744	$ 18,958,173
Lime, hydrated and quicklime	6,030,228	6,921,916	6,921,062	7,714,252	7,680,739
Sand and gravel	15,553,186	19,905,293	23,240,203	24,359,496	25,577,612
Sand-lime products[4]	729,328	714,528	520,619	578,872	267,377
Stone: limestone, granite, etc.	7,843,124	10,396,650	10,303,173	11,818,582	12,632,298
Total	$ 41,109,762	$ 50,433,064	$ 55,127,117	$ 62,968,946	$ 65,116,199
CLAY PRODUCTS					
Brick, face	$ 5,277,280	$ 6,214,362	$ 7,102,104	$ 9,199,325	$ 11,041,413
Brick, common	417,195	429,702	484,274	501,959	501,518
Brick, fancy and ornamental	510	1,179	726	974	1,335
Brick, sewer	16,352	19,768	5,687	11,185	9,141
Tile, drain	1,085,567	1,243,891	1,506,992	1,728,011	2,056,042
Tile, structural, roofing, and floor	1,165,915	1,210,981	1,166,075	1,306,141	1,442,927
Sewer pipe, copings, flue-linings, etc.	1,197,901	1,124,201	1,321,499	1,674,516	1,757,995
Pottery and other products	112,457	114,720	280,224	295,365	294,028
Haydite and clay	77,086	125,537	107,619	111,746	125,832
Total	$ 9,323,263	$ 10,484,341	$ 11,975,200	$ 14,829,222	$ 17,230,231
GRAND TOTAL	$373,215,436	$452,074,443	$453,412,427	$474,510,226	$503,757,221

[1]Cobalt in oxide, metallic cobalt, and cobalt content of residues marketed.
[2]Nickel in matte, oxide, and metallic nickel.
[3]Value of sulphuric acid produced.
[4]No deduction made for lime consumed in manufacturing.

TOTAL MINERAL PRODUCTION

Year	Exchange equalization or discount	Metallics	Non-metallics	Structural materials	Clay products	Total
Before 1891[1]		$ 9,520,269				$ 9,520,269
1891–99		9,072,635		$44,790,920		53,863,555
1900		2,565,286		6,733,338		9,298,624
1901		5,016,734		6,814,352		11,831,086
1902		6,257,499		7,134,135		13,391,634
1903		5,242,575		7,628,018		12,870,593
1904		4,906,677		6,665,970		11,572,647
1905		10,201,010		7,653,286		17,854,296
1906		13,353,080		9,035,303		22,388,383
1907		14,550,835	$ 3,020,537	$ 3,876,275	$ 3,571,726	25,019,373
1908		16,754,986	2,629,749	3,396,406	2,856,476	25,637,617
1909		22,928,496	2,825,751	4,028,206	3,198,922	32,981,375
1910		28,161,678	3,141,658	4,380,000	3,630,559	39,313,895
1911		29,102,867	3,674,926	4,935,609	4,263,395	41,976,797
1912		34,799,734	4,009,643	4,701,170	4,831,056	48,341,603
1913		37,507,935	4,296,450	5,866,775	5,561,151	53,232,311
1914		33,345,291	4,339,703	4,505,368	4,105,597	46,295,959
1915		44,109,679	4,655,250	3,609,371	1,871,379	54,245,679
1916		55,002,918	4,982,140	3,734,065	1,584,699	65,303,822
1917		56,831,857	7,702,942	4,962,284	2,596,749	72,093,832
1918		66,178,059	7,815,062	4,297,401	2,018,450	80,308,972
1919		41,590,759	6,308,182	7,208,413	3,776,562	58,883,916
1920	$ 1,376,275	48,281,553	8,141,796	11,921,019	4,735,154	74,455,797
1921	1,359,636	28,777,581	6,636,217	13,967,386	5,183,125	55,923,945
1922	208,621	40,290,157	7,591,913	13,640,166	6,944,218	68,675,075
1923	280,196	44,076,660	8,511,786	13,139,757	6,269,140	72,277,539
1924	196,750	52,130,314	7,555,283	12,398,465	5,137,865	77,418,677
1925	–2,838	62,495,472	7,488,034	12,451,174	5,148,626	87,580,468
1926	–595	59,218,297	7,842,632	12,681,308	5,356,469	85,098,111
1927		62,631,255	7,638,605	14,160,552	5,853,035	90,283,447
1928	2,811	71,267,003	7,822,641	14,815,814	6,177,664	100,085,933
1929	157,456	83,967,446	8,621,427	18,541,687	6,830,162	118,118,178
1930	36,703	83,356,365	8,492,263	16,571,626	5,221,214	113,678,171
1931	1,926,221	72,452,544	7,642,308	11,995,556	3,552,799	97,569,428
1932	6,134,157	63,997,017	7,361,897	7,295,917	1,690,505	86,479,493
1933	16,486,437	78,877,928	7,094,636	6,335,977	1,024,579	109,819,557
1934	29,287,439	99,985,594	7,553,571	7,766,563	1,261,006	145,854,173
1935	32,169,797	110,718,768	7,766,657	7,555,508	1,370,225	159,580,955
1936	34,139,926	131,091,593	8,933,036	8,931,899	1,573,936	184,670,390
1937	37,028,708	167,814,485	10,055,177	13,241,244	2,033,845	230,173,459
1938	42,070,230	155,835,230	9,949,317	10,012,203	2,083,496	219,950,476
1939	48,322,783	161,208,555	11,470,739	10,705,629	2,341,617	234,049,323
1940	58,154,794	176,072,441	12,514,093	13,950,607	2,513,884	263,205,819
1941	56,925,914	181,989,098	12,349,030	15,462,605	3,087,616	269,814,263
1942	49,280,883	183,359,295	12,406,382	13,767,041	2,549,487	261,363,088
1943	37,751,307	168,494,248	12,502,624	12,708,296	2,453,829	233,910,304
1944	30,874,701	155,066,073	11,075,707	13,391,477	2,347,396	212,755,354
1945	28,975,884	159,234,509	10,909,496	14,481,105	3,107,189	216,708,183
1946	28,762,356	127,729,390	10,205,701	20,187,881	4,321,499	191,206,827
1947	27,785,522	179,873,883	11,909,819	25,186,051	5,278,438	250,033,713
1948	30,044,272	215,624,013	14,550,912	29,030,823	6,563,754	295,824,498
1949	36,597,022	229,853,394	16,850,867	33,763,974	7,435,439	324,500,696
1950	42,935,140	259,605,408	20,241,863	41,109,762	9,323,263	373,215,436
1951	40,183,893	326,900,644	24,072,501	50,433,064	10,484,341	452,074,443
1952		362,615,447	23,694,663	55,127,117	11,975,200	453,412,427
1953		370,926,750	25,785,308	62,968,946	14,829,222	474,510,226
1954		395,185,129	26,225,662	65,116,199	17,230,231	503,757,221
Total...	$719,452,401	$5,718,015,122		$1,556,793,808		$7,994,261,331

[1]Prior to 1891, when the Ontario Bureau (now Department) of Mines was established, it is estimated that metals to a value of $9,520,269 were produced. No estimate has been made of the output of non-metallics up to 1891.

Metal Production

The aggregate metal production of Ontario mines from the earliest records up to the end of 1954 was valued at $6,437,467,523. The value of production in 1954, amounting to $395,185,129, was 78.44 percent of the total value of Ontario's mining industry.

METAL PRODUCTION TO DECEMBER 31, 1954

Metal or product	To December 31, 1953	1954	To December 31, 1954
Gold	$1,540,019,656	$ 80,460,251	$1,620,479,907
Exchange equalization	719,452,719	.....	719,452,719
Nickel, including nickel oxides and salts	1,915,059,143	176,556,296	2,091,615,439
Silver	308,254,629	4,530,484	312,785,113
Copper[1]	945,786,378	81,343,536	1,027,129,914
Pig iron, from domestic ore	98,257,508	.....	98,257,508
Cobalt[2]	47,386,532	5,912,997	53,299,529
Platinum metals	294,342,345	20,906,556	315,240,901
Iron ore[3]	135,752,284	20,341,203	156,093,487
Lead	5,355,450	375,321	5,730,771
Zinc, in ore and concentrates	1,146,069	170,122	1,316,191
Molybdenum	224,110	.....	224,110
Bismuth	263,613	.....	263,613
Selenium	4,530,608	474,130	5,004,738
Tellurium	259,583	12,591	272,174
Chromite	55,090	.....	55,090
Tungsten, in concentrates	808,338	.....	808,338
Magnesium	25,319,073	4,101,642	29,420,715
Calcium			
Barium	9,266	.....	9,266
Total	$6,042,282,394	$395,185,129	$6,437,467,523

[1]Includes small quantities of copper sulphate.
[2]Includes metal, oxide, salts, and cobalt content of residues exported.
[3]Value of ore shipped to all points.

Dividends.—During 1954, dividends were paid by 25 gold, 2 nickel-copper, and 1 silver-cobalt mining companies. Investment or holding companies, of which there are several, have been excluded in the case of gold and nickel-copper companies but not in the case of silver-cobalt companies.

DIVIDENDS PAID BY METAL-MINING COMPANIES TO DECEMBER 31, 1954

Industry	To end of 1953	1954	To end of 1954
Gold	$ 609,624,455	$15,530,063	$ 625,154,518
Nickel-copper	749,036,053	46,081,225	795,117,278
Silver-cobalt	104,281,018	541,801	104,822,819
Total	$1,462,941,526	$62,153,089	$1,525,094,615

Metal Prices and Exchange

The following table is a computation of the average exchange rate of the United States dollar in Canadian funds, the pound sterling in Canadian funds, the price of silver and copper on the New York market, and the price of gold in Canadian dollars per fine ounce.

Month	Average exchange rate, U.S. dollar in Canadian funds	Pound sterling in Canadian funds	Silver, cents per ounce		Copper, cents per pound, New York export, U.S. funds	Gold in Canadian dollars per fine ounce
			New York market, U.S. funds	In Canadian funds		
1953						
January	0.9705	2.7305	84.500	81.090	34.780	33.966
February	0.9773	2.7555	85.250	83.531	34.783	34.204
March	0.9833	2.7692	85.250	84.125	34.451	34.441
April	0.9837	2.7713	85.250	84.100	32.863	34.425
May	0.9941	2.7980	85.250	85.062	29.710	34.791
June	0.9944	2.7982	85.250	85.296	29.699	34.799
July	0.9918	2.7929	85.250	84.875	29.482	34.719
August	0.9883	2.7825	85.250	84.562	29.254	34.590
September	0.9843	2.7524	85.250	84.312	28.688	34.452
October	0.9825	2.7576	85.250	84.200	28.522	34.393
November	0.9777	2.7489	85.250	83.719	28.848	34.221
December	0.9731	2.7352	85.250	83.275	29.061	34.055
Average[1] (12 months)	0.9834	2.7660	85.187	84.012	30.845	34.421
1954						
January	0.9729	2.7356	85.250	83.281	28.767	34.052
February	0.9665	2.7193	85.250	82.812	29.000	33.828
March	0.9708	2.7329	85.250	82.968	29.168	33.977
April	0.9825	2.7693	85.250	84.050	29.520	34.388
May	0.9843	2.7748	85.250	84.250	29.658	34.451
June	0.9813	2.7661	85.250	83.969	29.603	34.344
July	0.9744	2.7459	85.250	83.450	29.570	34.104
August	0.9702	2.7295	85.250	83.094	29.492	33.959
September	0.9697	2.7165	85.250	82.950	30.066	33.937
October	0.9698	2.7134	85.250	82.469	31.529	33.943
November	0.9692	2.7090	85.250	82.969	31.259	33.925
December	0.9680	2.6988	85.250	82.825	31.036	33.879
Average[1] (12 months)	0.9733	2.7343	85.250	83.257	29.889	34.065

[1]Computed from daily quotations.

Prospecting

MINING CLAIMS RECORDED AND CANCELLED IN ONTARIO, 1907–54

Year	Number recorded	Number cancelled[1]	Year	Number recorded	Number cancelled[1]	Year	Number recorded	Number cancelled[1]
1907	13,996	.....	1923	6,092	2,328	1939	6,772	9,086
1908	4,634	.....	1924	5,222	2,804	1940	4,667	7,242
1909	9,746	.....	1925	4,751	2,460	1941	4,254	10,514
1910	5,792	.....	1926	13,496	5,322	1942	3,593	9,028
1911	9,001	361	1927	15,554	5,537	1943	5,232	3,057
1912	3,104	.....	1928	15,046	3,662	1944	12,527	2,376
1913	4,320	442	1929	8,207	8,090	1945	16,362	3,657
1914	1,913	7,913	1930	3,886	8,887	1946	23,763	6,003
1915	2,519	1,093	1931	5,779	10,885	1947	12,913	18,116
1916	2,470	1,911	1932	4,945	15,425	1948	9,029	13,932
1917	1,936	602	1933	8,077	4,813	1949	14,420	11,829
1918	1,534	304	1934	16,888	5,041	1950	14,233	17,735
1919	2,918	1,481	1935	9,460	9,240	1951	13,403	9,265
1920	2,160	2,203	1936	17,280	6,653	1952	16,009	13,789
1921	2,459	1,791	1937	15,292	11,445	1953	29,019	18,178
1922	5,686	1,490	1938	9,047	8,978	1954	50,176	21,777

[1]Data on claims cancelled are not available for 1907, 1908, 1909, 1910, and 1912. These figures include cancellations of claims in Eastern Ontario and Parry Sound district for the years 1951–54 only.

The number of mining claims staked during the year was 50,176. This was an increase from the 29,019 reported for the previous year. The Port Arthur division led in recording the largest number, followed by Sudbury, Eastern Ontario, and Sault Ste. Marie, in that order.

The following table shows the number of miners' licences issued and renewed and the number of mining claims recorded and cancelled in each mining division during 1954.

MINER'S LICENCES AND MINING CLAIMS, 1954

Mining division	Miners' licences		Mining claims	
	Issued	Renewed	Recorded	Cancelled
Eastern Ontario	.....	.....	6,218	1,610
Fort Frances	147	89	725	662
Kenora	331	132	2,400	1,003
Larder Lake	296	343	1,139	1,395
Montreal River	68	115	631	945
Parry Sound	.....	.....	564	870
Patricia[1]	225	134	862	130
Porcupine	185	175	813	968
Port Arthur and Kowkash	2,705	1,152	21,055	3,869
Red Lake	116	147	1,299	1,254
Sault Ste Marie	747	422	5,397	1,921
Sudbury	1,001	740	7,895	5,498
Timiskaming	233	214	1,178	1,652
At Toronto	2,682	2,614	.....	.....
Total	8,736	6,277	50,176	21,777

[1]In January, 1950, a recording office was opened at Red Lake, and a new Patricia mining division was established with a recording office at Sioux Lookout.

MINING CLAIMS RECORDED IN THE DIFFERENT MINING DIVISIONS, 1907 AND 1948–54

Mining division	1907	1948	1949	1950	1951	1952	1953	1954
Eastern Ontario	.....	.....	.....	.....	421	494	2,582	6,218
Fort Frances	.....	304	193	206	400	373	729	725
Kenora	.....	406	999	918	1,609	993	621	2,400
Larder Lake	3,813	818	1,747	1,186	1,237	846	618	1,139
Montreal River	866	512	481	668	975	578	738	631
Parry Sound[1]	102	.....	.....	.....	208	167	1,359	564
Patricia[2]	.....	.....	.....	3,112	624	285	704	862
Porcupine	.....	418	441	729	366	541	285	813
Port Arthur and Kowkash[3]	317	1,098	1,416	2,199	2,047	3,563	2,586	21,055
Red Lake	.....	345	1,018	785	801	931	1,127	1,299
Sault Ste. Marie	291	1,573	3,774	911	1,111	1,500	6,504	5,397
Sudbury	456	1,442	3,121	2,104	2,213	4,481	10,128	7,895
Timiskaming	8,151	1,094	622	1,011	1,391	1,257	1,038	1,178
At Toronto	.....	1,019	608	404	.....	.....	.....	.....
Total	13,996	9,029	14,420	14,233	13,403	16,009	29,019	50,176

[1]The office at Parry Sound was closed in 1921, and records are now kept at the Ontario Department of Mines, Toronto. Since 1951, the records for Parry Sound and Eastern Ontario have been kept separately.

[2]In January, 1950, a recording office was opened at Red Lake, and a new Patricia mining division established with a recording office at Sioux Lookout.

[3]In 1945 the records for Kowkash were transferred to Port Arthur, and their figures are combined.

METALLIC MINERALS

Gold

General

Ontario's 33 operating gold mines, the nickel-copper mines in the Sudbury district, and the copper-gold-silver mine of New Ryan Lake Mines, Limited, in the Matachewan area, produced 2,361,387 ounces of gold in 1954. This is 8.2 percent higher than the previous year's output of 2,182,435 ounces. The gold mines alone accounted for 2,315,213 ounces, having a value of $78,887,092 as compared with 2,142,461 ounces, worth $74,012,123, in 1953. The strike in the Porcupine camp, which involved 10 mines and began in August last year, was finally settled in March. All mines were back into production except the Paymaster mine, which did not re-open until October. The gold mines also produced 390,962 ounces of silver, and the total value of the output from the gold mining industry was $79,210,802, an average of $8.54 for each ton milled. The average price received by the mines for their gold was $34.065 per ounce. The price of gold is pegged at $35 per ounce United States funds, and so the price received depends on the day-to-day quotations for the Canadian dollar.

Dividends to the total of $15,530,063 were paid out during the year by 26 gold mines. This compares with $14,242,485 paid out in 1953 by the same number of mines.

The gold mines employed 1,083 salaried persons, and they were paid a total of $4,956,348. The average number of wage-earners, which includes those employed on surface, underground, and in the mill, amounted to 10,459, and they received $33,846,099 in wages, or an average yearly wage of $3,236. The industry paid out $3,760,644 for fuel and electricity, and the cost of process supplies amounted to $14,867,744. These producing mines spent $550,679 on prospecting for new properties in the province and a total of $701,537 for exploration both in the province and outside of it.

Only two non-producing gold mines reported operations, and they employed 47 wage-earners who received $140,758. Fuel and electricity costs were $22,530, and process supplies amounted to $60,855.

Production

The following tables show the annual production by mines in each area, the production by areas in 1954, and the total gold production from 1886 to the end of 1954.

PORCUPINE GOLD BELT, PRODUCTION, 1910–54[1]

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
Amca	1937	.....	$ 1,298	.....	$ 1,298
Amalgamated Goldfields	1923, 1926, 1928, 1934	500	$ 1,966	500	$ 1,966
Aunor	1940–50	1,770,187	$ 21,781,021		
	1951	175,977	2,413,346		
	1952	178,827	2,698,488		
	1953	139,759	1,889,590		
	1954	167,388	2,129,559	2,432,138	$ 30,912,004

[1]For historical data on the various mines, see Vol. LVIII, 1949, pt. 1, Table III in pocket.

PORCUPINE GOLD BELT, PRODUCTION, 1910–54—*Continued*

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
Bonetal	1941–51	352,254	$ 1,921,134	352,254	$ 1,921,134
Bonwhit	1951	8,068	$ 113,735		
	1952	67,009	902,615		
	1953	63,762	673,878		
	1954	61,716	710,561	200,555	$ 2,400,789
Broulan Reef	1939–50	1,284,734	$ 11,038,128		
	1951	169,120	1,919,449		
	1952	137,666	1,261,242		
	1953	82,520	741,505		
	1954	79,551	566,908	1,753,591	$ 15,527,232
Buffalo Ankerite	1926–50	4,713,947	$ 32,343,973		
	1951	118,995	927,620		
	1952	117,795	649,180		
	1953	1,125	108,290	4,951,862	$ 34,029,063
Canusa	1927, 1928, 1933, 1935	315	$ 14,840	315	$ 14,840
Clifton	1914, 1922–24	.....	$ 30,575	.....	$ 30,575
Concordia	1935	230	$ 580	230	$ 580
Coniaurum	1928–50	3,178,850	$ 26,989,733		
	1951	126,295	1,178,866		
	1952	129,325	1,018,762		
	1953	89,952	815,562		
	1954	118,180	964,329	3,642,602	$ 30,967,252
Consolidated West Dome Lake	1915–20, 1924–27, 1929, 1930	188,488	$ 1,120,306	188,488	$ 1,120,306
Davidson	1918–20	9,371	$ 53,914	9,371	$ 53,914
Delnite	1937–50	1,609,889	$ 12,443,355		
	1951	139,278	1,493,931		
	1952	158,794	1,802,159		
	1953	106,027	1,063,087		
	1954	144,431	1,299,541	2,158,419	$ 18,102,073
De Santis	1926, 1933, 1939–42	196,928	$ 1,366,707	196,928	$ 1,366,707
Devon	1940	2,333	$ 1,632	2,333	$ 1,632
Dome	1910–50	17,883,267	$172,293,194		
	1951	688,000	6,135,843		
	1952	687,400	5,803,685		
	1953	687,300	5,869,641		
	1954	697,600	5,867,430	20,643,567	$ 195,969,793
Faymar	1940–42	119,181	$ 853,292	119,181	$ 853,292
Gillies-Lake Porcupine	1929–31, 1935–37	54,502	$ 462,482	54,502	$ 462,482
Gold Reef	1915, 1917	128	$ 2,135	128	$ 2,135
Goldhawk	1947	636	$ 1,862	636	$ 1,862

PORCUPINE GOLD BELT, PRODUCTION, 1910–54—*Continued*

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
Hallnor	1938–50	1,502,531	$ 24,805,114		
	1951	138,424	1,817,719		
	1952	134,236	1,869,107		
	1953	69,385	900,344		
	1954	119,630	1,484,159	1,964,206	$ 30,876,443
N. A. Hermiston	1946	.....	$ 1,056	.....	$ 1,056
Hill Gold	1918	25	$ 635	25	$ 635
Hollinger	1910–50	49,620,460	$411,211,442		
	1951	933,081	8,981,784		
	1952	1,068,778	10,405,207		
	1953	751,690	6,865,339		
	1954	1,069,689	10,390,800	53,443,698	$ 447,854,572
Hoyle	1941–44, 1946–49	725,494	$ 2,689,438	725,494	$ 2,689,438
J. Huddlestone and P. Clyne	1923, 1925	.....	$ 3,257	.....	$ 3,257
Hughes	1926	.....	$ 30	.....	$ 30
Hugh-Pam	1948	1,207	$ 1,586		
	1949	6,255	12,168		
	1950	8,298	93,817		
	1951	7,740	51,752		
	1952	26,053	280,610		
	1953	42,625	345,079		
	1954	61,562	359,114	153,740	$ 1,144,126
Mace	1911, 1912, 1914–18, 1923–39, 1941	1,565,218	$ 9,827,448	1,565,218	$ 9,827,448
McIntyre	1912–50	20,281,481	$196,489,575		
	1951	754,470	7,662,620		
	1952	760,230	7,255,921		
	1953	574,090	5,540,353		
	1954	750,570	6,967,855	23,120,841	$ 223,916,324
McLaren-Porcupine	1933–35, 1937	876	$ 6,819	876	$ 6,819
Marbuan	1926–35	317,769	$ 1,154,663	317,769	$ 1,454,663
Moneta	1938–43	314,829	$ 5,589,356	314,829	$ 5,589,356
Munro Croesus	1915–18, 1923, 1931, 1932, 1934–36, 1948	5,333	$ 326,894	5,333	$ 326,894
Nakhodas	1940–42, 1944	44,028	$ 252,792	44,028	$ 252,792
Naybob	1932, 1933, 1935, 1937–43, 1948	247,146	$ 1,843,425	247,146	$ 1,843,425

PORCUPINE GOLD BELT, PRODUCTION, 1910–54—*Continued*

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
Newray	1913–15, 1917, 1918	14,804	$ 184,001	14,804	$ 184,001
Night Hawk Peninsular	1924–27, 1940, 1944	99,688	$ 580,462	99,688	$ 580,462
Northcrown	1913–18, 1920, 1921	226,180	$ 2,893,730	226,180	$ 2,893,730
Northern Turnbull	1934	30	$ 172	30	$ 172
Pamour	1936–50	6,926,801	$ 29,423,758		
	1951	581,746	2,053,929		
	1952	611,270	1,936,097		
	1953	627,398	2,016,615		
	1954	637,012	1,906,533	9,384,227	$ 37,336,932
Paymaster	1922, 1926–28, 1934–50	2,814,656	$ 21,060,221		
	1951	174,416	1,391,177		
	1952	174,454	1,361,208		
	1953	154,246	1,376,512		
	1954	28,135	194,206	3,345,857	$ 25,383,324
Porcupine Lake	1937–40, 1944	10,821	$ 50,100	10,821	$ 50,100
Porcupine Pet	1914, 1915	.....	$ 10,551	.....	$ 10,551
Porphyry Hill	1913, 1915	46	$ 6,236	46	$ 6,236
Preston East Dome	1938–50	2,685,179	$ 25,863,508		
	1951	233,516	2,233,200		
	1952	239,500	2,343,095		
	1953	128,720	1,457,084		
	1954	209,510	1,989,093	3,496,425	$ 33,885,980
Ross	1936–50	1,144,885	$ 8,968,227		
	1951	112,006	779,430		
	1952	110,331	774,191		
	1953	113,361	764,603		
	1954	112,728	729,382	1,593,311	$ 12,015,833
Schumacher	1915–18	112,124	$ 564,984	112,124	$ 564,984
J. Spence	1932	155	$ 2,738	155	$ 2,738
Tommy Burns	1917	21	$ 289	21	$ 289
Miscellaneous	1925, 1927–38, 1942–46, 1948–53	68	$ 616,261		
	1954	.....	3,185	68	$ 619,446
Totals	1910–45	98,686,956	$845,980,271		
	1946	3,952,840	33,303,325		
	1947	3,925,751	32,923,648		
	1948	4,356,812	35,135,980		
	1949	4,501,091	38,047,087		
	1950	4,582,185	41,943,114		
	1951	4,397,645	39,373,609		
	1952	4,601,668	40,365,229		
	1953	3,631,960	30,428,067		
	1954	4,257,702	35,562,655	136,888,610	$1,173,062,985

KIRKLAND LAKE GOLD BELT, PRODUCTION, 1910–54[1]

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
Baldwin Kirkland	1929, 1938	81	$ 1,247	81	$ 1,247
Bidgood Kirkland	1934–49, 1951	586,367	$ 5,917,133	586,367	$ 5,917,133
Bourkes Syndicate	1918, 1936–38	1,298	$ 8,935	1,298	$ 8,935
Gold Pyramid	1911	175	$ 650	175	$ 650
Golden Summit	1936, 1937, 1945	737	$ 3,738	737	$ 3,738
Kirkland Golden Gate	1913, 1933, 1935–44, 1947	101,503	$ 1,051,162	101,503	$ 1,051,162
Kirkland Lake Gold	1919–50	2,187,305	$ 27,233,107		
	1951	124,944	1,549,739		
	1952	120,543	1,540,202		
	1953	112,616	1,489,067		
	1954	117,137	1,351,081	2,662,545	$ 33,163,196
Lake Shore	1918–50	13,717,665	$227,029,333		
	1951	359,489	5,125,030		
	1952	263,595	3,094,159		
	1953	236,669	3,108,034		
	1954	252,455	2,926,613	14,829,873	$ 241,283,169
Macassa	1933–50	1,779,389	$ 28,096,315		
	1951	135,440	1,648,999		
	1952	139,660	1,533,857		
	1953	144,175	1,603,308		
	1954	145,286	1,720,376	2,343,950	$ 34,602,855
Moffat Hall	1934–35	16,388	$ 166,569	16,388	$ 166,569
Morris Kirkland	1936–38, 1940–42	127,253	$ 621,544	127,253	$ 621,544
Ontario-Kirkland	1922	6,496	$ 10,082	6,496	$ 10,082
Swastika	1910, 1911, 1913	2,190	$ 11,457	2,190	$ 11,457
Sylvanite	1927–50	3,345,231	$ 39,213,702		
	1951	171,017	1,722,843		
	1952	171,868	1,866,401		
	1953	170,032	1,864,941		
	1954	171,854	1,838,532	4,030,002	$ 46,506,419
Teck-Hughes	1917–50	6,842,884	$ 87,447,129		
	1951	197,860	1,823,513		
	1952	218,930	1,445,716		
	1953	228,425	1,341,450		
	1954	237,050	1,284,038	7,725,149	$ 93,341,846
Toburn	1913–18, 1922–50	1,097,091	$ 16,475,144		
	1951	40,525	576,107		
	1952	41,300	581,241		
	1953	7,400	106,014	1,186,316	$ 17,738,506
Trout Creek	1931	1	$ 1,662	1	$ 1,662

[1]For historical data on the various mines, see Vol. LVIII, 1949, pt. 1, Table II in pocket.

KIRKLAND LAKE GOLD BELT, PRODUCTION, 1910–54—*Continued*

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
Upper Canada	1938–50	1,098,581	$ 14,098,759		
	1951	151,568	1,573,070		
	1952	177,468	1,694,416		
	1953	182,883	1,634,415		
	1954	196,978	1,618,681	1,807,478	$ 20,619,341
Wright-Hargreaves	1913, 1921–50	7,356,948	$122,694,986		
	1951	182,210	3,004,993		
	1952	189,770	2,719,091		
	1953	192,390	2,848,599		
	1954	193,900	2,715,625	8,115,218	$ 133,983,294
Miscellaneous	1925, 1928, 1929, 1933, 1934, 1937, 1938, 1941–46, 1952, 1953				
	1952–54	.....	$ 131,440	.....	$ 131,440
Totals	1910, 1911, 1913–45	32,307,598	$489,626,817		
	1946	1,077,790	14,916,970		
	1947	1,092,316	15,430,524		
	1948	1,180,044	15,759,921		
	1949	1,288,886	17,361,328		
	1950	1,320,949	17,115,277		
	1951	1,363,053	17,027,072		
	1952	1,323,134	14,475,117		
	1953	1,274,590	13,996,000		
	1954	1,314,660	13,455,219	43,543,020	$ 629,164,245

LARDER LAKE GOLD AREA, PRODUCTION, 1911–54[1]

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
American Eagle	1911	50	$ 900	50	$ 900
Barry-Hollinger	1918, 1925–36, 1944–46	267,741	$ 1,622,118	267,741	$ 1,622,118
Beaverhouse Lake	1913, 1914, 1919–30, 1934, 1935, 1941–44	131,585	$ 808,080	131,585	$ 808,080
Briscoe-Bryce	1948	.....	$ 45	.....	$ 45
Britcana	1937	21	$ 702	21	$ 702
Caramora Porcupine	1948	.....	$ 1,154	.....	$ 1,154
Cathroy-Larder	1941–44, 1947	22,250	$ 118,750	22,250	$ 118,750
Chesterville	1939–45	1,314,546	$ 6,598,892		
	1946	225,458	1,029,230		
	1947	295,408	1,195,098		
	1948	310,564	1,313,134		
	1949	300,547	1,002,619		
	1950	320,759	770,309		
	1951	313,948	781,552		
	1952	179,209	616,747	3,260,439	$ 13,307,581

LARDER LAKE GOLD AREA, PRODUCTION, 1911–54—*Continued*

Mine	Years	Quanity tons	Value	Total quanity, tons	Total value
Detroit Syndicate	1911	50	$ 200	50	$ 200
Gold Hill	1927, 1928	4,416	$ 13,649	4,416	$ 13,649
Kerr-Addison	1911, 1938–50	9,248,250	$ 67,142,830		
	1951	1,612,707	12,432,241		
	1952	1,649,836	12,565,071		
	1953	1,643,298	11,693,657		
	1954	1,659,298	12,408,281	15,813,389	$ 116,242,080
Miller Independence	1918, 1935, 1936	36	$ 5,135	36	$ 5,135
New Telluride	1931, 1932, 1937, 1940, 1950	126	$ 2,088	126	$ 2,088
Omega	1913, 1927, 1928, 1936–48	1,615,081	$ 7,788,606	1,615,081	$ 7,788,606
Raven River	1937–39	40,514	$ 266,441	40,514	$ 266,441
Totals	1911, 1913, 1914, 1918–45	7,161,061	$ 46,239,660		
	1946	862,078	5,328,834		
	1947	1,109,513	6,593,108		
	1948	1,200,275	7,154,415		
	1949	1,860,742	11,382,022		
	1950	1,903,733	12,981,941		
	1951	1,926,655	13,213,793		
	1952	1,829,045	13,181,818		
	1953	1,643,298	11,693,657		
	1954	1,659,298	12,408,281	21,155,698	$ 140,177,529

[1]For historical data on the various mines, see Vol. LVIII, 1949, pt. 1, Table I in pocket.

ALGOMA DISTRICT, PRODUCTION, 1893–1954[1]

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
Agawa	1939, 1940	8,612	$ 22,397	8,612	$ 22,397
G. Calverley	1952	50	$ 4,400	50	$ 4,400
Cline Lake	1938–42, 1947, 1948	331,842	$ 2,369,053	331,842	$ 2,369,053
Darwin	1902, 1903, 1907, 1908, 1910, 1923, 1925, 1930, 1935–37, 1940, 1943, 1944	54,528	$ 546,852	45,528	$ 546,852
Deep Lake	1936–38, 1943	2,790	$ 57,180	2,790	$ 57,180

[1]For historical data on the various mines, see Vol. LVIII, 1949, pt. 1, Table IV in pocket.

ALGOMA DISTRICT, PRODUCTION, 1893–1954—*Continued*

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
P. Edward	1929, 1933, 1941	46	$ 694	46	$ 694
Edwards	1937	1,573	$ 16,977	1,573	$ 16,977
Golden Reed	1908	3	$ 125	3	$ 125
Havilah	1893, 1894, 1900, 1910, 1911	6,589	$ 26,535	6,589	$ 26,535
Hiawatha	1937, 1939, 1940	1,931	$ 6,826	1,931	$ 6,826
Kremzar	1940	.....	$ 96	.....	$ 96
Magino	1934–39, 1942, 1952 1953	116,627	$ 300,467 7,867	116,627	$ 308,334
Minto	1929–39, 1942, 1944	184,600	$ 1,140,457	184,600	$ 1,140,457
Norgold	1926, 1932, 1936–38, 1940	23,211	$ 84,576	23,211	$ 84,576
Norwalk	1904, 1910	820	$ 1,412	820	$ 1,412
Parkhill	1904, 1929, 1931–38, 1940, 1942–44	125,778	$ 1,691,795	125,778	$ 1,691,795
Shenango	1936, 1937, 1945	.....	$ 2,457	.....	$ 2,457
S. B. Smith	1935, 1936	9,228	$ 60,251	9,228	$ 60,251
Soo Mining and Prospecting Syndicate	1933	60	$ 282	60	$ 282
Stanley	1936	1,963	$ 2,936	1,963	$ 2,936
Ranson	1939	774	$ 5,938	774	$ 5,938
Regnery	1937, 1940–43, 1945	13,479	$ 124,353	13,479	$ 124,353
G. L. White	1936	.....	$ 1,124	.....	$ 1,124
Totals	1893, 1894, 1900, 1902–4, 1907, 1908, 1910, 1911, 1923, 1925, 1926, 1929–45, 1947, 1948, 1952 1953	875,504	$ 6,467,183 7,867	875,504	$ 6,475,050

SUDBURY DISTRICT, PRODUCTION, 1897–1954[1]

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
A. Alkins, claims	1945	.....	$ 148	.....	$ 148
Bousquet	1936–38, 1945, 1948	17,129	$ 164,823	17,129	$ 164,823
Crystal	1897, 1898, 1908	730	$ 4,998	730	$ 4,998
Curtin Prospecting Syndicate	1952 1953	.....	$ 640 543	.....	$ 1,183
Ensign	1905–7, 1944, 1945, 1948	8,590	$ 56,290	8,590	$ 56,290
Gomak	1936	1,387	$ 3,446	1,387	$ 3,446
Greenray	1951	.....	$ 1,616	.....	$ 1,616
Halcrow Swayze	1935	211	$ 1,372	211	$ 1,372
Jerome	1941–43	335,060	$ 2,195,651	335,060	$ 2,195,651
Kenty	1947	.....	$ 42	.....	$ 42
Lebel Oro	1910, 1911, 1913–16, 1932, 1934, 1937–39	221,070	$ 1,352,164	221,070	$ 1,352,164
Mac-Auer	1935	45	$ 293	45	$ 293
McMillan	1934–37	60,139	$ 370,672	60,139	$ 370,672
New Golden Rose	1937–41, 1943, 1944	144,237	$ 1,666,563	144,237	$ 1,666,563
Pileggi Mining Syndicate	1947, 1948	.....	$ 2,386	.....	$ 2,386
Renabie	1947 1948 1949 1950 1951 1952 1953 1954	25,743 100,072 155,049 157,948 88,736 169,674 168,243 166,982	$ 166,798 843,083 1,193,450 1,411,611 873,040 1,406,672 1,429,696 1,466,441	1,032,447	$ 8,790,791
Tionaga	1938, 1939	6,653	$ 81,059	6,653	$ 81,059
C. T. Young	1932	10	$ 725	10	$ 725
Miscellaneous	1948	.....	$ 49	.....	$ 49
Totals	1897, 1898, 1905–8, 1910, 1911, 1913–16, 1932, 1934–50, 1951 1952 1953 1954	1,234,073 88,736 169,674 168,243 166,982	$ 9,515,623 874,656 1,407,312 1,430,239 1,466,441	1,827,708	$ 14,694,271

[1]For historical data on the various mines, see Vol. LVIII, 1949, pt. 1, p. 20.

RAINY RIVER DISTRICT, PRODUCTION, 1895–1954[1]

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
Barker	1898	70	$ 490	70	$ 490
Big Turtle River	1929	19	$ 245	19	$ 245
Central Canada	1934	350	$ 742	350	$ 742
Russell Cone	1948, 1949, 1951, 1952 1954	....	$ 3,778 83	.....	$ 3,861
Elizabeth	1912	50	$ 400	50	$ 400
Foley	1897, 1898, 1933–35	5,568	$ 52,658	5,568	$ 52,658
Gold Winner	1900	15	$ 70	15	$ 70
Golden Crescent (A.D. 2)	1897	192	$ 1,543	192	$ 1,543
Golden Star	1898–1901, 1934, 1938, 1941	19,345	$ 170,616	19,345	$ 170,616
Hammond Reef	1897	977	$ 3,857	977	$ 3,857
Harold Lake	1895, 1896	1,131	$ 11,236	1,131	$ 11,236
Independence (Bennett tp.)	1898	125	$ 1,906	125	$ 1,906
Lucky Coon	1899, 1935, 1936	10	$ 249	10	$ 249
Manitou	1896	12	$ 413	12	$ 413
Olive	1897–1900, 1937, 1941, 1942	7,255	$ 80,636	7,255	$ 80,636
Saundary	1934	13	$ 435	13	$ 435
W. E. Stone	1919, 1920	2	$ 319	2	$ 319
Sunbeam	1904	650	$ 4,875	650	$ 4,875
Upper Seine (Sawbill)	1897–99, 1940, 1941	5,368	$ 21,785	5,368	$ 21,785
White Lilly	1933	65	$ 53	65	$ 53
Miscellaneous[2]	1935	.....	$ 263	.....	$ 263
Totals	1895–1952 1954	41,217	$ 356,569 83	41,217	$ 356,652

[1]For historical data on the various mines, see Vol. LVIII, 1949, pt. 1, p. 18.
[2]Mint sundries, etc.

THUNDER BAY DISTRICT, PRODUCTION, 1897–1954[1]

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
R. Anderson	1943	.....	$ 116	.....	$ 116
Ardeen	1932–36, 1942	143,724	$ 962,326	143,724	$ 962,326
Bankfield Consolidated	1937–42, 1944–47	231,009	$ 2,424,545	231,009	$ 2,424,545
Brenbar	1941, 1949	46	$ 5,160	46	$ 5,160
Cook Lake	1937	32	$ 918	32	$ 918
Mary J. Coveney	1924	.....	$ 114	.....	$ 114
Elmos	1942	3,947	$ 39,168	3,947	$ 39,168
Empress	1897	1,100	$ 2,378	1,100	$ 2,378
Gold Range	1941	.....	$ 668	.....	$ 668
Hard Rock	1938–51	1,458,375	$ 10,057,426	1,458,375	$ 10,057,426
Harkness-Hays	1920, 1929, 1932, 1935, 1936	78	$ 5,879	78	$ 5,879
Jellicoe	1939–41, 1947, 1948	16,948	$ 231,014	16,948	$ 231,014
Leitch	1936–50	400,382	$ 11,508,072		
	1951	29,988	918,893		
	1952	36,276	1,006,535		
	1953	38,614	1,107,417		
	1954	39,205	1,145,304	544,465	$ 15,686,221
Little Long Lac	1934–50	1,496,134	$ 19,515,108		
	1951	101,731	991,319		
	1952	99,607	806,347		
	1953	83,044	795,881		
	1954	.....	46,123	1,780,516	$ 22,151,778
MacLeod-Cockshutt	1938–50	2,363,814	$ 21,378,806		
	1951	366,547	2,574,598		
	1952	411,777	2,365,504		
	1953	453,732	1,988,114		
	1954	553,400	2,095,929	4,149,270	$ 30,402,951
J. B. McMartin	1934, 1935	3,525	$ 86,756	3,525	$ 86,576
Magnet Consolidated	1938–43	201,206	$ 4,037,464		
	1946–52	158,706	1,693,171	359,912	$ 5,730,635
Maloney Sturgeon	1937	1	$ 2,549	1	$ 2,549
Maylac	1946, 1947	1,518	$ 28,079	1,518	$ 28,079
Northern Empire	1934–41, 1949	425,866	$ 5,380,514	425,866	$ 5,380,514

[1]For historical data on the various mines, see Vol. LVIII, 1949, pt. 1, Table V in pocket.

THUNDER BAY DISTRICT, PRODUCTION, 1897–1954—*Continued*

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
North Shores	1923, 1929, 1932, 1933, 1935–37, 1941	3,808	$ 73,716	3,808	$ 73,716
W. Pauloski	1951	.....	$ 5,802	.....	$ 5,802
A. Pilon and M. Richards	1921	30	$ 1,122	30	$ 1,122
St. Anthony	1905–7, 1911–13, 1917, 1918, 1920, 1921, 1929, 1930, 1934–41	331,069	$ 2,165,292	331,069	$ 2,165,292
Sand River	1937–42	157,870	$ 1,863,840	157,870	$ 1,863,840
Schreiber Pyramid	1937	150	$ 2,680	150	$ 2,680
Sturgeon River	1936–42	145,123	$ 2,728,905	145,123	$ 2,728,905
Talmora Longlac	1948	2,687	$ 14,000	2,687	$ 14,000
Tashota	1931, 1935–38, 1940, 1941	51,234	$ 441,644	51,234	$ 441,644
Theresa	1935, 1938, 1941, 1943, 1945, 1950	7,436	$ 35,024		
	1951	2,013	36,365		
	1952	13,181	64,894		
	1953	3,490	30,938	23,320	$ 167,221
Tombill	1938–42	190,622	$ 2,589,984	190,622	$ 2,589,984
M. C. Williams	1940	20	$ 500	20	$ 500
Miscellaneous	1942, 1948	.....	$ 3,125	.....	$ 3,125
Totals	1897, 1905–7, 1911–13, 1917, 1918, 1920, 1921, 1923, 1924, 1929–45	5,333,654	$ 65,542,912		
	1946	384,521	3,905,263		
	1947	439,918	4,110,057		
	1948	409,736	3,936,131		
	1949	466,571	4,266,290		
	1950	627,771	4,984,327		
	1951	634,568	5,059,187		
	1952	560,841	4,246,153		
	1953	578,880	3,922,350		
	1954	592,605	3,287,356	10,029,065	$ 103,260,026

KENORA DISTRICT, PRODUCTION, 1885–1954[1]

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
Baden-Powell	1902–5	163	$ 4,952	163	$ 4,952
Big Master	1902, 1903, 1905, 1942, 1943	14,470	$ 75,115	14,470	$ 75,115
Black Jack	1893	50	$ 300	50	$ 300
Britannia	1899	20	$ 110	20	$ 110
Cameron Island (Damascus)	1898, 1906, 1934–36	1,287	$ 163,871	1,287	$ 163,871
Camp Bay	1904–6	1,417	$ 7,559	1,417	$ 7,559
Cedar Island (Cornucopia)	1896, 1932, 1935, 1936	17,050	$ 174,146	17,050	$ 174,146
Champion (Bad)	1900, 1925, 1926	231	$ 2,220	231	$ 2,220
Clark	1935	87	$ 1,250	87	$ 1,250
Combined	1904	37	$ 220	37	$ 220
J. G. Cross	1937	.....	$ 107	.....	$ 107
Crown Point	1900	150	$ 900	150	$ 900
Darkwater	1936, 1937	13	$ 1,086	13	$ 1,086
Eldorado	1904	30	$ 251	30	$ 251
Elora	1936, 1937, 1939	13,766	$ 49,017	13,766	$ 49,017
Empire	1908	300	$ 1,800	300	$ 1,800
Glass Reef	1900	.....	$ 171	.....	$ 171
Gold Hill	1886, 1893	220	$ 19,610	220	$ 19,610
Gold Panner	1900	100	$ 900	100	$ 900
Gold Rock	1929	300	$ 726	300	$ 726
Grace	1902, 1907, 1908	415	$ 865	415	$ 865
Kenricia	1939, 1940	22,344	$ 97,518	22,344	$ 97,518
Laurentian	1906–9	19,950	$ 141,140	19,950	$ 141,140
Lunward	1948	.....	$ 32	.....	$ 32

[1]For historical data on the various mines, see Vol. LVIII, 1949, pt. 1, p. 21.

KENORA DISTRICT, PRODUCTION, 1885–1954—*Continued*

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
Martin Kenty	1947	.....	$ 42	.....	$ 42
Mikado	1896–1902, 1910, 1911, 1931	57,813	$ 421,070	57,813	$ 421,070
Minerva	1885	28	$ 1,372	28	$ 1,372
Olympia	1906, 1911 1912, 1915	1,598	$ 4,782	1,598	$ 4,782
Quarry Island	1899	176	$ 1,063	176	$ 1,063
Regina	1895–99, 1902, 1904, 1905, 1936, 1941–43	36,828	$ 229,552	36,828	$ 299,552
Royal Sovereign	1902	.....	$ 122	.....	$ 122
Rush Bay (Golden Horn)	1904, 1906, 1907	615	$ 1,120	615	$ 1,120
Sakoose (Golden Whale)	1899–1901	8,028	$ 58,758	8,028	$ 58,758
Sandybeach Lake	1941, 1942	.....	$ 478	.....	$ 478
Straw Lake Beach	1938–41	33,662	$ 429,477	33,662	$ 429,477
Sultana	1894–1902, 1904–6, 1949	77,481	$ 431,138	77,481	$ 431,138
Treasure	1898	34	$ 529	34	$ 529
Twentieth Century	1902, 1903	8,688	$ 43,586	8,688	$ 43,586
Van Houten	1940, 1945, 1947	800	$ 9,269	800	$ 9,269
Vermilion Lake (Botham)	1930, 1935	43	$ 575	43	$ 575
Wabigoon–Contact Bay	1905, 1916–18, 1920, 1923, 1929	1,839	$ 7,936	1,839	$ 7,936
Wendigo	1900, 1936–43, 1951	206,054	$ 2,510,076	206,054	$ 2,510,076
Miscellaneous[1]	1940–42	476	$ 10,851	476	$ 10,851
Total	1885–1954	526,563	$ 4,975,662	526,563	$ 4,975,662

[1]Mint sundries, etc.

PATRICIA PORTION OF KENORA DISTRICT, PRODUCTION, 1911–54[1]

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
Berens River	1939–48	560,607	$ 8,801,845	560,607	$ 8,801,845
Bobjo	1929	.....	$ 11,510	.....	$ 11,510
Campbell Red Lake	1949	71,317	$ 884,014		
	1950	139,742	2,234,322		
	1951	173,143	2,562,874		
	1952	178,930	2,863,202		
	1953	181,026	3,083,279		
	1954	196,059	3,454,986	940,217	$ 15,082 677
Car Lake Syndicate	1929, 1936	307	$ 5,809	307	$ 5,809
Central Patricia	1934–51	1,729,248	$ 22,920,236	1,729,248	$ 22,920,236
Cochenour Willans	1939–50	667,642	$ 10,611,698		
	1951	70,531	1,312,202		
	1952	67,361	1,244,456		
	1953	61,680	947,227		
	1954	66,045	844,986	933,259	$ 14,960,569
W. D. Cooper and P. A. Barry	1935, 1936	.....	$ 5,591	.....	$ 5,591
Gold Eagle	1937–42	180,095	$ 1,496,844	180,095	$ 1,496,844
Hasaga	1938–45	761,803	$ 4,824,649		
	1946	82,427	299,101		
	1947	61,171	303,801		
	1948	135,212	780,853		
	1949	142,129	701,059		
	1950	143,035	598,610		
	1951	133,191	533,928		
	1952	56,314	204,397	1,515,282	$ 8,246,398
Howey	1930–41, 1945	4,630,779	$ 13,249,096		
	1952	.....	4,254	4,630,779	$ 13,253,350
Hudson Patricia	1936, 1937	11,228	$ 65,166	11,228	$ 65,166
J-M Consolidated	1934–40, 1947, 1948	105,357	$ 972,275	105,357	$ 972,275
N. McDonald	1924	.....	$ 126	.....	$ 126
R. McDonald	1923	.....	$ 124	.....	$ 124
McKenzie Red Lake	1935–50	1,129,758	$ 13,151,264		
	1951	80,828	873,083		
	1952	83,288	739,010		
	1953	75,070	748,099		
	1954	84,260	596,759	1,453,204	$ 16,108,215
McMarmac Red Lake	1940–44, 1947, 1948	152,978	$ 1,762,760	152,978	$ 1,762,760
Madsen Red Lake	1938–50	1,925,549	$ 17,046,167		
	1951	302,227	2,282,931		
	1952	304,251	2,316,155		
	1953	285,018	2,857,742		
	1954	286,246	2,818,318	3,103,291	$ 27,321,313

[1]For historical data on the various mines, see Vol. LVIII, 1949, pt. 1, Table VI in pocket.

PATRICIA PORTION OF KENORA DISTRICT, PRODUCTION, 1911–54—*Continued*

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
New Dickenson	1948	1,465	$ 5,194		
	1949	43,522	293,352		
	1950	46,234	788,443		
	1951	90,572	1,374,497		
	1952	102,442	1,551,161		
	1953	125,606	1,881,818		
	1954	131,554	2,167,064	541,395	$ 8,061,529
New Jason	1934, 1936–42	152,661	$ 2,251,974		
	1946	9,956	77,931		
	1947	18,532	199,920		
	1949	13,509	241,185		
	1950	38,654	493,476		
	1951	36,441	468,215		
	1952	6,820	74,192	276,573	$ 3,806,893
Pickle Crow	1935–50	1,525,783	$ 30,036,172		
	1951	105,645	1,690,082		
	1952	108,275	1,407,074		
	1953	85,821	1,453,117		
	1954	110,711	1,594,454	1,936,235	$ 36,180,899
Red Crest	1935, 1936	591	$ 9,721	591	$ 9,721
Red Lake Gold Shore	1936, 1937, 1939	86,333	$ 747,577	86,333	$ 747,577
G. A. Rowan	1933	.....	$ 368	.....	$ 368
Sachigo River	1938–42	46,416	$ 1,957,084	46,416	$ 1,957,084
G. Singleton	1933	.....	$ 137	.....	$ 137
Sol D'Or	1933–36	458	$ 8,770	458	$ 8,770
Starratt Olsen	1948	33,501	$ 148,545		
	1949	108,030	814,189		
	1950	136,801	1,202,286		
	1951	151,187	912,853		
	1952	155,690	901,468		
	1953	159,139	774,608		
	1954	99,375	500,888	843,723	$ 5,254,840
J. Tingley	1911	30	$ 57	30	$ 57
Uchi	1939–43	757,074	$ 4,391,733	757,074	$ 4,391,733
Miscellaneous[1]	1949, 1950	.....	$ 2,600		
	1953	.....	1,552	.....	$ 4,152
Totals	1911, 1923, 1924, 1929–45	11,480,689	$100,336,317		
	1946	555,745	6,244,038		
	1947	579,963	5,864,292		
	1948	784,843	8,001,217		
	1949	1,032,683	10,226,231		
	1950	1,131,209	12,825,918		
	1951	1,228,567	12,910,286		
	1952	1,063,371	11,305,369		
	1953	973,360	11,747,442		
	1954	974,250	11,977,336	19,804,680	$ 191,438,446

[1] Mint sundries, etc.

MATACHEWAN AND WEST SHININGTREE GOLD AREAS, PRODUCTION, 1922–54

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
Ashley	1932–36, 1946	157,636	$ 1,622,245	157,636	$ 1,622,245
Atlas	1933	12	$ 201	12	$ 201
Matachewan Consolidated	1934–45	1,836,001	$ 7,767,766		
	1946	228,890	894,145		
	1947	250,679	991,282		
	1948	256,252	943,481		
	1949	239,030	788,777		
	1950	246,622	719,179		
	1951	259,092	865,923		
	1952	164,407	510,551		
	1953	50,227	161,938		
	1954	.....	15,278	3,525,200	$ 13,658,320
Ronda	1939	24,592	$ 97,644	24,592	$ 97,644
Tyranite	1939–42	223,810	$ 1,166,640	223,810	$ 1,166,640
White Rock	1922, 1933	17	$ 1,406	17	$ 1,406
Young-Davidson	1934–50	4,583,491	$ 16,334,463		
	1951	307,254	694,218		
	1952	287,265	873,243		
	1953	323,094	923,720		
	1954	312,217	1,037,337	5,813,321	$ 19,862,981
Miscellaneous	1948	.....	$ 14	.....	$ 14
Totals	1922, 1932–45	5,470,913	$ 22,483,177		
	1946	431,509	1,564,349		
	1947	503,738	1,838,013		
	1948	506,761	1,725,944		
	1949	563,295	1,805,136		
	1950	564,816	1,910,624		
	1951	566,346	1,560,141		
	1952	451,672	1,383,794		
	1953	373,321	1,085,658		
	1954	312,217	1,052,615	9,744,588	$ 36,409,451

SOUTHEASTERN ONTARIO, PRODUCTION, 1891–1954

Mine	Years	Quantity, tons	Value	Total quantity, tons	Total value
Atlas Arsenic	1900,1902, 1903	6,114	$ 44,667	6,114	$ 44,667
Bannockburn	1895	.....	$ 58	.....	$ 58
Big Dipper	1907, 1909	52	$ 340	52	$ 340
Boerth	1900	.....	$ 208	.....	$ 208
Cleveland	1908	239	$ 5,475	239	$ 5,475
Cobalt Frontenac	1919, 1922	.....	$ 1,364	.....	$ 1,364
Cook Land	1901, 1902, 1904	1,483	$ 6,989	1,483	$ 6,989

SOUTHEASTERN ONTARIO, PRODUCTION, 1891–1954—*Continued*

Area	Years	Quantity, tons	Value	Total quantity, tons	Total value
Cordova (Belmont)	1892, 1893 1898–1903 1912–15, 1917 1939, 1940	560 70,185 16,491 33,434	$ 5,450 289,517 45,480 134,101	120,670	$ 474,548
Craig	1905, 1906	1,850	$ 5,760	1,850	$ 5,760
Crescent	1891, 1892	1,700	$ 6,780	1,700	$ 6,780
Deloro (Canadian Goldfields)	1897–1902	39,143	$ 213,973	39,143	$ 213,973
Gatling Pearce	1893	.....	$ 1,918	.....	$ 1,918
Gilmour	1909, 1910	550	$ 3,669	550	$ 3,669
Ledyard	1893, 1894	55	$ 236	55	$ 236
Little Doris	1898	400	$ 2,500	400	$ 2,500
Old Diamond (Mayboro)	1941	300	$ 2,310	300	$ 2,310
Sophia	1900	1,500	$ 850	1,500	$ 850
Sovereign	1900	262	$ 861	262	$ 861
Star of the East	1905, 1907	976	$ 1,941	976	$ 1,941
Miscellaneous[1]	1937	.....	$ 238	.....	$ 238
Total	1891–1941	175,294	$ 774,685	175,294	$ 774,685

[1] Mint sundries, etc.

GOLD PRODUCTION BY AREAS, ONTARIO'S GOLD-MINING INDUSTRY, 1885–1954

Area	Years	Quantity, tons	Value	Total quantity, tons	Total value
Southeastern Ontario	1891–95, 1897–1910, 1912–15, 1919, 1922, 1939–54	175,294	$ 774,685	175,294	$ 774,685
Larder Lake area	1911, 1913, 1914, 1918–21, 1923–50	14,097,402	$ 89,679,980		
	1951	1,926,655	13,213,793		
	1952	1,829,045	13,181,818		
	1953	1,643,298	11,693,657		
	1954	1,659,298	12,408,281	21,155,698	$ 140,177,529
Kirkland Lake belt	1910, 1911, 1913–50	38,267,583	$570,210,837		
	1951	1,363,953	17,027,072		
	1952	1,323,134	14,475,117		
	1953	1,274,590	13,996,000		
	1954	1,314,660	13,455,219	43,543,020	$ 629,164,245

GOLD PRODUCTION BY AREAS, ONTARIO'S GOLD-MINING INDUSTRY, 1885–1954—*Continued*

Area	Years	Quantity, tons	Value	Total quantity, tons	Total value
Porcupine belt	1910–50	120,005,635	$1,027,333,425		
	1951	4,397,645	39,373,609		
	1952	4,601,668	40,365,229		
	1953	3,631,960	30,428,067		
	1954	4,257,702	35,562,655	136,888,610	$1,173,062,985
Matachewan area	1922, 1932–50	8,041,032	31,327,243		
	1951	566,346	1,560,141		
	1952	451,672	1,383,794		
	1953	373,321	1,085,658		
	1954	312,217	1,052,615	9,744,588	$ 36,409,451
Sudbury district	1897, 1898, 1905–8, 1910, 1911, 1913–16, 1932, 1934–45				
	1947–50	1,234,073	$ 9,515,623		
	1951	88,736	874,656		
	1952	169,674	1,407,312		
	1953	168,243	1,430,239		
	1954	166,982	1,466,441	1,827,708	$ 14,694,271
Algoma district	1893, 1894, 1900, 1902–4, 1907, 1908, 1910, 1911, 1923, 1925, 1926,				
	1929–45	875,454	$ 6,457,727		
	1947	.....	2,700		
	1948	.....	642		
	1952	50	1,371		
	1953	.....	7,867	875,504	$ 6,475,050
Thunder Bay district	1897, 1905–7, 1911–13, 1917, 1918, 1920, 1921, 1923, 1924,				
	1929–50	7,662,171	$ 86,744,980		
	1951	634,568	5,059,187		
	1952	560,841	4,246,153		
	1953	578,880	3,922,350		
	1954	592,605	3,287,356	10,029,065	$ 103,260,026
Rainy River district	1895–1901, 1904, 1913, 1919, 1920, 1929, 1933–38,				
	1940–42	41,217	$ 352,791		
	1948	.....	356		
	1949	.....	1,035		
	1951	.....	1,016		
	1952	.....	1,371		
	1954	.....	83	41,217	$ 356,652

GOLD PRODUCTION BY AREAS, ONTARIO'S GOLD-MINING INDUSTRY, 1885–1954—*Continued*

Area	Years	Quantity, tons	Value	Total quantity, tons	Total value
Kenora district	1915–18, 1920, 1923, 1926, 1929–45	525,763	$ 4,964,743		
	1947	800	8,227		
	1948	.....	32		
	1949	.....	2,335		
	1951	.....	325	526,563	$ 4,975,662
Patricia portion of Kenora district	1911, 1923, 1924, 1929–50	15,565,132	$143,498,013		
	1951	1,228,567	12,910,286		
	1952	1,063,371	11,305,369		
	1953	973,360	11,747,442		
	1954	974,250	11,977,336	19,804,680	$ 191,438,446
Miscellaneous	1899–1902, 1923, 1926, 1935–43	955	$ 85,488		
	1948	.....	2,287		
	1949	.....	115		
	1953	.....	344		
	1954	.....	816	955	$ 89,050
Totals	1885, 1886, 1891–1950	206,492,511	$1,970,963,264		
	1951	10,205,570	90,020,085		
	1952	9,999,455	86,372,277		
	1953	8,643,652	74,311,624		
	1954	9,277,714	79,210,802	244,618,902	$2,300,878,052

Dividends

The following tables show the yearly dividends and bonuses paid by gold-mining companies, the yearly dividends and bonuses paid according to areas, and the total dividends and bonuses paid to December 31, 1954.

PORCUPINE BELT, DIVIDENDS AND BONUSES PAID BY GOLD-MINING COMPANIES, 1912–54

Mine	Years	Value	Total
Aunor	1941–50	$ 3,860,000.00	
	1951	440,000.00	
	1952	360,000.00	
	1953	320,000.00	
	1954	320,000.00	$ 5,300,000.00
Broulan Reef	1940–45, 1949, 1950	$ 1,622,572.83	
	1951	481,118.35	
	1952	536,502.78	
	1953	178,834.26	
	1954	536,502.78	$ 3,355,531.00
Buffalo Ankerite	1933–41, 1943–45	$ 2,763,008.68	$ 2,763,008.68
Coniaurum	1932, 1937–50	$ 3,905,607.25	
	1951	110,669.72	
	1952	55,334.86	$ 4,071,611.83

PORCUPINE BELT, DIVIDENDS AND BONUSES PAID BY GOLD-MINING COMPANIES, 1912–54—*Continued*

Mine	Years	Value	Total
Delnite	1940–43, 1949, 1950	$ 804,267.09	
	1951	119,150.68	
	1952	119,150.68	
	1953	119,150.68	
	1954	119,150.68	$ 1,280,869.81
Dome	1915–17, 1920–50	$ 70,065,880.45	
	1951	1,460,001.00	
	1952	1,362,667.60	
	1953	1,362,667.60	
	1954	1,362,667.60	$ 75,613,884.25
Hallnor	1939–50	$ 9,120,000.00	
	1951	520,000.00	
	1952	560,000.00	
	1953	440,000.00	
	1954	400,000.00	$ 11,040,000.00
Hollinger	1912–50	$127,258,000.00	
	1951	885,600.00	
	1952	1,180,800.00	
	1953	1,180,800.00	
	1954	1,180,800.00	$131,686,000.00
Hugh-Pam	1954	$ 79,987.98	$ 79,987.98
McIntyre	1917–50	$ 50,623,471.43	
	1951	2,405,970.00	
	1952	2,397,990.00	
	1953	2,394,000.00	
	1954	2,394,000.00	$ 60,215,431.43
Moneta	1938–47	$ 1,526,316.00	$ 1,526,316.00
Naybob	1941	$ 190,912.36	$ 190,912.36
Pamour	1938–46, 1949, 1950	$ 4,250,000.00	
	1951	200,000.00	
	1952	150,000.00	
	1953	150,000.00	
	1954	150,000.00	$ 4,900,000.00
Paymaster	1938–46, 1949	$ 949,198.10	$ 949,198.10
Porcupine Crown	1914–17	$ 840,000.00	840,000.00
Preston East Dome	1940–50	$ 4,965,000.00	
	1951	180,000.00	
	1952	240,000.00	
	1953	240,000.00	
	1954	240,000.00	$ 5,865,000.00
Rea	1915	$ 12,000.00	$ 12,000.00
Vipond	1927	$ 67,500.00	$ 67,500.00
Totals	1912–50	$282,823,734.19	
	1951	6,802,509.75	
	1952	6,962,445.92	
	1953	6,385,452.54	
	1954	6,910,302.04	$309,884,444.44

MATACHEWAN AREA, DIVIDENDS AND BONUSES PAID BY GOLD-MINING COMPANIES, 1939–54

Mine	Years	Value	Total
Matachewan Consolidated	1940, 1946–49	$ 498,475.04	$ 498,475.04
Young-Davidson	1939–46, 1948–52	$ 475,232.40	
	1953	15,841.08	
	1954	23,761.62	$ 514,835.10
Totals	1939–44, 1946–52	$ 973,707.44	
	1953	15,841.08	
	1954	23,761.62	$ 1,013,310.14

KIRKLAND LAKE BELT, DIVIDENDS AND BONUSES PAID BY GOLD-MINING COMPANIES, 1915–54

Mine	Years	Value	Total
Kirkland Lake Gold	1934–50	$ 5,318,817.16	
	1951	159,800.97	
	1952	159,800.97	
	1953	53,266.99	$ 5,691,686.09
Lake Shore	1918–50	$101,460,000.00	
	1951	700,000.00	
	1952	600,000.00	
	1953	200,000.00	
	1954	200,000.00	$103,160,000.00
Macassa	1934–47, 1949, 1950	$ 8,013,313.66	
	1951	321,368.16	
	1952	294,587.48	
	1953	214,245.44	
	1954	267,806.80	$ 9,111,321.54
Sylvanite	1930–50	$ 10,112,967.50	
	1951	395,940.00	
	1952	263,960.00	
	1953	329,950.00	
	1954	329,950.00	$ 11,432,767.50
Teck-Hughes	1926–50	$ 44,536,296.32	
	1951	721,071.60	
	1952	721,071.60	
	1953	721,071.60	
	1954	721,071.60	$ 47,420,582.72
Tough-Oakes	1915, 1916	$ 398,625.00	$ 398,625.00
Toburn	1934–46	$ 2,349,500.00	$ 2,349,500.00
Upper Canada	1940–50	$ 2,307,241.83	
	1951	163,744.56	
	1952	163,744.47	
	1953	130,993.08	
	1954	147,368.70	$ 2,913,092.64
Wright-Hargreaves	1922–28, 1930–50	$ 48,097,500.00	
	1951	715,000.00	
	1952	660,000.00	
	1953	770,000.00	
	1954	660,000.00	$ 50,902,500.00
Totals	1915, 1916, 1918–50	$222,594,261.47	
	1951	3,176,925.29	
	1952	2,863,164.52	
	1953	2,419,527.11	
	1954	2,326,197.10	$233,380,075.49

ALGOMA DISTRICT, DIVIDENDS AND BONUSES PAID BY GOLD-MINING COMPANIES, 1941–54

Mine	Year	Value	Total
Cline Lake	1941	$ 64,200.20	$ 64,200.20
Total	1941	$ 64,200.20	$ 64,200.20

KENORA DISTRICT, DIVIDENDS AND BONUSES PAID BY GOLD-MINING COMPANIES, 1940–54

Mine	Years	Value	Total
Wendigo	1940–42, 1944, 1945	$ 686,440.24	$ 686,440.24
Total	1940–42, 1944, 1945	$ 686,440.24	$ 686,440.24

THUNDER BAY DISTRICT, DIVIDENDS AND BONUSES PAID BY GOLD-MINING COMPANIES, 1935–54

Mine	Years	Value	Total
Hard Rock	1939–43	$ 926,922.94	$ 926,922.94
Leitch	1937–50	$ 2,852,154.95	
	1951	233,000.40	
	1952	233,000.40	
	1953	203,875.35	
	1954	58,250.10	$ 3,580,281.20
Little Long Lac	1936–46	$ 3,976,965.00	
	1951	110,460.00	
	1952	110,460.00	
	1953	55,230.00	$ 4,253,115.00
MacLeod-Cockshutt	1940–44, 1949, 1950	$ 1,713,394.00	
	1951	286,249.00	
	1952	429,373.50	
	1953	286,249.00	
	1954	286,249.00	$ 3,001,514.50
Magnet	1940–43	$ 855,000.00	$ 855,000.00
Northern Empire	1935, 1937–43, 1946, 1948–50	$ 1,720,000.00	
	1951	48,000.00	
	1952	100,000.00	$ 1,868,000.00
Sturgeon River	1940–42	$ 219,980.64	$ 219,980.64
Tombill	1939–42	$ 454,000.00	$ 454,000.00
Totals	1935–50	$ 12,718,417.53	
	1951	677,709.40	
	1952	872,833.90	
	1953	545,354.35	
	1954	344,499.10	$ 15,158,814.28

LARDER LAKE AREA, DIVIDENDS AND BONUSES PAID BY GOLD-MINING COMPANIES, 1940–54

Mine	Years	Value	Total
Chesterville	1940–43, 1947–49	$ 876,457.30	$ 876,457.30
Kerr-Addison	1940–50	$ 18,164,355.84	
	1951	3,784,240.80	
	1952	3,784,240.80	
	1953	3,784,240.80	
	1954	3,784,240.80	$ 33,301,319.04
Totals	1940–50	$ 19,040,813.14	
	1951	3,784,240.80	
	1952	3,784,240.80	
	1953	3,784,240.80	
	1954	3,784,240.80	$ 34,177,776.34

PATRICIA PORTION OF KENORA DISTRICT, DIVIDENDS AND BONUSES PAID BY GOLD-MINING COMPANIES, 1934–54

Mine	Years	Value	Total
Berens River	1941–42, 1946	$ 520,000.00	$ 520,000.00
Campbell Red Lake	1952	$ 199,975.00	
	1953	199,975.00	
	1954	699,912.50	$ 1,099,862.50
Central Patricia	1936–47, 1949	$ 4,700,000.00	$ 4,700,000.00
Cochenour Willans	1940–44, 1946–50	$ 1,893,959.20	
	1951	355,398.60	
	1952	236,932.40	
	1953	118,466.20	$ 2,604,756.40
Gold Eagle	1942	$ 237,450.51	$ 237,450.51
Howey	1934–45, 1947–50	$ 2,760,000.00	
	1953	40,000.00	$ 2,800,000.00
Madsen Red Lake	1940–50	$ 2,483,464.88	
	1951	349,952.80	
	1952	104,985.84	
	1953	419,943.36	
	1954	419,943.36	$ 3,778,290.24
McKenzie Red Lake	1936–44, 1949, 1950	$ 2,978,249.89	
	1951	88,200.00	$ 3,066,449.89
McMarmac Red Lake	1943	$ 82,000.20	$ 82,000.00
New Dickenson	1954	$ 550,021.15	$ 550,021.15
New Jason	1941	$ 119,960.20	$ 119,960.20
Pickle Crow	1936–50	$ 9,818,425.00	
	1951	313,685.00	
	1952	313,685.00	
	1953	313,685.00	
	1954	313,685.00	$ 11,073,165.00
Totals	1934–50	$ 25,468,509.88	
	1951	1,107,236.40	
	1952	980,578.24	
	1953	1,092,069.56	
	1954	1,983,562.01	$ 30,631,956.09

SUDBURY DISTRICT, DIVIDENDS AND BONUSES PAID BY GOLD-MINING COMPANIES, 1954

Mine	Year	Value	Total
Renabie	1954	$ 157,500.75	$ 157,500.75
Total	1954	$ 157,500.75	$ 157,500.75

DIVIDENDS AND BONUSES PAID BY GOLD-MINING COMPANIES BY AREAS, 1912–54

Year	Porcupine	Kirkland Lake and Larder Lake	Northwestern Ontario	Total
1912	$ 270,000.00			$ 270,000.00
1913	1,170,000.00			1,170,000.00
1914	1,410,000.00			1,410,000.00
1915	2,212,000.00	$ 132,875.00		2,344,875.00
1916	4,326,000.00	265,750.00		4,591,750.00
1917	1,699,542.45			1,699,542.45
1918	1,773,042.45	100,000.00		1,873,042.45
1919	2,086,028.30	100,000.00		2,186,028.30
1920	3,176,928.45	80,000.00		3,256,928.45
1921	4,222,990.20	120,000.00		4,342,990.20
1922	4,938,013.56	492,500.00		5,430,513.56
1923	5,186,271.54	366,250.00		5,552,521.54
1924	5,887,722.00	586,250.00		6,473,972.00
1925	7,083,842.06	1,150,000.00		8,233,842.06
1926	8,510,673.23	2,368,464.40		10,879,137.63
1927	8,453,572.73	3,351,071.60		11,804,644.33
1928	7,164,113.29	5,685,286.40		12,849,399.69
1929	4,955,599.54	5,066,286.40		10,021,855.94
1930	5,195,427.51	5,938,276.40		11,133,703.91
1931	5,227,596.87	8,875,123.60		14,102,720.47
1932	6,145,412.60	10,011,761.40		16,157,174.00
1933	7,572,357.79	10,561,761.40		18,134,119.19
1934	11,931,487.01	13,930,381.29	$ 500,000.00	26,361,868.30
1935	9,946,024.58	14,584,641.49	420,500.00	24,951,166.07
1936	11,021,671.80	16,989,799.66	1,652,900.00	29,664,371.46
1937	12,169,515.61	20,259,963.51	2,714,950.00	35,144,429.12
1938	12,769,209.68	16,299,276.70	3,095,650.10	32,164,136.48
1939	14,201,733.86	15,940,988.92	3,661,785.52	33,804,508.30
1940	15,790,180.65	13,923,696.12	5,127,737.80	34,841,614.57
1941	16,502,343.41	14,134,988.75	4,913,538.85	35,550,871.01
1942	12,274,518.21	9,385,700.83	4,279,842.81	25,940,061.85
1943	11,797,596.96	8,296,861.08	2,447,702.39	22,542,160.43
1944	10,234,169.02	6,983,162.18	2,326,896.93	19,544,228.13
1945	9,494,013.19	5,974,189.44	1,226,213.78	16,694,416.41
1946	8,571,576.05	5,756,141.70	1,338,060.84	15,665,778.59
1947	6,858,213.02	4,813,753.15	1,287,447.29	12,959,413.46
1948	6,519,774.95	4,657,360.65	1,138,036.12	12,315,171.72
1949	6,791,356.14	6,639,665.72	1,552,460.32	14,983,482.18
1950	7,283,215.48	7,812,846.82	2,180,029.30	17,276,091.60
1951	6,802,509.75	6,961,166.09	1,832,469.04	15,596,144.88
1952	6,962,445.92	6,647,405.32	1,853,412.14	15,463,263.38
1953	6,385,452.54	6,203,767.91	1,653,264.99	14,242,485.44
1954	6,910,302.04	6,110,437.90	2,509,323.48	15,530,063.42
Total	$309,884,444.44	$267,557,851.83	$47,712,221.70	$625,154,517.97

DIVIDENDS AND BONUSES PAID BY GOLD-MINING COMPANIES TO DECEMBER 31, 1954

Name of company	Date of incorporation	Authorized capital, dollars or shares	Dividends and bonuses paid to end of 1953	Dividends and bonuses paid during 1954	Rate per share, 1954	Total dividends and bonuses paid to Dec. 31, 1954	Date when last dividend or bonus was paid
Aunor Gold Mines, Ltd.	May 19, 1939	$2,000,000	$ 4,980,000.00	$ 320,000.00	16c.	$ 5,300,000.00	Dec. 1, 1954
Berens River Mines, Ltd.	July 2, 1936	$2,000,000	520,000.00	.....	.....	520,000.00	Dec. 23, 1946
Broulan Porcupine Mines, Ltd.	Mar. 18, 1936	$3,000,000	1,360,472.53	.....	.....	1,360,472.53	Apr. 2, 1951
Broulan Reef Mines, Ltd.	June 30, 1951	$5,500,000	1,024,082.64	536,502.78	9c.	1,560,585.42	Dec. 30, 1954
Buffalo Ankerite Gold Mines, Ltd.	Oct. 5, 1932	$1,000,000	2,763,008.68	.....	.....	2,763,008.68	Jan. 11, 1945
Campbell Red Lake Mines, Ltd.	July 18, 1944	$4,000,000	399,950.00	699,912.50	17½c.	1,099,862.50	July 28, 1954
Central Patricia Gold Mines, Ltd.	Apr. 20, 1931	$2,500,000	4,700,000.00	.....	.....	4,700,000.00	June 30, 1952
Chesterville Larder Lake Gold Mining Co., Ltd.	Mar. 20, 1907	$2,000,000	876,457.30	.....	.....	876,457.30	May 16, 1949
Cline Lake Gold Mines, Ltd.	Aug. 5, 1936	$2,000,000	64,200.20	.....	.....	64,200.20	Feb. 28, 1941
Cochenour Willans Gold Mines, Ltd.	Apr. 19, 1936	$3,000,000	2,604,756.40	.....	.....	2,604,756.40	July 10, 1953
Coniaurum Mines, Ltd.	July 4, 1929	3,000,000	4,071,611.83	.....	.....	4,071,611.83	May 19, 1952
Consolidated Howey Gold Mines, Ltd.	Mar. 12, 1926	$2,000,000	2,800,000.00	.....	.....	2,800,000.00	Apr. 1, 1953
Delnite Mines, Ltd.	Oct. 23, 1934	$3,000,000	1,161,719.13	119,150.68	4c.	1,280,869.81	Oct. 1, 1954
Dome Mines, Ltd.	July 7, 1923	$2,000,000	74,251,216.65	1,362,667.60	70c.	75,613,884.25	Oct. 29, 1954
Gold Eagle Gold Mines, Ltd.	Feb. 13, 1934	$3,000,000	237,450.51	.....	.....	237,450.51	Oct. 21, 1942
Hallnor Mines, Ltd.	Apr. 6, 1936	$2,000,000	10,640,000.00	400,000.00	20c.	11,040,000.00	Dec. 1, 1954
Hard Rock Gold Mines, Ltd.	Jan. 6, 1934	$3,000,000	926,922.94	.....	.....	926,922.94	June 21, 1943
Hollinger Consolidated Gold Mines, Ltd.	May 25, 1916	$25,000,000	130,505,200.00	1,180,800.00	24c.	131,686,000.00	Dec. 29, 1954
Hugh-Pam Porcupine Mines, Ltd.	Dec. 9, 1935	$4,000,000	.....	79,987.98	2c.	79,987.98	Feb. 12, 1954
Kerr-Addison Gold Mines, Ltd.	Nov. 19, 1915	$5,000,000	29,517,078.24	3,784,240.80	80c.	33,301,319.04	Dec. 30, 1954
Kirkland Lake Gold Mining Co. Ltd.	Nov. 19, 1915	$5,000,000	5,691,686.09	.....	.....	5,691,686.09	Oct. 31, 1953
Lake Shore Mines, Ltd.	Feb. 25, 1914	$2,000,000	102,960,000.00	200,000.00	10c.	103,160,000.00	Nov. 15, 1954
Leitch Gold Mines, Ltd.	July 23, 1935	$3,000,000	3,522,031.10	58,250.10	2c.	3,580,281.20	Feb. 15, 1954
Little Long Lac Gold Mines, Ltd.	Jan. 26, 1933	2,000,000	4,253,115.00	.....	.....	4,253,115.00	June 12, 1953
Macassa Mines, Ltd.	Apr. 12, 1926	$3,000,000	8,843,514.74	267,806.80	10c.	9,111,321.54	Dec. 15, 1954
McIntyre Porcupine Mines, Ltd.	Mar. 16, 1911	$4,000,000	57,821,431.43	2,394,000.00	$3.00	60,215,431.43	Dec. 1, 1954
McKenzie Red Lake Gold Mines, Ltd.	Feb. 1, 1933	$3,000,000	3,066,449.39	.....	.....	3,066,449.89	Dec. 7, 1951
MacLeod-Cockshutt Gold Mines, Ltd.	Sept. 22, 1933	$3,000,000	2,715,265.50	286,249.00	10c.	3,001,514.50	Oct. 15, 1954

DIVIDENDS AND BONUSES PAID BY GOLD-MINING COMPANIES TO DECEMBER 31, 1954—*Continued*

Name of company	Date of incorporation	Authorized capital, dollars or shares	Dividends and bonuses paid to end of 1953	Dividends and bonuses paid during 1954	Rate per share, 1954	Total dividends and bonuses paid to Dec. 31, 1954	Date when last dividend or bonus was paid
McMarmac Red Lake Gold Mines, Ltd.	July 21, 1939	$3,000,000	$ 82,000.20	.....	.....	$ 82,000.20	May 10, 1943
Madsen Red Lake Gold Mines, Ltd.	Mar. 8, 1935	$3,000,000	3,358,346.88	$ 419,943.36	12c.	3,778,290.24	Dec. 23, 1954
Magnet Consolidated Mines, Ltd.	Apr. 23, 1936	$3,000,000	855,000.00	.....	.....	855,000.00	Dec. 10, 1943
Matachewan Consolidated Mines, Ltd.	July 10, 1933	4,000,000	498,475.04	.....	.....	498,475.04	June 14, 1949
Moneta Porcupine Mines, Ltd.	Oct. 14, 1910	$3,000,000	1,526,316.00	127,193.00	5c.	1,653,509.00	July 30, 1954
Naybob Gold Mines, Ltd.	Jan. 3, 1934	$5,000,000	190,912.36	.....	.....	190,912.36	Oct. 15, 1941
New Dickenson Mines, Ltd	Nov. 27, 1944	$3,750,000	.....	550,021.15	20c.	550,021.15	Nov. 1, 1954
New Jason Mines, Ltd.	Nov. 9, 1938	$3,000,000	119,960.20	.....	.....	119,960.20	Dec. 30, 1941
Northern Empire Mines, Co., Ltd.	July 28, 1932	$500,000	1,868,000.00	.....	.....	1,868,000.00	June 30, 1952
Pamour Porcupine Mines, Ltd.	Mar. 7, 1934	5,000,000	4,750,000.00	150,000.00	3c.	4,900,000.00	Dec. 15, 1954
Paymaster Consolidated Mines, Ltd.	Feb. 15, 1930	$9,000,000	949,198.10	.....	.....	949,198.10	Nov. 15, 1949
Pickle Crow Gold Mines, Ltd.	Jan. 8, 1934	$3,500,000	10,759,480.00	313,685.00	10c.	11,073,165.00	June 30, 1954
Porcupine Crown Mines, Ltd.	May 25, 1913	$2,000,000	840,000.00	.....	.....	840,000.00	July 15, 1917
Porcupine Reef Gold Mines, Ltd.	Oct. 4, 1935	$4,000,000	434,473.05	.....	.....	434,473.05	Apr. 2, 1951
Preston East Dome Mines, Ltd.	Jan. 7, 1911	$3,000,000	5,625,000.00	240,000.00	8c.	5,865,000.00	July 15, 1954
Rea Consolidated Gold Mines, Ltd.	Apr. 5, 1911	$1,000,000	12,000.00	.....	.....	12,000.00	1915
Renabie Mines, Ltd	Jan. 3, 1941	$1,500,000	.....	157,500.75	15c.	157,500.75	Dec. 15, 1954
Sturgeon River Gold Mines, Ltd.	Aug. 22, 1934	$3,000,000	219,980.64	.....	.....	219,980.64	Apr. 30, 1942
Sylvanite Gold Mines, Ltd.	June 13, 1913	$3,300,000	11,102,817.50	329,950.00	10c.	11,432,767.50	July 2, 1954
Teck-Hughes Gold Mines, Ltd., The	Mar. 2, 1923	$5,000,000	46,699,511.12	721,071.60	15c.	47,420,582.72	Oct. 1, 1954
Toburn Gold Mines, Ltd.	Jan. 24, 1931	$2,000,000	2,349,500.00	.....	.....	2,349,500.00	Nov. 22, 1946
Tombill Gold Mines, Ltd.	Oct. 7, 1935	$2,000,000	454,000.00	.....	.....	454,000.00	Dec. 23, 1942
Tough-Oakes Gold Mines, Ltd.	July 15, 1913	$3,000,000	398,625.00	.....	.....	398,625.00	Dec. 27, 1916
Upper Canada Mines, Ltd.	Apr. 4, 1929	$3,500,000	2,765,723.94	147,368.70	4½c.	2,913,092.64	Aug. 27, 1954
Vipond Consolidated Mines, Ltd.	July 17, 1922	$2,500,000	67,500.00	.....	.....	67,500.00	Apr. 15, 1927
Wendigo Gold Mines, Ltd.	Oct. 5, 1933	$2,000,000	686,440.24	.....	.....	686,440.24	May 1, 1945
Wright-Hargreaves Mines, Ltd.	June 16, 1916	5,500,000	50,242,500.00	660,000.00	12c.	50,902,500.00	Oct. 1, 1954
Young-Davidson Mines, Ltd.	Apr. 8, 1926	$3,000,000	491,073.48	23,761.62	1½c.	514,835.10	Apr. 1, 1954
Total	.....	.....	$609,624,454.55	$15,530,063.42	.....	$ 625,154,517.97	.....

Gold-Milling Plants

The rated daily capacity of gold-milling plants in Ontario was estimated at 29,110 tons in 1954. The daily operating average reported to the Statistician of the Department totalled 26,910 tons, and the capacity of idle plants was 2,900 tons.

TONNAGE OF GOLD-MILLING PLANTS IN ONTARIO, 1954

Area and mine	Rated daily capacity	Daily operating average	Idle plants
	tons	tons	tons
LARDER LAKE AREA:			
Kerr-Addison	4,000	4,546	.....
KIRKLAND LAKE BELT:			
Kirkland Lake Gold	400	321	.....
Lake Shore	1,500	692	.....
Macassa	400	398	.....
Sylvanite	600	470	.....
Teck-Hughes	600	649	.....
Upper Canada	500	540	.....
Wright-Hargreaves	750	531	.....
PORCUPINE BELT:			
Aunor	300	515	.....
Broulan Reef	700	555	.....
Buffalo Ankerite (2 mills)	.....	.....	1,000
Coniaurum	500	354	.....
Delnite	520	457	.....
Dome	1,950	1,937	.....
Hallnor	400	366	.....
Hollinger	3,900	3,600	.....
McIntyre Porcupine	2,400	2,295	.....
Pamour	1,745	1,745	.....
Paymaster-Consolidated	600	352	.....
Preston East Dome	800	663	.....
Ross (Hollinger)	300	313	.....
MATACHEWAN AND WEST SHINIMGTREE AREAS:			
Matachewan Consolidated	.....	.....	1,000
Young-Davidson	1,050	864	.....
SUDBURY DISTRICT:			
Renabie	450	457	.....
THUNDER BAY DISTRICT:			
Leitch	120	107	.....
Little Long Lac	.....	.....	100
MacLeod-Cockshutt	1,500	1,516	.....
Magnet	.....	.....	150
Theresa	.....	.....	100
PATRICIA PORTION:			
Campbell Red Lake	600	537	.....
Central Patricia	.....	.....	400
Cochenour Willans	225	181	.....
McKenzie Red Lake	240	230	.....
Madsen Red Lake	800	784	.....
New Dickenson	360	360	.....
New Jason	.....	.....	150
Pickle Crow	400	303	.....
Starratt Olsen	500	272	.....
Total	29,110	26,910	2,900

Labour Statistics

The following figures summarize labour statistics for the gold-mining industry, as reported to the Ontario Department of Mines:

AVERAGE YEARLY WAGE, GOLD-MINING INDUSTRY, 1953 AND 1954

Area or district	1953			1954		
	Number of wage-earners	Wages paid	Average wages per annum	Number of wage-earners	Wages paid	Average wages per annum
Porcupine belt	5,523	$15,959,211	$2,890	5,605	$17,946,392	$3,202
Kirkland Lake area	2,251	6,930,778	3,079	2,158	6,905,951	3,200
Larder Lake area	839	2,679,809	3,194	930	3,046,788	3,276
Matachewan area	173	545,205	3,151	119	381,904	3,209
Sudbury district	145	421,552	2,907	144	430,545	2,990
Algoma district	.....	.....	.....	.....	.....	.....
Thunder Bay district	437	1,414,410	3,237	327	1,114,920	3,409
Patricia portion	1,197	3,890,772	3,250	1,176	4,019,599	3,418
Kenora and Rainy River districts	.....	.....	.....	.....	.....	.....
Southeastern Ontario	.....	.....	.....	.....	.....	.....
Operating but non-producing	27	73,247	2,713	47	140,758	2,995
Total	10,592	$31,914,984	$3,013	10,506	$33,986,857	$3,23

World Output

The following table showing the output by the leading gold-producing countries from 1950 to 1954, inclusive, is taken from the Year Book of the American Bureau of Metal Statistics, 1954.

GOLD PRODUCTION OF THE WORLD (*a*)
(IN FINE OUNCES)

Country	1950	1951	1952	1953	1954
NORTH AMERICA:					
United States	2,375,130	1,996,493	1,937,818	1,990,149	1,867,296
Canada	4,441,227	4,392,751	4,471,725	4,055,723	4,366,506
Mexico	408,112	393,420	459,391	458,808	386,925
Total North America	7,224,469	6,782,664	6,868,934	6,504,680	6,620,727
CENTRAL AMERICA AND WEST INDIES:	303,800	313,600	315,500	325,400	.....
SOUTH AMERICA:					
Brazil (*b*)	131,207	135,837	136,764	115,869	119,984
British Guiana	13,740	14,689	24,223	20,966	26,938
Chile	185,538	174,864	177,050	130,690	124,967
Colombia	379,412	430,723	422,240	436,045	377,467
Ecuador	91,946	12,683	24,267	29,239	16,900
French Guiana	12,249	12,056	8,231	2,576	.....
Peru	147,968	158,270	130,944	128,211	147,278
Surinam	4,546	6,494	6,134	6,482	6,780
Venezuela	34,462	2,861	4,797	27,304	56,074
Total South America, as reported	1,001,068	948,477	934,650	897,382	.....

GOLD PRODUCTION OF THE WORLD—*Continued*
(IN FINE OUNCES)

Country	1950	1951	1952	1953	1954
EUROPE:	400,000	300,000	300,000	300,000	.....
AUSTRALIA:					
New South Wales	51,350	48,910	39,030	26,461	31,427
Queensland	88,249	78,580	85,756	91,887	97,338
Victoria	67,826	66,063	66,777	63,917	52,702
Western Australia	610,333	648,245	727,469	823,062	861,745
Tasmania	15,578	14,446	16,072	16,988	19,215
Other Australia	36,201	39,307	45,331	52,866	53,706
Total Australia (Commonwealth)	869,537	895,551	980,435	1,075,181	1,116,133
OCEANIA, OTHER:					
Fiji	103,421	93,635	78,282	80,500	.....
New Guinea	80,099	94,082	127,431	120,787	86,728
New Zealand	76,527	75,115	59,373	38,656	41,713
Total Oceania, other	260,047	262,832	265,086	239,943	.....
ASIA:					
India	196,848	226,233	253,264	233,013	240,712
Japan	135,033	177,472	201,392	256,590	253,933
Korea, Republic of	5,144	1,000	15,657	15,860	52,250
Philippines Republic	333,991	393,602	469,408	480,625	416,052
Saudi Arabia	66,202	73,104	69,394	81,566	128
Taiwan (Formosa)	18,232	30,500	33,178	24,821	21,541
Total Asia, as reported	755,450	901,911	1,042,293	1,082,475	984,616
AFRICA:					
Bechuanaland	261	493	1,245	1,109	.....
Belgian Congo	339,408	352,302	368,749	371,011	366,175
Ethiopia	43,524	32,938	27,291	26,696	.....
French Cameroons	7,169	5,420	2,604	1,029	685
French Equatorial Africa	54,996	52,848	51,504	54,173	45,305
Gold Coast	689,441	698,676	691,460	730,936	787,057
Kenya	22,945	19,765	10,210	9,590	6,607
Liberia	11,025	9,806	949	863	1,135
Madagascar	1,935	1,961	1,768	1,640	1,363
Nigeria	2,238	1,566	1,349	861	.....
Sierra Leone	3,484	3,292	2,591	3,585	286
Southern Rhodesia	511,163	486,907	496,731	501,057	535,852
Tanganyika (exports)	65,127	65,583	64,693	69,886	72,212
Uganda	586	223	181	572	568
Union of South Africa	11,663,713	11,516,450	11,818,681	11,939,593	13,227,847
Total Africa, as reported	13,417,015	13,248,230	13,540,006	13,712,601	.....
RUSSIA	*8,000,000	*9,500,000	*9,500,000	*9,000,000	.....
TOTAL WORLD AS REPORTED	32,231,386	33,153,265	33,746,904	33,137,662	.....
ESTIMATED WORLD TOTAL (*c*)	32,700,000	33,500,000	34,200,000	33,500,000	.....

(*a*) In compiling this table free use has been made of the reports of the Director of the Mint, the U.S. Bureau of Mines, and other publications.

(*b*) Mined gold only; production of alluvial gold unknown.

(*c*) This estimate includes the following countries who also produce gold: Angola, Argentina, Austria, Bolivia, Bulgaria, Burma, China, Czechoslovakia, Egypt, Eritrea, French Morocco, French West Africa, Hungary, Malaya, Mozambique, North Korea, Northern Rhodesia, Papua, Sarawak, South West Africa, Sudan and Thailand from whom definitive figures are not available.

* = Conjectural.

Nickel-Copper and Platinum Metals

The nickel-copper mines of the Sudbury district made another record in 1954 when the total value of all metals contained in the 16,187,520 tons of ore shipped amounted to $228,996,855. This is 7.79 percent greater than in the previous year when the value was $264,402,309. Total nickel shipments, which includes some nickel contained in the cobalt ores, was 316,019,050 pounds, worth $176,556,296. Total copper shipments, which consisted of shipments from the Sudbury district, from New Ryan Lake Mines, Limited, in Matachewan, in concentrates from Wright-Hargreaves gold mine, and from silver cobalt ores, amounted to 281,552,-361 pounds, valued at $81,343,536. Government stockpiling and defence requirements account for the major portion of the free world supply of nickel, and although this is expected to continue, it may be modified, and more nickel will be available for civilian applications.

The nickel-copper ores also contain, besides the precious metals, selenium, tellurium, and cobalt. The value of the selenium output amounted to $474,130, and tellurium to $12,591. Cobalt in the form of metal, cobalt oxide, and electrolytic cobalt came to 1,426,710 pounds, valued at $3,730,926. This marks the first commercial production of electrolytic cobalt in Canada.

Dividends

The International Nickel Company of Canada, Limited, and Falconbridge Nickel Mines, Limited, the two producing companies, paid dividends amounting to $46,081,225 in 1954. This brings the grand total of dividends paid by these companies to the end of 1954 to $795,117,278.

DIVIDENDS PAID BY NICKEL COMPANIES TO END OF 1954[1]

Company		Period	To end of 1953	1954
Canadian Copper Company		1894–1901	$ 1,975,000.00	.....
International Nickel Company	preferred	1906–28	12,299,273.00	.....
	common	1909–28	65,811,694.00	.....
International Nickel Company of Canada, Limited	preferred	1929–53	48,126,786.55	$ 1,933,898.75
	common	1929–53	574,664,091.91	42,276,690.10
Falconbridge Nickel Mines, Limited		1933–53	19,868,081.22	1,870,636.00
Total		.....	$722,744,926.68	$46,081,224.85
Mond Nickel Company	deferred	1906–14	£ 264,043	.....
	preferred	1904–29	2,556,359	.....
	ordinary	1905–29	2,581,984	.....
Total		.....	£ 5,402,386 or $ 26,291,126	....
Grand total		.....	$749,036,052.68	$46,081,224.85

[1]For previous historical data, see Vol. LXI, 1952, pt. 1, p. 41.

General Statistics

The nickel-copper mines in the Sudbury district, with their smelters and refineries, employed 2,233 salaried personnel, who received a total of $11,937,862 in salaries. The average number of wage-earners was 18,075, and they were paid a total of $71,701,732. Fuel and electricity costs amounted to $20,263,625, and process supplies came to $21,469,396.

STATISTICAL SYNOPSIS OF THE NICKEL-COPPER INDUSTRY IN ONTARIO, 1952–54

Year	Number of producing companies	Number of plants in Ontario	Dividends paid	Salaried employees		Wage-earners		Selling value of products	
				Number	Salaries	Number	Wages	Kind	Value
1952	4	12 mines[1]	$41,608,768	791	$ 4,316,829	9,748	$36,310,121	Nickel in matte	$ 54,357,284
		3 smelters		896	4,408,772	5,667	20,403,537	Metallic nickel	84,269,593
		2 refineries		306	1,498,964	2,289	8,089,975	Nickel oxide and salts	12,999,561
								Copper in matte	4,802,161
								Converter copper	66,040,997
								Gold	1,497,223
								Silver	1,028,539
								Platinum metals	18,475,723
								Selenium and tellurium	274,835
								Cobalt oxide	2,589,819
Total			$41,608,768	1,993	$10,224,565	17,704	$64,803,633		$246,335,735
1953	5	13 mines[2]	$38,054,482	868	$ 4,952,119	10,132	$40,354,953	Nickel in matte	$ 53,760,841
		3 smelters		992	4,776,229	5,802	21,792,505	Metallic nickel	94,259,028
		2 refineries		313	1,565,850	2,268	8,342,784	Nickel oxide and salts	12,427,039
								Copper in matte	5,558,504
								Converter copper	71,769,628
								Gold (standard)	1,367,645
								Silver	1,054,020
								Platinum metals	20,046,390
								Selenium and tellurium	397,251
								Cobalt oxide	3,761,963
Total			$38,054,482	2,173	$11,294,198	18,202	$70,490,242		$264,402,309
1954	5	17 mines[3]	$46,081,225	905	$ 5,261,665	9,765	$39,944,854	Nickel in matte	$ 59,959,587
		3 smelters		1,007	5,031,472	5,980	23,000,385	Metallic nickel	103,441,336
		2 refineries		321	1,644,725	2,330	8,756,493	Nickel oxide and salts	12,969,617
								Copper in matte	6,698,390
								Converter copper	74,180,946
								Gold	1,558,192
								Silver	1,064,584
								Platinum metals	20,906,556
								Selenium and tellurium	486,721
								Cobalt oxide	3,730,926
Total			$46,081,225	2,233	$11,937,862	18,075	$71,701,732		$284,996,855

[1]Includes the Crean Hill mine of International Nickel Company of Canada, Limited, the Hardy mine of Falconbridge Nickel Mines, Limited, and Coldstream Copper Mines, Limited, which were active but non-producing.

[2]Includes the Crean Hill mine of International Nickel Company of Canada, Limited, which was active but non-producing.

[3]Includes the Crean Hill mine of International Nickel Company of Canada, Limited, the Fecunis Lake, Boundary, and Longvack mines of Falconbridge Nickel Mines, Limited, which were active but non-producing.

NICKEL-COPPER MINING AND SMELTING, 1950–54

	1950	1951	1952	1953	1954
	tons	tons	tons	tons	tons
Ore shipped	10,777,859	12,885,455	14,380,684	14,982,227	16,187,520
Ore treated	10,786,506	12,870,547	14,348,126	14,881,098	16,124,184
Copper in blister produced in Ontario	108,802	120,339	115,699	119,856	127,196
Nickel produced in Ontario	82,816	88,045	88,848	92,806	102,380
Matte exported	60,229	71,973	78,324	77,045	88,868
Nickel content of matte exported	40,775	48,259	51,475	49,626	55,518
Copper content of matte exported	8,395	8,301	9,416	10,294	12,783

Production of Precious Metals

In the refining of the nickel-copper ores, gold, silver, and metals of the platinum group are recovered. In 1954 these mines reported 45,735 ounces of gold, valued at $1,558,192; 1,278,672 ounces of silver, worth $1,064,584; and a total of 343,706 ounces of the platinum metals with an aggregate value of $20,906,556.

PRECIOUS METALS RECOVERED, 1950–54

	1950	1951	1952	1953	1954
	ounces	ounces	ounces	ounces	ounces
Platinum metals:					
Platinum	124,453	153,461	122,315	137,545	154,356
Palladium	109,560	126,708	119,568	127,689	144,331
Rhodium, ruthenium, and iridium	39,170	38,197	37,839	38,329	45,019
Total ounces	273,183	318,366	279,722	303,563	343,706
Value	$17,822,766	$22,490,536	$18,475,723	$20,046,390	$20,906,556
Gold ounces	36,264	40,394	43,689	39,726	45,735
Silver ounces	1,045,106	1,128,205	1,231,047	1,254,637	1,278,672

Operations at the Mines

International Nickel Company of Canada, Limited.—Ore was mined all year from the Frood open pit and, with the ore from the Frood-Stobie underground workings, amounted to almost 50 percent of the total shipments of ore by the company. Caving operations at the Creighton mine, which is their next largest producer, supplied ore from No. 3 shaft area and from square-set stopes and pillars in No. 5 shaft area. The Levack, Garson, and Murray mines all shipped ore, and development work was extended at these properties. Development work was continued at the Crean Hill mine, and a headframe, hoist and compressor building, change-house, and office were under construction.

Falconbridge Nickel Mines, Limited.—This company continued development and expansion at all their properties. Ore was shipped from the Falconbridge, East, McKim, Hardy, and Mount Nickel mines. Further underground development was continued, and mine and other buildings were under construction at the Boundary, Fecunis Lake, and Longvack mines.

Milnet Mines, Limited.—This company leased a section of the property of Jonsmith Mines, Limited, in 1953 and continued operations there until July, 1954. All ore mined during the year was shipped to Falconbridge.

Nickel Rim Mines, Limited.—This company, formerly East Rim Nickel Mines, Limited, was reorganized during the year and the name changed to Nickel Rim Mines, Limited. Operation of the mill started in January, and all concentrates were shipped to Falconbridge for treatment.

Nickel Offsets, Limited.—Very little development took place at the property during the year, and all concentrates were shipped to Falconbridge.

Silver-Cobalt

Shipments of ore and concentrates, amounting to 11,149 tons, were made by the mines in the Cobalt and Gowganda areas during 1954 to Deloro Smelting and Refining Company, Limited, Deloro; Noranda Mines, Limited, Noranda, Quebec; American Metals Company, Limited, New York, N.Y., U.S.A.; and Baker-Meekins Company, Incorporated, Baltimore, Md., U.S.A. Silver production originating from these mines was 3,732,456 ounces, valued at $3,107,530, and the cobalt output was 826,255 pounds, worth $2,182,071.

The total silver production for the province was 5,443,721 ounces, valued at $4,530,484, and was made up of shipments from the cobalt-silver mines, from the gold mines, and of silver contained in the nickel-copper ores of the Sudbury district. Small amounts also came from Jardun Mines, Limited, a silver-lead-zinc property in the Algoma district, and from New Ryan Lake Mines, Limited, a copper-gold-silver property in the Matachewan area.

SILVER PRODUCTION, 1953 AND 1954

Source	1953		1954	
	Fine ounces	Value	Fine ounces	Value
Sales of bullion by the reduction companies, smelters, and mines; Contained in silver-cobalt concentrates and residues exported from Canada; Estimated as recovered from concentrates treated in other provinces	3,537,324	$2,971,706	3,732,456	$3,107,530
In crude gold bullion	355,550	299,501	390,962	323,710
Recovered by nickel-copper refineries	1,254,637	1,054,020	1,278,672	1,064,584
In copper-gold-silver ores	5,712	4,799	10,915	9,087
In silver-lead-zinc ores	1,396	1,173	30,716	25,573
Total	5,154,619	$4,331,199	5,443,721	$4,530,484

Cobalt from all sources amounted to 2,252,965 pounds, having a value of $5,912,997, and combines the output from the silver-cobalt mines and the nickel-copper mines of the Sudbury district. The latter mines recover cobalt in the form of metal and cobalt oxide; and for the first time in Canada the International Nickel company initiated production of electrolytic cobalt.

Deloro and the silver-cobalt mines reported employing 215 salaried personnel, who were paid $732,424, and 1,037 wage-earners, who received $3,182,826 in wages. Fuel and electricity costs were $537,318, and process supplies amounted to $1,058,058.

In the Cobalt camp the following mines were in operation: Cobalt Chemicals, Limited, operated their smelter from March until the end of the year treating ores from mines in the Cobalt and Gowganda areas; Cobalt Consolidated Mining Corporation, Limited, operated all year, and production was obtained from the Agaunico, Colonial, Cobalt Lode, Right-of-Way, and Kerr Lake mines, and milling was done at the Colonial and "104" mills; Harrison-Hibbert Mines, Limited, operated until August when the plant was closed down; Mensilvo Mines, Limited, operated until November when it was leased to Silver Crater Mines, Limited; Nipissing-O'Brien Mines, Limited, carried on mining operations all year and operated their mill from September. Silver-Miller Mines, Limited, which owns the Brady Lake, La Rose, and Lawson mines (all producing), reported shipping to Deloro and Noranda; United Cobalt Mines, Limited, operated their custom's mill from the beginning of the year to August.

SHIPMENTS FROM SILVER MINES, SMELTERS, AND REFINERIES, 1904–54

Year	Bismuth		Copper[1]		Lead[1]		Nickel[2]		Cobalt[3]		Arsenic		Silver		Total
	tons		tons		tons		tons		tons		tons		ounces		
1904–1925[4]	[5]25	$ 82,796	669	$231,383	141	$17,623	5,180	$ 927,695	[6]12,227	$16,398,380	55,173	$4,560,796	363,774,234	$226,296,692	$248,515,365
1926	3	6,440	35	5,394	11	1,463	83	30,051	332	1,136,014	2,025	135,549	8,981,557	5,541,009	6,855,920
1927	1	1,003	20	2,940	3	312	100	52,829	440	1,764,534	2,481	197,668	8,883,829	4,970,194	6,989,480
1928	7	5,067	38	15,764	27	2,169	111	57,039	477	1,671,900	2,049	178,149	6,688,454	3,882,570	5,812,658
1929	13	23,413	13	3,098	3	267	115	63,167	464	1,801,915	1,871	154,887	7,970,540	4,239,980	6,286,727
1930	6	6,366	23	5,070	22	1,748	53	27,455	347	1,143,631	1,375	109,928	9,109,885	3,460,247	4,754,445
1931	4	3,532	29	5,438	40	2,529	47	31,650	261	651,179	1,788	135,170	5,415,655	1,546,888	2,376,386
1932	8	7,289	18	2,152	43	1,756	33	17,772	245	587,957	1,212	98,914	5,106,888	1,592,893	2,308,733
1933	4	3,731	19	2,802	20	692	71	41,730	200	576,465	734	56,534	3,939,990	1,387,749	2,069,703
1934	4	3,444	12	.....	10	525	85	47,393	297	592,497	824	56,412	3,268,740	1,531,719	2,231,990
1935	3	6,796	18	2,804	11	706	118	65,784	341	512,705	1,279	75,326	3,625,143	2,326,447	2,990,568
1936	2	3,516	14	3,445	9	450	152	70,600	444	805,580	683	42,491	2,244,435	990,476	1,916,648
1937	3	5,654	23	6,057	15	1,525	82	55,348	253	848,145	695	41,032	1,823,452	806,343	1,764,104
1938	5	9,754	15	2,910	11	748	70	38,768	229	790,913	1,088	56,538	4,316,558	1,865,798	2,765,429
1939	.....	.....	22	4,517	4	16	113	59,362	366	1,213,454	871	52,257	1,496,861	599,405	1,929,011
1940	9	24,620	5	1,093	.....	.....	173	95,069	397	1,235,220	1,047	62,798	1,282,873	491,571	1,910,371
1941	4	10,379	.....	.....	.....	.....	141	84,964	132	255,904	1,444	14,792	573,111	220,369	686,408
1942	1	3,219	.....	.....	.....	.....	12	1,513	42	88,448	702	152,331	854,735	390,554	636,065
1943	.....	.....	7	1,759	.....	.....	24	8,828	88	191,407	204	32,924	143,151	66,257	301,175
1944	.....	.....	.....	64	.....	.....	5	1,726	18	34,106	179	26,922	688,255	295,949	358,767
1945	.....	.....	2	637	.....	.....	28	10,105	55	90,026	112	12,352	481,420	211,427	324,547
1946	.....	.....	6	1,321	.....	.....	16	5,641	38	64,471	163	16,684	290,667	252,836	340,953
1947	.....	.....	6	2,147	.....	.....	17	8,230	221	779,010	.....	.....	481,950	358,561	1,147,948
1948	3	10,724	49	18,925	3	1,099	139	87,936	606	2,189,391	384	55,663	1,009,003	756,092	3,119,830
1949	.....	.....	.....	.....	.....	.....	80	54,589	97	346,208	88	8,797	955,445	709,418	1,119,012
1950	.....	.....	7	3,471	.....	.....	19	17,911	71	302,150	124	16,220	2,945,256	2,380,356	2,720,108
1951	8	34,048	8	4,826	.....	.....	25	27,880	132	639,422	858	94,406	2,959,988	2,798,669	3,599,251
1952	.....	.....	28	15,872	.....	.....	38	40,249	115	637,084	794	71,477	4,845,081	4,046,611	4,811,293
1953	.....	.....	21	12,663	.....	.....	41	44,218	56	251,114	702	56,150	3,536,364	2,970,900	3,335,045
1954	.....	.....	42	23,945	.....	.....	112	185,756	413	2,182,071	590	48,333	3,732,456	3,107,530	5,547,635
Total	113	$251,791	1,149	$380,497	373	$33,718	7,283	$2,261,258	19,404	$39,781,301	81,539	$6,721,500	461,425,976	$280,095,510	$329,525,575

[1]Copper and lead are recovered from certain silver ores and concentrates shipped to United States refineries.
[2]Nickel metal and metallic contents of all nickel compounds.
[3]Cobalt metal and metallic contents of all cobalt compounds and cobalt contained in ores and speiss residues exported. In 1932, it includes 22,258 pounds worth $10,024 from northwestern Ontario.
[4]Prior to 1914 an estimate based on assays was made of the nickel, cobalt, and arsenic in the ores. Since that date recoveries have been reported.
[5]Recoveries of bismuth from base bullion were not reported prior to 1923.
[6]Includes 460 tons of speiss residues, worth $153,116, shipped in 1922.

In the Gowganda area, Castle-Trethewey Mines, Limited, operated the mine all year, and the mill from May to November. New Morrison Mines, Limited, operated from January to September, and Siscoe Metals of Ontario, Limited, operated their mine and mill all year.

Iron Ore, Pig Iron, and Steel

Shipments of iron ore, sinter, and concentrates from Steep Rock Iron Mines, Limited, and Algoma Ore Properties, Limited, and a small amount from Mag-Iron Mining and Milling, Limited, totalled 2,416,911 tons valued at $20,365,003. This was lower than the figure of 2,832,090 tons shipped in 1953, worth $23,137,997, owing to less demand by the steel industry.

At Algoma Ore Properties all the ore came from the underground workings of the Helen and Victoria mines and was sent to the sinter plant at Jamestown, two miles distant. Much of this output is consumed by the parent company, Algoma Steel Corporation, Limited, at Sault Ste. Marie, but the major portion was shipped to steel mills in the United States. All production from Steep Rock came from the Hogarth open pit, and the greater part of this was sold to United States customers. Mag-Iron had a small staff working from March to December, and small shipments of concentrates were shipped to England and the United States.

These companies employed 167 salaried personnel, who received $481,372 in salaries, and 1,718 wage-earners, who were paid $7,055,298. Fuel and electricity costs amounted to $1,881,736, and process supplies to $4,545,886. There were 5 companies that reported doing development work on their properties, but which were not producing. They employed 248 wage-earners, who received $857,624 in wages.

IRON AND STEEL STATISTICS, 1950–54[1]

Year	Domestic ore smelted[2]	Foreign ore smelted[2]	Limestone for flux (pig iron)	Pig iron produced	Steel made
	tons	tons	tons	tons	tons
1950	414,725	2,774,801	574,266	1,804,092	2,526,770
1951	570,412	3,168,571	669,367	2,066,993	2,619,072
1952	705,000	3,442,000	738,000	2,286,000	2,800,000
1953	509,000	3,914,000	824,000	2,572,000	3,264,000
1954	248,000	2,935,000	569,000	1,897,000	2,537,000

[1]Figures supplied by the Dominion Bureau of Statistics.

[2]In the production of pig iron.

IRON BLAST FURNACES IN OPERATION, 1954

Company	Stacks operating	Furnaces		Location
		Number of stacks	Annual capacity	
			tons	
Algoma Steel Corporation, Ltd.	3	6	1,498,000	Sault Ste. Marie.
Canadian Furnace Co., Ltd.	1	2	212,000	Port Colborne.
Dominion Foundries and Steel, Ltd.	1	1	320,000	Hamilton.
Steel Company of Canada, Ltd.	4	4	1,241,000	Hamilton.

PIG IRON, STEEL, AND FERRO-ALLOY PRODUCERS, 1954

Company	Location	Products
Algoma Steel Corporation, Ltd.	Sault Ste. Marie	Pig iron, steel
Atlas Steels, Ltd.	Welland	Steel
Burlington Steel Co., Ltd.	Hamilton	Steel
Canadian Carborundum Co., Ltd.	Niagara Falls	Ferro-silicon
Canadian Electric Castings, Ltd.	Orillia	Steel
Canadian Furnace Co., Ltd.	Port Colborne	Pig iron
Chromium Mining and Smelting Corporation, Ltd.	Sault Ste. Marie	Ferro-alloys
Dominion Foundries and Steel, Ltd.	Hamilton	Pig iron, steel
Electro Metallurgical Company (division of Union Carbide Canada, Ltd.)	Welland	Ferro-alloys
Exolon Co., Ltd.	Thorold	Ferro-silicon
Fahralloy Canada, Ltd.	Orillia	Steel
Ford Motor Co. of Canada, Ltd.	Windsor	Steel
Hayward Tyler of Canada, Ltd.	Kitchener	Steel
Lionite Abrasives, Ltd.	Niagara Falls	Ferro-silicon
Norton Co.	Chippawa	Ferro-silicon
Sheepbridge Engineering (Canada) Ltd.	Guelph	Steel
Steel Co. of Canada, Ltd.	Hamilton	Pig iron, steel
Welland Electric Steel Foundry	Welland	Steel
William Kennedy and Sons, Ltd.	Owen Sound	Steel

Lead and Zinc

Jardun Mines, Limited, at their property in Algoma district, recovered lead, zinc, and some silver from their concentrates. The lead content amounted to 2,815,611 pounds, having a value of $375,321, and the zinc to 1,420,048 pounds, worth $170,122. This company employed 85 wage-earners, who received $243,485, and paid out $24,270 for fuel and electricity and $52,873 for process supplies.

Calcium and Magnesium

The combined value of calcium and magnesium produced by Dominion Magnesium, Limited, was $4,101,642. This company's plant is at Haley Station, Renfrew county, and was in continuous operation all year. An average of 180 wage-earners was employed, and they were paid a total of $529,584 in wages. Fuel and electricity costs amounted to $417,250, and $11,624 was spent for process supplies.

NON-METALLIC MINERALS

Arsenic

Deloro Smelting and Refining Company, Limited, produces white arsenic in their treatment of the arsenical ores from the Cobalt and Gowganda districts, and its chief use is as a decolourizing agent in the glass manufacturing industry. Production in 1954 was 1,180,350 pounds, valued at $48,333.

Asbestos

The Canadian Johns-Manville Company, Limited, operated the only producing asbestos mine in Ontario in 1954. Their mine is in Munro township, and the product is used in the manufacturing of asbestos cement for pipe, shingle, tile, and wallboard, and for asbestos paper. Shipments amounted to 21,389 tons, valued at $3,497,824. The company paid an average of 214 wage-earners $721,968 in wages and spent $216,268 on fuel and electricity, and $167,964 on process supplies.

Feldspar

Only two producers, both in eastern Ontario, made shipments of feldspar during the year, totalling 1,791 tons, worth $22,052. Feldspar is used for the most part by the ceramic trades, and the remainder is used for soaps and cleansers. Only a very high grade is used in the manufacture of artificial teeth and as such commands a large premium.

Fluorspar

Huntingdon Fluorspar Mines, Limited, in eastern Ontario was the only shipper of fluorspar during the year, and their plant only operated from May until November. The shipments were all consigned to Canadian steel mills, which use it as a powerful fluxing agent. The total production value was $40,130, only slightly higher than that of 1953. An average of 15 men were employed and were paid a total of $16,600 in salaries and wages.

Graphite

Frobisher, Limited, which owns the Black Donald mine, reported shipping graphite to the value of $253,441 during the year. These shipments contained 132 tons of high-grade flake, 118 tons of dust, and 2,202 tons of amorphous foundry grades. Natural graphite is used by the iron and steel industry in the form of crucibles and foundry facings. It is also used as a lubricant, as a conductive filler for dry batteries, and in pencils; considerable quantities have been used recently as a moderator in atomic piles.

Gypsum

The Canadian Gypsum Company, Limited, and Gypsum, Lime and Alabastine, Canada, Limited, reported total production of 357,432 tons, valued at $822,094, which is greater in tonnage but slightly less in value than the 1953 production. These companies, the former with a quarry at Hagersville and the latter at Caledonia, operate manufacturing plants where the raw material is converted into gypsum plaster and wallboard. The average number of wage-earners employed, aside from the manufacturing plants, was 113, who were paid a total of $487,064 in wages. Fuel and electricity costs amounted to $102,248, and process supplies to $106,770.

GYPSUM SALES, 1950–54

Grade	1950	1951	1952	1953	1954
	tons	tons	tons	tons	tons
Crushed	16,613	.....	169,308	170,677	357,116
Fine-ground	694	555	109,684	200	316
Calcined, sold	225	18,143	27,153	22,051	23,224
Calcined, used in products	181,782	243,883	251,839	312,444	334,208
Total sold or used	199,314	262,581	278,992	334,495	357,432
Total value	$875,217	$672,276	$1,060,429	$899,630	$822,094
Wage-earners[1] ..... number	197	180	207	213	113
Wages paid	$515,703	$529,958	$673,234	$704,515	$487,064

[1]Exclusive of wage-earners employed in the manufacturing division of the Caledonia plant.

Mica

The production of amber mica is dropping steadily each year owing to the exhaustion of present known deposits. The output for the year was 137,208 pounds, valued at $4,195, and consisted of shipments from 10 operators.

SHIPMENTS OF AMBER MICA, 1952–54

Grade	1952		1953		1954	
	Quantity	Value	Quantity	Value	Quantity	Value
	pounds		pounds		pounds	
Ground and rough	.....	.....	7,189	$ 448	.....	.....
Splittings, and knife-trimmed	14,460	$2,554	100,778	2,904	3,378	$2,193
Scrap	314,740	2,064	276,548	4,335	133,830	2,002
Total	329,200	$4,618	384,515	$7,687	137,208	$4,195

Mineral Waters

The shipment of mineral water for the year came to 2,000 gallons, worth $750. This was reported by two firms, both having springs in the Ottawa valley.

Natural Gas and Petroleum

NATURAL GAS PRODUCTION BY FIELDS, 1954

County	Field	Producing formation	Quantity
			M cu. ft.
Brant	Brant	Clinton and Medina	9,460
Elgin	Bayham	Clinton and Medina	10,000
	Malahide	Clinton and Medina	929
Essex	Kingsville and Leamington	Guelph	13,729
Haldimand, Lincoln, Wentworth	Haldimand	Clinton and Medina	1,551,614
Kent	Camden gore	Salina	56,582
	Chatham	Salina-Guelph	57,605
	Declute	Guelph	226,884
	Dover	Trenton	95,668
	Harwich	Clinton and Medina	2,515
	Tilbury	Guelph	1,592,897
	Zone	Salina-Guelph	140,268
Lambton	Becher	Salina-Guelph	88,289
	Bickford	Guelph	240
	Colinville	Guelph	278,428
	Dawn	Salina-Guelph	1,227
	Duthill	Guelph	2,857
	Enniskillen	Guelph	323
	Kimball	Salina	2,976,367
	Payne	Guelph	861,108
	Seckerton	Guelph	267,959
	Sombra	Guelph	201,288
	Waubuno	Guelph	696
Middlesex and Elgin	Mosald	Salina	547,673
Norfolk	Norfolk	Clinton and Medina	469,147
Oxford	Brownsville	Clinton and Medina	17,616
	South Norwich	Clinton and Medina	35,065
Welland	Welland	Clinton and Medina	509,384
Total produced	.....	.....	10,015,818
Average retail value	.....	.....	$11,758,549

Natural Gas

The production of natural gas in Ontario in 1954 amounted to 10,015,818 M cubic feet, a gain of 180,349 M cubic feet or 1.8 percent over 1953. The total quantity of natural gas distributed was 16,714,060 M cubic feet or 757,656 M cubic feet greater than 1953. The gross retail value of the gas sold directly to consumers amounted to $16,930,000, at an average retail value of $1.174 per M cubic feet.

Additions to natural gas reserves resulting from the 1954 drilling are estimated to be 18,500,000 M cubic feet, which makes the total estimated recoverable reserves as of December, 1954, 178,700,000 M cubic feet compared with 170,200,000 M cubic feet at the end of 1953.

Petroleum

Ontario's total oil production in 1954 amounted to 412,474 barrels compared with 299,685 barrels in 1953 for a significant gain of 37.6 percent. The year's production was the highest since 1909 when the Fletcher field started to decline.

The increase is due primarily to the development of the Rodney field, which saw the completion of 31 successful oil wells, or 69 percent of the total of 45 successful oil well completions for the whole province during the year.

OIL PRODUCTION BY FIELDS, 1948–54

Field	1948	1949	1950	1951	1952	1953	1954
	barrels	barrels	barrels	barrels	barrels	barrels	barrels
ELGIN COUNTY:							
Rodney	.....	1,147	1,546	4,050	12,043	126,400	240,252
Wallacetown	1,821	1,929	1,766	1,793	1,923	1,877	1,774
ESSEX COUNTY:							
Staples	609	.....	.....	.....	.....	.....	141
KENT COUNTY:							
Bothwell-Thamesville	15,238	16,793	15,521	13,135	12,035	10,227	9,309
Dover	3,830	3,562	3,295	3,309	2,704	1,331	2,773
Miscellaneous	.....	200	419	298	185	31	21
LAMBTON COUNTY:							
Becher	59,846	146,617	140,578	88,634	75,951	62,987	57,100
Brooke	.....	.....	1,006	746	1,482	.....	.....
Dawn	151	.....	.....	.....	.....	.....	.....
Dante	7,046	985	2,235	1,389	2,902	1,180	772
Oil Springs	26,165	25,692	25,310	26,576	26,957	27,067	26,010
Petrolia	40,982	42,852	40,905	39,374	36,636	35,497	33,430
Watford-Kerrwood	2,479	2,010	1,670	1,264	1,344	1,440	1,053
Kimball-Corunna	297	222	828	1,506	1,585	2,446	3,133
Warwick (Guelph)	.....	.....	.....	.....	.....	14,836	22,760
Miscellaneous	115	14	46	116	125	76	421
MIDDLESEX COUNTY:							
Glencoe	18,341	18,580	15,494	14,935	15,925	14,290	13,525
BRANT COUNTY:							
Onondaga	69	67	37	46	16	.....	.....
Total production	176,989	260,670	250,656	197,171	191,813	299,685	412,474
Total value	$608,109	$905,143	$892,335	$677,905	$641,400	$1,005,535	$1,390,000
Average price	$3.44	$3.47	$3.56	$3.435	$3.35	$3.36	$3.36

ONTARIO OIL FIELDS AND THEIR PRODUCTION, 1954

County	Field	Township	Producing formation	Number of active wells	Production
					barrels
Elgin	Rodney	Aldborough	Dundee	110	240,252
	Wallacetown	Dunwich	Dundee	23	1,774
Essex	Staples	Tilbury west	Guelph	1	141
Kent	Bothwell-Thamesville	Zone, Camden, Orford, Mosa, Aldborough	Dundee	85	9,309
	Dover	Dover	Trenton	5	2,773
		Howard	Dundee	.....	[1] 21
Lambton	Petrolia	Enniskillen, Moore, Sarnia, Plympton	Dundee	347	33,431
	Oil Springs	Enniskillen	Dundee	623	26,010
	.....	Euphemia	Dundee	7	835
	Payne	Moore	Dundee	1	293
	Corunna, Kimball, Seckerton	Moore	Salina, Guelph	6	3,133
	Becher	Sombra	Salina	31	57,164
	Watford-Kerrwood	Brooke, Adelaide, Warwick, Metcalfe	Dundee	5	1,053
		Warwick	Guelph	1	22,760
Middlesex	Glencoe	Mosa	Dundee	147	13,525
Total	.....	.....	.....	1,392	412,474

[1] Produced from a Guelph test.

Drilling and Exploration

During the year, leases were acquired and exploratory permits were issued for oil and gas covering about 2,055,000 acres as follows: 1,530,000 acres in the Hudson Bay lowlands, 225,000 acres under the waters of Lakes St. Clair and Huron, and 300,000 acres on land in southwestern Ontario. It is estimated that at the year's end, the total acreage under lease or permit totalled about 5,000,000 acres.

Drilling activity remained at a high level with an impressive total of 374 completions, having a total footage of 477,800 feet.

Two very interesting gas discoveries were made during the year. The first one in Esquesing township, Halton county, is of particular interest because of its distance from the established productive areas and because of its producing horizon. The second one in Howard township near Lake Erie is unique in that the pressure is abnormally high, and one result was a rush to acquire leases in the area.

Nepheline Syenite

Both the open pit and the underground mine of American Nepheline, Limited, were in operation during the year. Shipments of all grades of nepheline syenite amounted to 123,669 tons, valued at $1,770,528. This is an increase in value of 12 percent over the previous year when production was worth $1,576,271. Nepheline syenite is used extensively in the ceramic industries, and about two-thirds of the output is consumed by glass manufacturers alone. The company employed an average of 30 salaried personnel, who were paid $100,077, and 118 wage-earners, who received a total of $444,911 in wages. Fuel and electricity costs amounted to $99,257, and process supplies to $123,727.

Peat

The production of peat moss and humus declined in 1954, when the total amounted to 1,279,250 pounds, valued at $19,809, compared with 2,638,420, worth $52,535, which was shipped the previous year. This came from two bogs, one in Welland county and the other in Wentworth county, and the material is used for horticultural purposes and for stable and poultry litter. One producer of peat for fuel, whose bog is in Ellice township, shipped 6 tons valued at $60.

Quartzite, Quartz, and Silica Brick

Lorrain quartzite is quarried at Killarney on Georgian Bay by Electro Metallurgical Company of Canada, Limited, and on Manitoulin Island by Canadian Silica Corporation, Limited. A large part of this production is exported to the United States, and the Canadian consumption is used mainly in the manufacture of silicon and ferro-silicon. The International Nickel and Falconbridge mines have quarries near their plants, and the output is used by them as flux. Total production for the year amounted to 1,476,745 tons, valued at $1,270,731, which is slightly higher in quantity, but less in value than for 1953. There was an average of 10 salaried employees and 89 wage-earners employed by the industry, and they were paid a total of $336,184. Fuel and electricity costs were $64,978, and process supplies came to $100,253.

Algoma Steel Corporation, Limited, operates a quarry near Sault Ste. Marie, and this production is used in the manufacture of silica brick for furnace linings in their own steel plant. The production in 1954 was 2,370,000 bricks, worth $221,117, which was lower than for the preceding year. The company employed an average of 36 men at the quarry, who were paid $96,672, and it also paid out $23,614 for fuel and electricity.

QUARTZ, QUARTZITE, AND SILICA BRICK, 1950–54

Year	Rock sold or used		Silica brick sold or used		Total value
	Quantity	Value	Quantity	Value	
	tons		M		
1950	1,386,833	$1,027,791	1,215	$174,372	$1,010,663
1951	1,545,136	1,496,404	1,217	204,831	1,701,235
1952	1,371,806	1,235,245	1,161	246,108	1,481,353
1953	1,450,770	1,301,048	1,467	313,175	1,614,223
1954	1,476,745	1,270,731	2,370	221,117	1,491,848

Salt

Salt production in Ontario comes from wells drilled in salt beds in the southwest part of the province. Fine salt, obtained by vacuum-pan evaporation of brine, was produced at Goderich, Sandwich, and Sarnia. This is used extensively in the chemical industries for the manufacture of soda ash, caustic soda, and related chemicals. Coarse salt, obtained by open-pan evaporation of brine, was produced at Warwick and Goderich and is used in the curing of fish, for ice and dust control on highways, and for dairy uses. Brunner Mond Canada, Limited, whose plant is at Amherstburg, uses the brine obtained from their wells nearby in the manufacture of soda ash, calcium chloride, and other chemicals. The salt industry employed 234 wage-earners, paying them $779,802 in wages, and spent $451,208 for fuel and electricity, and $155,899 for process supplies.

SALT SOLD OR USED, 1950–54

Schedule	1950	1951	1952	1953	1954
	tons	tons	tons	tons	tons
Fine	185,292	205,933	208,559	240,556	262,586
Coarse	9,869	7,784	6,995	4,934	1,750
Other grades	96,021	106,269	88,885	45,409	22,090
Total	291,182	319,986	304,439	290,899	286,426
Brine (salt equivalent)	405,400	452,599	452,586	458,147	446,640
Total sold or used	696,582	772,585	757,025	749,046	733,066
Value	$4,639,867	$4,789,990	$4,401,780	$3,919,810	$4,440,418
Wage-earners...number	266	258	241	241	234
Wages	$652,040	$688,503	$799,228	$791,672	$779,802

Sulphur

The sulphur content of the sulphuric acid obtained by Canadian Industries, Limited, from the stack gases of International Nickel at Copper Cliff amounted to 49,598 tons valued at $495,980.

Talc

The only producer of talc in Ontario is Canada Talc Industries, Limited, whose mine is in Hastings county. This output is used for paints, ceramics, and other applications where prime white colour is of first importance. The company shipped 13,697 tons, valued at $169,651, during 1954, which was slightly higher than in the previous year. There were 21 wage-earners employed, who received $42,399 in wages. Fuel and electricity costs were $14,452, and process supplies amounted to $6,188.

TALC STATISTICS, 1950–54

Year	Sales		Wage-earners, mine and mill	Wages paid
	Quantity	Value		
	tons		number	
1950	15,263	$182,048	18	$27,364
1951	13,651	160,540	19	41,182
1952	12,454	149,711	21	36,983
1953	13,310	125,209	19	38,416
1954	13,697	169,651	21	42,399

STRUCTURAL MATERIALS

Construction Contracts

The value of Canadian construction contracts awarded in 1954, as reported by *MacLean Building Reports, Limited*, was $2,154,959,200, as compared with $2,017,060,700 in 1953. Ontario contracts were $939,746,400, or 43.60 percent of the total.

VALUE OF CONSTRUCTION CONTRACTS, 1950–54

Classification	1950	1951	1952	1953[1]	1954
Residential	$233,617,200	$215,932,500	$226,780,100	$328,660,100	$449,822,400
Business	157,347,000	206,461,500	204,306,400	231,449,700	276,294,700
Industrial	64,891,800	233,472,300	119,546,900	140,028,200	75,300,800
Engineering	141,305,900	361,560,600	182,134,700	149,674,400	138,328,500
Total	$597,161,900	$1,017,426,900	$732,768,100	$849,812,400	$939,746,400

[1]Corrected figures.

Cement

The continued growth in the building industry is reflected in the figures for cement production in 1954, which were 7,208,061 barrels, with a selling value of $18,958,173, compared with 7,078,181 barrels, valued at $18,497,744, in the previous year. The two operating companies, Canada Cement Company, Limited, and St. Mary's Cement Company, Limited, paid out $191,771 in salaries and $2,449,391 in wages to an average of 640-wage-earners. Fuel and electricity costs amounted to $3,704,826, and process supplies to $1,223,079.

PORTLAND CEMENT STATISTICS, 1950–54

Year	Operating plants	Sales		
		Quantity	Value	Average price per barrel
	number	barrels[1]		
1950	3	5,313,521	$10,953,896	$2.06
1951	3	5,438,101	12,494,677	2.30
1952	3	5,577,025	14,142,060	2.53
1953	3	7,078,181	18,497,744	2.61
1954	3	7,208,061	18,958,173	2.63

[1]350-pound barrel.

Lime

The production of quicklime and hydrated lime, combined, totalled 610,591 tons, valued at $7,680,739, which was slightly less in tonnage but higher in value than for the previous year. There were 10 reporting companies, and they paid out $170,632 in salaries, $1,090,136 in wages to 347 wage-earners, $1,834,385 for fuel and electricity, and $90,011 for process supplies.

LIME STATISTICS, 1950–54

Year	Lime marketed or used						Fuel cost	Wage-earners	Wages
	Hydrated			Quicklime					
	Quantity	Total value	Value per ton	Quantity	Total value	Value per ton			
	tons	$	$	tons	$	$	$	number	$
1950..	91,497	1,347,677	14.72	479,993	4,682,551	9.76	1,598,504	296	718,832
1951..	92,387	1,424,614	15.42	527,382	5,497,302	10.42	1,745,415	356	984,166
1952..	86,816	1,580,916	18.21	535,463	5,340,146	9.97	1,824,154	377	1,094,388
1953..	102,418	1,707,096	16.67	556,644	6,007,156	10.79	2,176,447	418	1,230,416
1954..	106,665	1,909,042	17.90	503,926	5,771,697	11.45	1,834,385	347	1,090,136

Distribution of the quicklime and hydrated lime sold in 1954, as reported by the producing companies, was as follows:

Industrial consumption	Quicklime		Hydrated lime	
	Quantity	Value	Quantity	Value
	tons		tons	
Building trades, finishing and masonry	29,660	$ 496,025	84,998	$1,603,080
Agriculture	.....	.....	1,832	25,923
Chemical and metallurgical industries:				
Smelters	280	1,321	1,640	23,010
Iron and steel	50,713	547,368	515	7,224
Gold-milling	9,521	95,692	3,856	54,108
Pulp and paper	29,587	318,288	1,091	15,403
Glass	11,229	116,473	.....	.....
Sugar	6,118	38,982	.....	.....
Tanneries	2,008	26,658	2,492	35,014
Fertilizers and insecticides	482	5,239	.....	.....
Dealers and others	187,961	2,025,914	3,610	50,662
Other chemicals[1]	176,367	2,099,737	6,631	94,618
Total	503,926	$5,771,697	106,665	$1,909,042

[1]Uses for lime under this heading include the manufacture of alkali, acetate of lime, and calcium carbide, the last-mentioned being used largely for making cyanamid.

Sand and Gravel

Commercial sand and gravel production in 1954 amounted to 46,433,191 tons, valued at $25,577,612, compared with 43,658,099 tons worth $24,359,496 in the preceding year. These totals include sand and gravel used by railroads as ballast, gravel used by mines as back fill, and sand recovered by dredging operations.

The reporting operators, of which there were 289, employed 179 salaried personnel, who received $829,299, and 1,652 wage-earners, who were paid a total of $4,421,883. Fuel and electricity costs amounted to $1,727,160, and $344,005 was paid out for process supplies.

A comparison of sand and gravel production for the years 1953 and 1954 is given in the following table:

OUTPUT OF SAND AND GRAVEL, 1953 AND 1954

Source	1953		1954	
	Quantity	Value	Quantity	Value
	tons		tons	
Private pit operators	21,244,610	$14,442,150	23,545,290	$14,861,339
Dredged from Great Lakes and rivers	1,260,719	1,246,208	1,263,165	1,345,321
Department of Highways	12,487,000	4,859,000	12,634,000	5,386,100
Miscellaneous counties and townships	6,932,244	3,466,122	7,340,652	3,670,326
Estimate for other producers[1]	1,733,526	346,016	1,650,084	314,526
Total	43,658,099	$24,359,496	46,433,191	$25,577,612

[1]Railway ballast.

Sand-Lime Brick

Only one company reported shipments of sand-lime brick during the year, the total value of which amounted to $267,377. This company employed an average of 29 wage-earners, who received $83,898 in wages.

Stone

Total production of stone, which includes limestone, sandstone, granite and trap, and marble, amounted to 10,142,056 tons, valued at $12,632,298. This is an increase in value of 6.88 percent when compared with the total value of $11,818,582 reported in 1953. The industry employed an average of 1,059 wage-earners who received $3,198,379 in wages. Fuel and electricity costs amounted to $774,248, and $1,243,284 was paid out for process supplies.

The following table gives a comparison of production for the last three years:

OUTPUT OF STONE, 1952–54

Variety	1952		1953		1954	
	Quantity	Value	Quantity	Value	Quantity	Value
	tons		tons		tons	
Limestone	7,818,958	$ 9,153,307	8,390,852	$10,359,697	9,816,205	$11,446,494
Marble	30,638	211,105	31,336	262,145	32,189	323,247
Trap / Granite	350,724	798,680	381,141	1,045,358	276,944	675,443
Sandstone	17,091	140,081	15,557	151,382	16,718	187,114
Total	8,217,411	$10,303,173	8,818,886	$11,818,582	10,142,056	$12,632,298

Clay Products

Owing to the continued expansion of housing programs and industrial construction, the value of clay products reported during the year rose to $17,230,231, a gain of 16.19 percent from the total value of $14,829,222 in the previous year. There were 63 companies and individuals whose output contributed to this total, and they employed an average of 114 salaried personnel, who were paid $568,435, and 1,867 wage-earners, who received $5,471,015 in wages. The total paid out for fuel and electricity amounted to $2,710,070, and process supplies cost $351,025.

HEAVY CLAY PRODUCTS MARKETED, 1954

Kind		Quantity	Value
Brick:			
Soft-mud process	face, number	11,059,750	$ 538,714
	common, number	3,397,250	142,367
Stiff-mud (wire-cut) process	face, number	172,258,185	9,109,333
	common, number	11,018,590	354,651
Dry-press	face, number	25,208,903	1,393,366
	common, number	150,000	4,500
Fancy or ornamental brick (including special shapes, embossed and enamelled brick)	number	10,940	1,335
Sewer		.....	9,141
Paving brick	number	1,503,583	123,167
Tile:			
Structural (hollow blocks, including fireproofing and load-bearing tile)	tons	64,545	1,249,319
Roofing tile		.....	350
Floor tile (quarries)	sq. ft.	169,326	70,091
Drain	number	37,123,217	2,056,042
Sewer pipe (including copings, flue linings)		.....	1,757,995
Pottery (flower pots), from domestic clay		.....	294,028
Haydite and other products		.....	125,590
Blue clay	tons	47	242
Total value		.....	$17,230,231

VALUE OF CLAY PRODUCTS SOLD OR USED, 1950–54

Product	1950	1951	1952	1953	1954
Brick:					
Common and sewer	$ 433,547	$ 449,470	$ 489,961	$ 513,144	$ 510,659
Pressed, fancy, building tile, etc.	6,443,705	7,426,522	8,268,905	10,506,440	12,970,620
Pottery	110,057	114,720	280,224	295,365	294,028
Drain tile	1,058,567	1,243,891	1,506,992	1,728,011	2,056,042
Sewer pipe	1,197,901	1,124,201	1,321,499	1,674,516	1,273,050
Haydite and other products; clay	79,486	125,537	107,619	111,746	125,832
Total	$9,323,263	$10,484,341	$11,975,200	$14,829,222	$17,230,231

MISCELLANEOUS STATISTICS

Mining Company Incorporations

A summary of mining companies incorporated and licensed in Ontario from 1950 to 1954, inclusive, follows:

MINING COMPANIES INCORPORATED AND LICENSED, 1950–54

Year	Incorporated				Extra-provincial and mortmain licences	
	Number	Nominal capital	"No par" companies		Number	Capital for use in Ontario
			Number	Shares		
1950	112	$310,012,000	34	38,048,650	3	$ 1,065,000
1951	94	254,958,655	37	56,183,800	5	420,000
1952	126	353,115,000	31	43,969,500	13	2,997,000
1953	148	429,856,000	23	23,970,500	15	1,661,000
1954	148	399,361,000	49	51,466,250	36	25,110,000

MINING COMPANIES WITH SPECIFIED CAPITAL INCORPORATED IN ONTARIO IN 1954

Name of company	Head office	Date of incorporation	Capital
Ackro Mines, Limited	Toronto	Apr. 22	$ 40,000
Advocate Mines, Limited	Toronto	Dec. 31	3,500,000
Allstate Uranium Corporation, Limited	Toronto	Dec. 9	3,000,000
Anthony Gas and Oil Explorations, Limited	Acton	Dec. 23	3,000,000
Argosy Drillers, Limited	Timmins	Feb. 15	50,000
Bamoos Lake Mines, Limited	Toronto	Feb. 8	5,000,000
Baseline Mines, Limited	Toronto	Apr. 7	3,500,000
Big Glen Mines, Limited	Toronto	Mar. 23	3,000,000
Bilmor Explorations, Limited[1]	Toronto	June 3	30,000
Blind River Uranium Mines, Limited	Toronto	May 17	4,000,000
Book-Smith Oils, Limited[1]	Welland	Feb. 17	100,000
Bracemac Mines, Limited	Toronto	Dec. 29	5,000,000
Brivel Explorations, Limited[1]	Sault Ste. Marie	June 21	50,000
Buckles Algoma Uranium Mines, Limited	Toronto	Apr. 29	3,000,000
Buf-Gaspe Mines, Limited	Toronto	Apr. 20	3,500,000
Bullet Hill Mining Company, Limited	Sudbury	Feb. 15	3,000,000
Burning Rock Uranium Mines, Limited	Toronto	July 15	40,000
Calode Uranium Mining Company, Limited	Toronto	Apr. 23	4,000,000

[1] "No Par" shares issued in addition. See list of companies having shares without nominal or par value. Eighteen companies are included in both tables.

MINING COMPANIES WITH SPECIFIED CAPITAL INCORPORATED IN ONTARIO IN 1954—*Continued*

Name of company	Head office	Date of incorporation	Capital
The Canadian Lithium Mining Corporation, Limited	Toronto	Sept. 8	$ 5,000,000
Cantab Mines, Limited	Toronto	Dec. 30	3,500,000
Castlebar Silver and Cobalt Mines, Limited	Toronto	May 7	4,000,000
Cassmill Exploration Company, Limited	Orillia	Dec. 31	100,000
Cavendish Uranium and Mining Company, Limited	Toronto	May 5	100,000
Central Guiana Exploration Company, Limited	Toronto	Nov. 12	1,000,000
Chyka Mines, Limited	Toronto	Sept. 14	4,000,000
Claymac Mines, Limited	Toronto	Sept. 14	4,000,000
Cobalt Coleman Mining Syndicate, Limited	Toronto	Feb. 1	35,000
Cochenour Marcus Gold Mines, Limited	Toronto	Sept. 14	3,000,000
Colborne Natural Gas, Limited	Toronto	Apr. 27	3,000,000
Concor-Chibougamau Mines, Limited	Toronto	Apr. 28	3,000,000
Consolidated Bi-Ore Mines, Limited	Sudbury	Sept. 8	7,000,000
Copperanium Mines, Limited	Toronto	Apr. 9	3,500,000
Cossitt Petroleums, Limited[1]	Toronto	Aug. 25	30,000
Craskie Mines, Limited	Toronto	Jan. 18	4,000,000
Crowland Gas, Limited[1]	Township of Crowland	Dec. 13	75,000
Delmico Mines, Limited	Toronto	Jan. 15	4,000,000
Diatomite Minerals and Fertilizer, Limited[1]	Huntsville	Mar. 24	200,000
Dolmac Mines, Limited	Toronto	Feb. 2	3,500,000
Don Henry Uranium Mines, Limited	Toronto	Oct. 27	3,000,000
Durecon Explorations, Limited	Toronto	July 30	4,000,000
Eastern-Northern Explorations, Limited	Toronto	June 9	5,000,000
Ebor Uranium Mines, Limited	Toronto	Nov. 19	3,500,000
Energy Mines, Limited	Toronto	Mar. 1	3,000,000
Elgin Oils (Bradford), Limited[1]	Rodney	June 17	600,000
Erie Enterprises and Petroleums, Limited[1]	St. Thomas	Apr. 27	30,000
Escarpment Oils, Limited	Toronto	Feb. 8	100,000
Fano Uranium Mines, Limited	Sudbury	Oct. 25	3,500,000
Fermoy Lead Mines, Limited	Toronto	Nov. 1	150,000
Fitzpatrick Uranium Mines, Limited	Toronto	July 30	3,000,000
Flash Petroleums, Limited[1]	Toronto	Mar. 25	36,000
Gaff Mines, Limited	Toronto	Sept. 16	3,000,000
Gavan Mines, Limited	Toronto	June 22	3,000,000
Geoil, Limited	Toronto	Dec. 20	6,000,000
Gill Uranium Mines, Limited	Toronto	Dec. 6	5,000,000
Great Shield Uranium Mines, Limited	Toronto	Feb. 12	5,000,000
Greenstone Mines, Limited	Toronto	Mar. 18	3,000,000
Greenwich Lake Uranium Mines, Limited	Toronto	Nov. 12	3,000,000
Gripp Lake Mines, Limited	Toronto	Dec. 13	5,000,000
Gusto Mines, Limited	Toronto	Dec. 2	3,500,000
Halo Uranium Mines, Limited	Toronto	Sept. 22	5,000,000
Hamason Mines, Limited	Toronto	Feb. 18	3,000,000
Harvey Kendrick Development, Limited[1]	Toronto	Mar. 1	80,000
Higgins Uranium Mines, Limited	Toronto	Oct. 27	100,000
Howard Roberts Exploration, Limited	Sarnia	Jan. 26	100,000
International Lithium Mining Corporation, Limited	Toronto	Aug. 9	3,500,000
Iron Bay Mines, Limited	Haileybury	Feb. 24	6,000,000
Iron Bridge Explorations, Limited	Toronto	Oct. 26	100,000
Jalaweg Explorations, Limited[1]	Toronto	Feb. 8	30,000
Jem Exploration Corporation, Limited	Toronto	May 21	250,000
Kelly-Desmons Mining Corporation, Limited	Toronto	Nov. 29	4,000,000
Kenlew Mines, Limited	Toronto	Jan. 27	3,000,000
Killala Lake Mines, Limited	Toronto	Mar. 11	5,000,000
Kinloch Mines, Limited	Sault Ste. Marie	Apr. 29	150,000
Kinmount Uranium Mines, Limited	Toronto	July 8	3,000,000
Laco Mines, Limited	Toronto	Feb. 8	5,000,000
Lake Kaginu Mines, Limited	Toronto	Feb. 25	5,000,000

[1] "No Par" shares issued in addition. See list of companies having shares without nominal or par value. Eighteen companies are included in both tables.

MINING COMPANIES WITH SPECIFIED CAPITAL INCORPORATED IN ONTARIO IN 1954—*Continued*

Name of company	Head office	Date of incorporation	Capital
Lake Lauzon Mines, Limited	Toronto	Mar. 3	$ 3,000,000
Lake Nordic Uranium Mines, Limited	Toronto	Aug. 3	6,000,000
Larkspur Oil Company, Limited	Toronto	Oct. 4	300,000
Macu Mines, Limited	North Bay	Apr. 14	3,000,000
Magoma Mines, Limited	Toronto	Feb. 12	3,500,000
Man-Echo Mines, Limited	Toronto	Feb. 5	5,000,000
Man-Lun Mines, Limited	Toronto	Mar. 23	3,500,000
Marian Lake Uranium Mines, Limited	Toronto	Nov. 1	4,000,000
Mauranium Metal Mining Syndicate, Limited	Sault Ste. Marie	Oct. 8	35,000
Merchants Gas Company, Limited[1]	Toronto	Jan. 20	80,000
Mi-Con Exploration and Consultant, Limited[1]	Toronto	Mar. 15	100,000
Mildred Exploration and Investments, Limited[1]	Toronto	Feb. 15	90,000
Milmine Mining Syndicate, Limited	Toronto	July 15	35,000
Miramichi Mines, Limited	Toronto	Dec. 13	3,000,000
Moon Lake Uranium Mines, Limited	Toronto	Apr. 23	3,000,000
Multiwin Explorations, Limited	Toronto	Jan. 18	3,000,000
Nama Creek Mines, Limited	Toronto	Jan. 28	3,000,000
Nellie Lake Metal Mines, Limited	Timmins	June 7	3,000,000
Neoscope Explorations, Limited[1]	Toronto	Feb. 15	30,000
Norart Uranium and Gold Mines, Limited	Toronto	Feb. 15	3,000,000
Noreagle Uranium Mines, Limited	North Bay	June 16	4,000,000
Normingo Mines, Limited	North Bay	Feb. 17	3,000,000
Northdale Mining and Exploration, Limited	Sudbury	Apr. 1	100,000
North Lake Mines, Limited	Toronto	Mar. 30	3,000,000
Northern Uranium Mines, Limited	Toronto	May 25	3,000,000
Oceanic Iron Ore of Canada, Limited	Toronto	June 16	100,000
Oka Rare Metals Mining Company, Limited	Toronto	Mar. 22	40,000
Ontario Rare Metal Mines, Limited	Toronto	May 7	3,000,000
Ormsby Mines, Limited	Toronto	Jan. 11	4,000,000
Pago Mining, Limited	Toronto	Sept. 24	350,000
Panel Consolidated Uranium Mines, Limited	Toronto	Sept. 27	10,000,000
Parbar Mines, Limited	Toronto	May 10	3,000,000
Paul-Liane Explorations, Limited	Toronto	July 28	3,500,000
Pelly River Mines, Limited	Toronto	Mar. 23	5,000,000
Perlite Mining Corporation, Limited	Toronto	Sept. 22	3,000,000
Peter-Rock Mining Company, Limited	Ajax	Jan. 18	4,000,000
Pleno Mines, Limited	Toronto	Nov. 30	3,500,000
Plympton Uranium and Metal Mines, Limited	Toronto	Feb. 22	4,000,000
Ridley Uranium Mines (Canada), Limited	Toronto	June 23	4,000,000
Rock-Echo Mines, Limited	Toronto	Mar. 15	3,000,000
Sabine Uranium Mines, Limited	Windsor	Sept. 9	3,000,000
Saxon Uranium Mines, Limited	Toronto	June 25	6,000,000
Shakespeare Uranium Mines, Limited	Toronto	Apr. 1	3,000,000
Shirley Lake Mining Company, Limited	Toronto	Apr. 9	40,000
Silverclaim Lake Mines, Limited	Toronto	Sept. 14	20,000
Socanium Mines, Limited	Toronto	June 10	40,000
Spanish American Mines, Limited	Sault Ste. Marie	Oct. 8	3,000,000
Spot Uranium Mines, Limited	Toronto	Nov. 26	3,000,000
Squaw River Uranium Mines, Limited	Toronto	Dec. 23	100,000
Stanleigh Uranium Mining Corporation, Limited	Toronto	Aug. 11	5,000,000
Stanol Minerals, Limited	Fort Frances	June 7	100,000
Starfire Uranium Mines, Limited	Toronto	Feb. 8	3,500,000
Stelba Uranium Mines, Limited	Toronto	Dec. 28	3,000,000
Sturgeon Lake Mining Syndicate, Limited	Port Arthur	Sept. 20	35,000
Super Sonic Exploration Company, Limited[1]	Toronto	Dec. 9	250,000
Swift Copper Mines, Limited	Toronto	Nov. 10	4,000,000
Talvey Metal Mines, Limited	Toronto	Mar. 5	5,000,000
Tandem Mines, Limited	Toronto	May 13	5,000,000
Tarbell Mines, Limited	Toronto	June 7	3,000,000
Temagami Mining Company, Limited	Toronto	Aug. 26	5,000,000
Tide Lake Lithium Mines, Limited	Toronto	Nov. 16	5,000,000
Toff Uranium Mines, Limited	Toronto	Nov. 8	3,500,000
Towle-Humpage Mines, Limited	Sudbury	Oct. 28	300,000

[1] "No Par" shares issued in addition. See list of companies having shares without nominal or par value. Eighteen companies are included in both tables.

MINING COMPANIES WITH SPECIFIED CAPITAL INCORPORATED IN ONTARIO IN 1954—*Continued*

Name of company	Head office	Date of incorporation	Capital
Triton Uranium Mines, Limited	Toronto	Dec. 28	$ 3,500,000
United Cement and Mining, Limited	Toronto	Feb. 9	3,000,000
Wadge Mines, Limited	Toronto	Feb. 11	3,000,000
Werner Lake Nickel Mines, Limited	Toronto	Nov. 19	5,000,000
West Penn Oil Company (Canada), Limited[1]	Toronto	Mar. 22	50,000
Westwadge Mines, Limited	Toronto	July 27	5,000,000
Wildnest Mines, Limited	Toronto	Mar. 15	3,000,000
X-Ray Assay Laboratories, Limited[1]	Woodbridge	Apr. 29	90,000
Yreka Mines, Limited	Toronto	Oct. 28	3,000,000
Total (148 companies)			$399,361,000

[1]"No Par" shares issued in addition. See list of companies having shares without nominal or par value. Eighteen companies are included in both tables.

MINING COMPANIES INCORPORATED IN ONTARIO IN 1954 HAVING SHARES WITHOUT NOMINAL OR PAR VALUE

Name of company	Head office	Date of incorporation	Number of shares
Acmac Mining Corporation, Limited	Toronto	Feb. 23	250,000
Alexander Oil and Gas Company, Limited	Chatham	Oct. 8	150,000
Apamag Mines, Limited	Haileybury	Oct. 25	3,000,000
Baranouri Uranium Mines, Limited	Toronto	Sept. 16	3,000,000
Bilmor Explorations, Limited[1]	Toronto	June 3	10,000
Book-Smith Oils, Limited[1]	Welland	Feb. 17	60,000
Brivel Explorations, Limited[1]	Sault Ste. Marie	June 21	30,000
Canada Radium Corporation, Limited	Toronto	Aug. 23	5,000,000
Canadian Shell Explorations, Limited	Toronto	Feb. 22	1,000
Chip Mines, Limited	Toronto	Sept. 16	3,000,000
Cossitt Petroleums, Limited[1]	Toronto	Aug. 25	1,000
Crowland Gas, Limited[1]	Township of Crowland	Dec. 13	25,000
Diatomite Minerals and Fertilizer, Limited[1]	Huntsville	Mar. 24	100,000
Elgin Oils (Bradford), Limited[1]	Rodney	June 17	10,000
Erie Enterprises and Petroleums, Limited[1]	St. Thomas	Apr. 27	10,000
Flash Petroleums, Limited[1]	Toronto	Mar. 25	4,000
Flightway Explorations, Limited	Toronto	July 29	50,000
Floranada Mines, Limited	Toronto	June 9	100,000
Garrison Creek Consolidated Mines, Limited	Toronto	Dec. 9	5,000,000
Gerido Lake Mines, Limited	Toronto	Dec. 15	5,000,000
Harvey Kendrick Development, Limited[1]	Toronto	Mar. 1	20,000
Hucamp Mines, Limited	Toronto	Jan. 27	4,000,000
Intercounty Natural Gas Company, Limited	Toronto	Aug. 6	500,000
Jalaweg Explorations, Limited[1]	Toronto	Feb. 8	1,000
Lakeland Natural Gas, Limited	Toronto	July 13	40,000
Le Moyne Explorations, Limited	Toronto	Sept. 17	1,000,000
Mancore Explorations, Limited	Toronto	Apr. 29	500,000
Merchants Gas Company, Limited[1]	Toronto	Jan. 20	20,000
Matinenda Uranium Mines, Limited	Toronto	Oct. 12	3,500,000
Mi-Con Exploration and Consultant, Limited[1]	Toronto	Mar. 15	10,000
Mildred Exploration and Investments, Limited[1]	Toronto	Feb. 15	10,000
Moncton Mining Corporation, Limited	Toronto	Apr. 21	250
Neoscope Explorations, Limited[1]	Toronto	Feb. 15	10,000
Nesnorm Explorations, Limited	Toronto	Feb. 12	40,000
Northern Ontario Natural Gas Company, Limited	Toronto	May 6	4,000
Okleco Mines, Limited	Toronto	Feb. 19	5,000,000
Pyroclore Uranium Exploration Company, Limited	Toronto	Jan. 15	500,000
Rosita Mines, Limited	Toronto	June 3	1,000,000
Shim Explorations, Limited	Toronto	May 25	4,000

[1]See also list of companies with specified capital.

MINING COMPANIES INCORPORATED IN ONTARIO IN 1954 HAVING SHARES WITHOUT NOMINAL OR PAR VALUE—*Continued*

Name of company	Head office	Date of incorporation	Number of shares
Super Sonic Exploration Company, Limited[1]	Toronto	Dec. 9	100,000
Surpass Petrochemicals, Limited	Toronto	Jan. 27	3,500,000
Systematic Explorations, Limited	Toronto	Aug. 24	40,000
Tecumseh Developments, Limited	Toronto	July 19	3,500,000
Tory Hill Uranium and Rare Metals, Limited	Windsor	Nov. 24	300,000
Transator Explorations, Limited	Toronto	May 19	1,000
Victoria Algoma Mineral Company, Limited	Toronto	Apr. 9	3,000,000
West Penn Oil Company (Canada), Limited[1]	Toronto	Mar. 22	10,000
White Owl Prospectors, Limited	Toronto	Apr. 26	50,000
X-Ray Assay Laboratories, Limited[1]	Woodbridge	Apr. 29	5,000
Total (49 companies)			51,466,250

[1]See also list of companies with specified capital.

INCORPORATED COMPANIES WHOSE NAMES WERE CHANGED DURING 1954

New name	Old name
Armour Uranium and Copper Mines, Limited	Naneek Mines, Limited
Atore Explorations, Limited	Five Canucks Exploration, Limited
Barrentier Mines, Limited	Barrentier Gold Mines, Limited
Belcher Mining Corporation, Limited	Landover Oils and Mines, Limited
Big Jackpot Mines, Limited	Jackpot Uranium Mines, Limited
Bluegrass Uranium Mines, Limited	Bluegrass Raymond Mines, Limited
Burrex Mines, Limited	Anvil Porcupine Gold Mines, Limited
Calico Mines, Limited	Canadian Lithium Company, Limited
Camdeck Mines, Limited	Camdeck Gold Mines, Limited
Can-Met Explorations, Limited	Lapaska Mines, Limited
Claybar Uranium and Oil, Limited	Barclay Oil Company, Limited
Consolidated Denison Mines, Limited	North Denison Mines, Limited
Consolidated Dragon Oils, Limited	Dragon Oils and Gas, Limited
Consolidated Matarrow Mines, Limited	Matarrow Mines, Limited
Consolidated Mosher Mines, Limited	New Mosher Longlac Mines, Limited
Consolidated Northland Mines, Limited	Northland Mines (1940), Limited
Consolidated Sudbury Basin Mines, Limited	Ontario Pyrites Company, Limited
Copa Mining Corporation, Limited	Spodateenah Mines, Limited
Dupel Mines, Limited	Pepperess Mines, Limited
Durham Explorations, Limited	Durham Red Lake Gold Mines, Limited
Emo Mines, Limited	Emo Nickel Mines, Limited
Endeavor Mining Corporation, Limited	Albion Pershing Gold Mines, Limited
Farcroft Mines, Limited	Bathwick Mines, Limited
Great Sweet Grass Oils, Limited	Sweet Grass Oils, Limited
Gunnar Mines, Limited	Gunnar Gold Mines, Limited
Lake Cinch Mines, Limited	Cinch Lake Uranium Mines, Limited
Manilake Mines, Limited	Marian River Uranium Mines, Limited
Metro Minerals, Limited	Pyroclore Uranium Exploration Company, Limited
Mogul Mining Corporation, Limited	Mogul Gold Mines, Limited
Nello Mining, Limited	Partanen Malartic Gold Mine, Limited
New Athona Mines, Limited	Athona Mines (1937), Limited
New Hosco Mines, Limited	Hosco Gold Mines, Limited
New Taku Mines, Limited	Numalake Mines, Limited
New Vinray Mines, Limited	Vinray Malartic Mines, Limited
Nickel Rim Mines, Limited	East Rim Nickel Mines, Limited
North Rankin Nickel Mines, Limited	Rankin Inlet Nickel Mines, Limited
Pickering Metal Mines, Limited	Pickering Uranium Mines, Limited
Platte Uranium Mines, Limited	Adhawl Gold Mines, Limited
Rayrock Mines, Limited	American Yellowknife Mines, Limited
Saskalon Uranium and Oils, Limited	Savannah Oils and Mines, Limited
Shoreland Mines, Limited	Shoreland Gold Mines, Limited
Southern Union Oils, Limited	Montoco Petroleums, Limited

INCORPORATED COMPANIES WHOSE NAMES WERE CHANGED DURING 1954—
Continued

New name	Old name
Surety Oils and Minerals, Limited	Surety Oil Company, Limited
Thorncrest Explorations, Limited	Thorncrest Oil and Gas Company, Limited
Trio Uranium Mines, Limited	Trio Petroleum Corporation, Limited
Waterways Iron and Uranium Mines, Limited	Opasatika Iron Mines, Limited
West Maygill Gas and Oil, Limited	Maygill Petroleum Company, Limited

EXTRA-PROVINCIAL COMPANIES AND MORTMAIN LICENCES ISSUED BY ORDER-IN-COUNCIL IN 1954

Name of company	Place of incorporation	Date of licence	Capital for use in Ontario
Area Mines, Limited	Province of Quebec	Jan. 21	$ 200,000
Bethlehem Mines Corporation	State of West Virginia	June 14	10,000,000
Bonaventure Uranium Mines, Limited	Province of Quebec	Oct. 19	100,000
Buffalo Canadian Gold Mines, Limited	Canada	Feb. 4	100,000
Calvan Consolidated Oil and Gas Company, Limited	Canada	May 31	500,000
Cavendish Uranium Mines, Limited	Province of Quebec	Apr. 28	200,000
Confederation Mining Corporation, Limited	Province of Quebec	Aug. 4	100 000
Dickens Uranium and Development Corporation	State of Delaware	Nov. 23	100,000
Dominion Uranium Corporation	Province of Quebec	Aug. 25	300,000
Fathom Drilling, Limited	Province of Manitoba	Feb. 10	15,000
Felmont Oil Corporation	State of Delaware	Aug. 25	1,200,000
Husky Oil and Refining, Limited	Province of Saskatchewan	Nov. 16	4,000,000
Kemp Uranium Mines, Limited	Province of Quebec	Dec. 15	200,000
Kenmac Chibougamau Mines, Limited	Province of Quebec	Dec. 2	200,000
Ladoric Mines, Limited	State of Delaware	June 10	25,000
Lake Superior Iron, Limited	Province of Quebec	Sept. 10	2,000,000
Lyndhurst Mining Company, Limited	Province of Quebec	June 2	100,000
Minnesota Mining and Manufacturing of Canada, Limited	Canada	Oct. 7	2,000,000
Mount Petroleum Corporation of Canada, Limited	Canada	Dec. 3	100,000
North Star Oil, Limited	Canada	Aug. 13	1,000,000
Nueva Exploration Company	State of Delaware	Dec. 30	90,000
Oreland Mining Corporation	Province of Quebec	Feb. 18	100,000
Pato Mines (Columbia), Limited, The	Great Britain and Northern Ireland	May 19	1,300,000
Power Uranium Company, Limited	Province of Quebec	Dec. 3	150,000
Randex Uranium Mines, Incorporated	State of Delaware	Feb. 18	20,000
Ranger Lake Uranium Company, Limited	State of Delaware	Nov. 15	40,000
Shell Oil Company	State of Delaware	May 18	40,000
Socony-Vacuum Oil Company of Canada, Limited	State of Delaware	June 18	100 000
Spragge Uranium and Exploration Corporation	State of Delaware	Oct. 6	30,000
Stancan Uranium Corporation	State of Delaware	Nov. 8	50,000
Tazin Mines, Limited	Canada	Apr. 1	150,000
Trans-Dominion Mining and Oils Corporation	Province of Quebec	July 26	200,000
Uranium King Corporation	Province of Quebec	May 14	100,000
Victoria Consolidated Silver Mining Company, Limited, The	Canada	July 5	100,000
Whitney Uranium Mines, Limited	Province of Quebec	May 25	100,000
Wintern Mining Corporation	Province of Quebec	Mar. 18	100,000
Total (36 companies)			$25,110,000

Mining Revenue and Expenditure

The revenue of the Department of Mines for the fiscal year ending March 31, 1955, was $5,773,923.49 as compared with $5,224,540.29 in the previous year. Expenditures were $1,741,314.30. The following table gives details of the revenue:

REVENUE, APRIL 1, 1954, TO MARCH 31, 1955

ORDINARY:		
Licences and Permits:		
Sand and gravel	$ 885.00	
Unwrought metal sales	96.00	
Refinery	85.00	
Miners	111,105.24	
Gas	130.00	
Quarry	799.55	
		$ 113,100.79
Mining Claims:		
Recording fees	$390,025.25	
Abstracts and miscellaneous	34,159.23	
		424,184.48
Rentals:		
Gas leases	$58,592.00	
Mining leases	28,132.13	
Licences of occupation	25,698.16	
		112,422.29
Royalties:		
Sand and gravel	$110,106.29	
Gas and oil	2,287.35	
		112,393.64
Taxes:		
Acreage	$ 156,280.73	
Profit	4,509,127.87	
Gas	39,855.82	
		4,705,264.42
Laboratory Fees:		
Cable testing	$ 34,316.13	
Chemical and assay	2,893.70	
Sampling and assay	136,164.85	
		173,374.68
Services:		
Prints, maps, and reports	$13,556.02	
Record books	1,229.00	
Sale of gold and silver ores		
Miscellaneous revenue	6,211.77	
		20,996.79
CAPITAL:		
Mining lands sales		112,186.40
TOTAL REVENUE:		$5,773,923.49

STATEMENT OF MONIES FROM OFFICES OF THE MINING LANDS BRANCH, APRIL 1, 1954, TO MARCH 31, 1955

Mining division	Purchase price	Licences of occupation	Mining leases	Blueprints	Recording fees	Miner's licences	Miscellaneous fees	Total
Head office	$ 5,826.85	$1,159.35	$1,148.25	$ 97.25	$ 47,344.15	$ 62,546.99	$ 4,439.90	$122,562.74
Fort Frances	7,718.18	148.70	.....	168.25	6,317.00	1,595.00	521.60	16,468.73
Kenora	6,922.72	1,204.99	.....	375.25	19,505.00	3,517.00	1,458.30	32,983.26
Larder Lake	16,274.81	418.25	[1]—3.80	289.75	9,780.00	3,218.00	1,076.95	31,053.96
Montreal River	137.06	36.30	1,754.83	153.50	5,679.00	923.00	560.15	9,243.84
Patricia	3,715.26	512.16	.....	59.50	6,367.00	1,681.00	547.73	12,882.65
Porcupine	6,881.77	5.53	1,124.28	255.00	12,192.00	2,749.00	1,397.60	24,605.18
Port Arthur	6,900.99	31.32	1,900.63	1,264.75	101,774.00	13,401.00	6,215.23	131,487.92
Red Lake	11,102.67	2,909.36	.....	130.25	11,421.50	1,127.00	1,523.90	28,214.68
Sault Ste. Marie	9,970.76	227.92	.....	1,045.00	71,980.60	7,836.25	6,540.18	97,600.71
Sudbury	34,921.72	650.35	.....	1,602.50	86,272.00	9,584.00	8,604.42	141,634.99
Timiskaming	1,813.61	[2]—93.34	1,196.93	286.75	11,393.00	2,927.00	1,273.27	18,797.22
Total	$112,186.40	[3]$7,210.89	[3]$7,121.12	[4]$5,727.75	$390,025.25	$111,105.24	$34,159.23	$667,535.88

[1]Amounts received in previous years credited to Mining Leases were later transferred to Licences of Occupation.
[2]Amounts received in previous years credited to Licences of Occupation were later transferred to Mining Leases.
[3]The amounts shown for Licences of Occupation and Mining Leases are respectively $18,487.27 and $21,011.01 less than shown in the revenue statement on page 62. The differences in both cases are annual rentals collected by the Accounts Branch.
[4]The amount shown for Blueprints is $7,828.27 less than shown in the revenue statement on page 62. The difference is the revenue collected from the sale of blueprints by the Publications office.

Provincial Assay Office

As an aid in the development of mineral resources of Ontario, the Government established a Provincial Assay Office in Belleville in 1898. This was for the purpose of making assays of the various ores found in the Province and to assist the prospector in the development of claims. This office is now established in the East Block of the Parliament Buildings, Toronto.

Free assays may be obtained as provided by the Mining Act of Ontario, R.S.O. 1937, Chapter 47, Section 67, as amended 1943, as follows:

> Every licensee who stakes out and records a mining claim shall be given by the recorder two free assay coupons on recording it, and two additional free assay coupons on recording each forty days' work thereafter, and on forwarding or delivering, charges prepaid, samples from the mining claim to the Provincial Assayer, Toronto, together with the required number of coupons, he shall be entitled to have such samples assayed without charge.

Some assays require one coupon in payment, and some require two or more, as indicated on the coupons now being distributed.

Minerals and rocks not requiring chemical analysis are identified free of charge, and tests for radioactivity are also free. All other work requires a fee, as outlined in the schedule of charges of this office.

Special Work

The examination of certain samples requires specialized mineralogical techniques. This has applied mostly to the identification and description of radioactive minerals. This mineralogical work must be supported by every means available including chemical X-ray and microscopic and spectrographic analysis. A great deal of this work was done during the year for prospectors, mining companies, and our Geological Branch. Some 250 X-ray powder photographs were made.

A detailed study of five garnet samples was made for the Geological Branch. This involved the resolution of each garnet into its component "molecules" by means of the various techniques referred to above.

A study was made of a suite of plagioclase samples for the Geological Branch. This involved the determination of the composition of the plagioclase by X-ray and optical means.

The metal plating on articles of kitchenware was investigated for Sunnybrook Hospital.

A special analysis was made of seven minute mineral separates submitted by a mining company. Quantitative analysis was made on each, which included four of the rare earths and certain other rare elements.

The laboratory participated in a problem of co-operative analysis designed to devise and improve methods for the determination of columbium. These tests were conducted by the U. S. Geological Survey.

Trace-element analyses were made on a suite of nine rock samples for the University of Cincinnati. This was part of a geological research problem in the Parry Sound District.

Various pieces of work were done on behalf of the Ontario Provincial Police. Three court appearances were made during the year. These cases involved high-grading and fraud.

Dr. E. S. Moore is investigating a geological problem involving the origin of ore deposits in the Gowganda area. The distribution of silver in a large suite of samples was studied by special methods.

The Provincial Assayer and Chemist, D. A. Moddle, reports as follows:

ASSAY RETURNS FOR 1954

Determinations	For coupons	For cash	For the Department	Accounts outstanding	Total
Aluminium	4	.....	5	.....	9
Antimony	1	.....	.....	.....	1
Arsenic	4	.....	.....	.....	4
Barium	10	.....	.....	1	11
Beryllium	3	.....	.....	.....	3
Bismuth	1	.....	.....	.....	1
Cadmium	3	.....	2	.....	5
Calcium	5	8	5	2	20
Chromium	6	1	.....	.....	7
Cobalt	144	12	8	2	166
Columbium	45	1	.....	.....	46
Copper	417	57	25	37	536
Gold[1]	816	88	25	104	1,033
Iron	138	38	14	24	214
Lead	49	2	5	6	62
Lithium	7	1	.....	.....	8
Magnesium	3	5	.....	1	9
Manganese	29	1	10	.....	40
Molybdenum	22	4	.....	9	35
Nickel	204	30	10	14	258
Palladium[2]	10	2	1	1	14
Platinum[2]	39	10	3	1	53
Phosphorus	15	2	5	.....	22
Silicon	12	4	5	2	23
Silver[1]	258	36	21	20	335
Sodium	.....	.....	5	.....	5
Sulphur	40	4	.....	1	45
Tantalum	33	.....	.....	.....	33
Thorium	42	.....	.....	2	44
Tin	16	3	1	1	21
Titanium	66	5	5	2	78
Tungsten	9	.....	3	1	13
Vanadium	10	.....	5	.....	15
Uranium	235	95	28	21	379
Zinc	94	10	5	11	120
Zirconium	14	.....	1	2	17
Others	75	5	.....	.....	67
Totals	2,879	424	197	265	3,765

[1]Fire assays.

[2]Fire assay—spectrographic determinations.

OTHER ANALYTICAL WORK

	1953	1954
Miscellaneous spectrographic analyses	663	578
Routine (28-element) spectrographic analyses	630	1,271
Radioactivity determinations	1,001	1,093
Examination and identification of minerals and rocks	756	1,075
Special mineral examinations involving X-ray and other work	65	([1])
Complete rock analyses	13	12
Coal analyses	1	2

[1]There was a considerable increase in this type of work, but exact figures are not available.

FEES RECEIVED

Year	Coupons	Cash
1952	3,909	$1,992.27
1953	4,546	2,101.18
1954	7,350	2,896.15

Summary

Due to the complex nature of the work it is difficult to determine an accurate index for the amount done in a year. However, the over-all increase over 1953 is estimated at 50 percent. This is a natural consequence in a year of intense prospecting activity.

The figures on page 65 show slight increases for gold and base metals. The number of rare-element analyses is noteworthy: uranium, 379; thorium, 44; columbium, 46; tantalum, 33; etc. A number of rare-earth analyses were made but are not shown.

The number of mineral identifications has doubled since 1952. In addition the nature of the mineralogical work has changed as described in a previous paragraph.

In 1948 the Department first offered a general qualitative spectrographic analysis. This was the first time in Canada that a routine service of this kind was available to the mining industry. It is significant, therefore, that in 1954 a total of 1,271 of these 28-element analyses, or 5 for every working day, were reported.

Mining Accidents in 1954

By

The Staff of the Mines Inspection Branch

STATISTICAL REVIEW

Introduction

During 1954, at the mines, metallurgical works, quarries, and clay, shale, sand, and gravel pits regulated by the Mining Act, there were 2,701 accidents reported to the Ontario Department of Mines up to January 21, 1955. Thirty-three fatalities, from 32 separate accidents, and 2,668 non-fatal accidents were recorded.

The returns represent a decrease in the accident frequency, for fatal accidents, from the previous year.

The report shows a fatality rate of 0.87 persons killed per 1,000 persons employed, which is a decrease of 0.12 per thousand over the preceding year and 0.48 per thousand lower than the average for the last 25 years. There were 71 non-fatal accidents per thousand persons employed, the same as the rate in 1953, but 4 accidents, or 5.3 percent, fewer than the average for the last 25 years.

The total employment figures show an increase of 11.7 percent from 37,401 in 1953 to 41,784 in 1954. The increase is due to expansion of the industry in the Sudbury and Blind River areas.

In this report mining operations are divided into the following groups:

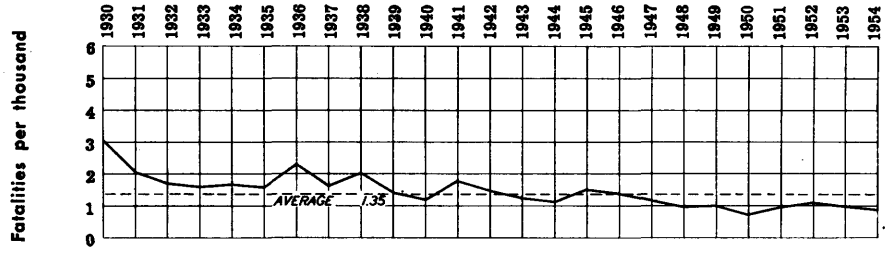
Group 1–Underground at Mines.
Group 2–On Surface at Mines.
Group 3–Metallurgical Works.
Group 4–Quarries.
Group 5–Clay, Shale, Sand, and Gravel Pits.
Group 6–Contract Diamond-drilling.
Group 7–Operations in the Mining Industry for which Employment Figures are Not Available.

EMPLOYMENT UNDERGROUND AND ON SURFACE AT MINES
(GROUPS 1 and 2), 1944–54

Year	Underground (Group 1)		Surface (Group 2)		Total
	Number	Percent	Number	Percent	
1944	11,184	62	6,914	38	18,098
1945	10,535	61	6,687	39	17,222
1946	11,503	61	7,442	39	18,945
1947	12,653	61	8,111	39	20,764
1948	13,663	63	7,851	37	21,514
1949	13,968	64	7,918	36	21,886
1950	14,591	64	8,372	36	22,963
1951	15,000	63	8,626	37	23,626
1952	15,201	65	8,283	35	23,484
1953	14,415	63	8,401	37	22,816
1954	16,246	65	8,910	35	25,156
Average	13,542	63	7,956	37	21,498

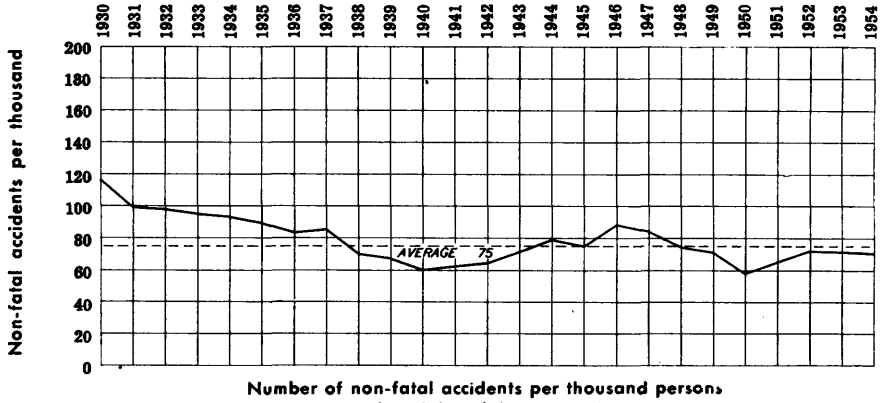
ACCIDENT AND EMPLOYMENT STATISTICS (GROUPS 1 – 6), SHOWN GRAPHICALLY, 1930 – 54

1.



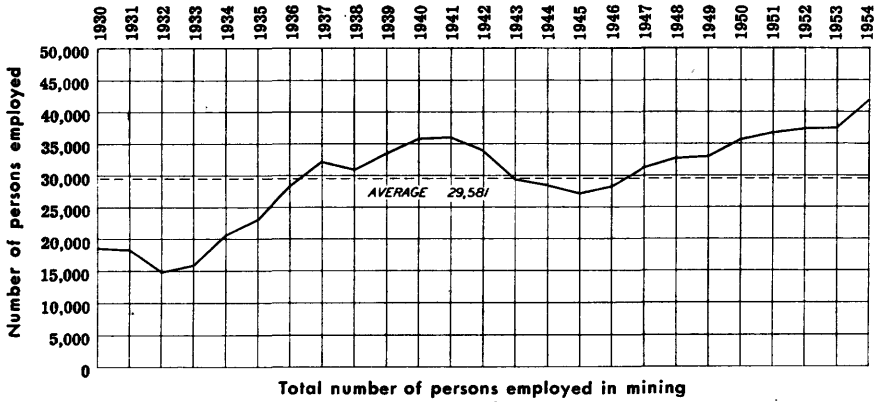
Number of fatalities per thousand persons employed in mining operations.

2.



Number of non-fatal accidents per thousand persons employed in mining operations.

3.



Total number of persons employed in mining operations.

Summary of Fatal and Non-Fatal Accidents

The following table is a summary for the past 25 years of the number of persons injured per 1,000 employed at mining operations:

ACCIDENTS TO EMPLOYEES IN MINES, METALLURGICAL WORKS, QUARRIES, AND CLAY, SHALE, SAND, AND GRAVEL PITS (GROUPS 1–6), 1930–54

Year	Persons injured			Persons employed at all operations[1]			Persons injured per 1,000 employed	
	Fatally	Non-fatally	Total	Producing operations	Non-producing operations	Total	Fatally	Non-fatally
1929	55	2,389	2,444	17,145	1,849	18,994	2.89	126
1930	56	2,167	2,223	18,217	317	18,534	3.02	117
1931	37	1,813	1,850	17,820	447	18,267	2.03	99
1932	25	1,452	1,477	14,378	431	14,809	1.69	98
1933	25	1,514	1,539	15,080	804	15,884	1.57	95
1934	34	1,913	1,947	19,302	1,254	20,556	1.65	93
1935	36	2,048	2,084	21,444	1,528	22,972	1.57	89
1936	65	2,359	2,424	25,725	2,547	28,272	2.30	83
1937	52	2,721	2,773	28,938	3,220	32,158	1.62	85
1938	62	2,147	2,209	29,434	1,421	30,855	2.01	70
1939	47	2,246	2,293	32,444	897	33,341	1.41	67
1940	42	2,128	2,170	35,137	438	35,575	1.18	60
1941	64	2,240	2,304	35,317	618	35,935	1.78	62
1942	50	2,167	2,217	33,336	431	33,767	1.48	64
1943	36	2,101	2,137	29,083	394	29,477	1.22	71
1944	32	2,238	2,270	28,032	444	28,476	1.12	79
1945	41	2,026	2,067	25,639	1,413	27,052	1.52	75
1946	39	2,483	2,522	25,458	2,691	28,149	1.38	88
1947	35	2,608	2,643	29,965	1,136	31,101	1.13	84
1948	31	2,429	2,460	31,571	1,136	32,707	0.95	74
1949	33	2,341	2,374	32,586	327	32,913	1.00	71
1950	25	2,070	2,095	35,073	481	35,554	0.70	58
1951	34	2,387	2,421	36,178	551	36,729	0.93	65
1952	41	2,697	2,738	36,759	502	37,261	1.10	72
1953	37	2,654	2,690	36,781	620	37,401	0.99	71
1954[2]	33	2,668	2,701	40,785	999	41,784	0.87	71
Average	40	2,225	2,265	28,579	1,002	29,581	1.35	75

Fatal Accidents

FATALITY RATE PER 1,000 (GROUPS 1–6), 1954

Distribution	Group	Men employed	Number killed	Rate per thousand
Mines, underground	1	16,246	22	1.49
Mines, surface	2	8,910	3	0.36
Metallurgical works	3	11,933	3	0.29
Quarries	4	1,472	1	0.70
Clay, shale, sand, and gravel pits	5	2,022	2	1.02
Contract diamond-drilling	6	1,201	2	1.72
Total	.....	41,784	33	0.87

[1]Employment figures in this report are based on the average number of men employed for one year.

[2]Accident frequency rates in this report are calculated on a basis of 300 man-shifts per year so that the exposure rate will compare with previous years. With the shortening of the work week in some areas the yearly exposure per man is lessening.

A COMPARISON OF FATAL ACCIDENTS AND FATALITIES (GROUPS 1–6) BY YEARS, 1950–54

Distribution	Group	1950[1]		1951		1952		1953[2]		1954	
		Number of accidents	Number killed	Number of accidents	Number killed	Number of accidents	Number killed	Number of accidents	Number killed	Number of accidents	Number killed
Mines, underground	1	16	16	21	24	29	33	18	20	22	22
Mines, surface	2	1	1	3	3	3	3	5	5	3	3
Metallurgical works	3	4	5	4	4	1	1	3	3	3	3
Quarries	4	2	2	2	2	1	1	4	4	1	1
Clay, shale, sand, and gravel pits	5	1	1	1	1	1	1	3	3	2	2
Contract diamond-drilling	6	0	0	0	0	1	2	2	2	1	2
Total	.....	24	25	31	34	36	41	35	37	32	33

[1]The 1950 figures are corrected to include an accident that occurred during 1950 resulting in the death of one man in 1951.
[2]The 1953 figures are corrected to include an accident that occurred during 1953 resulting in the death of one man in 1954.

FATALITIES BY AGE GROUPS (GROUPS 1–6)

17–20	21–25	26–30	31–35	36–40	41–45	46–50	Over 50	Total
4	1	4	7	8	7	2	0	33

FATALITIES ACCORDING TO INDUSTRIES (GROUPS 1–6)

Gold mines	12	Nepheline mines	1
Copper, nickel, and zinc mines	5	Quarries	1
Iron mines	5	Clay, shale, sand, and gravel pits	2
Silver-cobalt mines	3		
Nickel-copper smelters	3	Total	33
Uranium mines	1		

CAUSES OF FATALITIES AT MINES (GROUPS 1–6), 1950–54[1]

UNDERGROUND (GROUP 1)

Cause	Class of accident	1950,[2] percent	1951, percent	1952, percent	1953,[3] percent	1954	
						Number	Percent
Fall of ground	A	50	50	37	15	6	28
Explosives	B	0	8	15	10	2	9
Run of ore, rock, etc.	C	0	13	9	25	2	9
Shaft accidents	D	19	4	6	15	4	18
Fall down stope, raise, etc.	E	31	17	6	0	4	18
Haulage	F	0	4	6	20	2	9
Rock burst	G	0	0	12	10	0	0
Unclassified	H	0	4	9	5	2	9
Total	.....	100	100	100	100	22	100

[1]This table is similar to that of previous years except for surface accidents at mines, Groups 2 to 6 are classified separately. Formerly, Group 1 accidents were classified and Groups 2 to 6 were included as "Unclassified." Open-pit mining operations such as Frood-Stobie, American Nepheline, Bethlehem Iron Mines, Steep Rock, etc. (as distinct from rock quarries) have been and are included in Group 1.

[2]The 1950 figures are corrected to include an accident that occurred during 1950 resulting in the death of one man in 1951.

[3]The 1953 figures are corrected to include an accident that occurred during 1953 resulting in the death of one man in 1954.

ON SURFACE (GROUPS 2–6)

Cause	Class of accident	1950, percent	1951, percent	1952, percent	1953, percent	1954	
						Number	Percent
Falling objects	A	22	20	14	12	0	18
Explosives	B	.....	.....	.....	.....	0	0
Run of materials	C	22	10	.....	.....	4	37
Machinery	D	12	20	14	6	2	0
Fall of person	E	.....	10	.....	30	1	9
Transportation and haulage	F	22	30	28	35	2	18
Chemicals and burns	G	22	.....	14	.....	1	9
Unclassified	H	.....	10	29	17	1	9
Total	.....	100	100	100	100	11	100

FATALITIES BY MONTHS (GROUPS 1–6)

Month	Number of accidents	Number of men killed
January	1	1
February	5	5
March	3	3
April	1	1
May	1	1
June	3	3
July	5	5
August	1	1
September	1	1
October	6	7
November	4	4
December	1	1
Total	32	33

Non-Fatal Accidents

Mines (Groups 1 and 2)

There were 25,356 persons employed at mines in Ontario in 1954. During the year, 1,715 were injured, giving a non-fatal accident rate of 68 per 1,000.

CAUSES OF NON-FATAL ACCIDENTS AT MINES

Causes	Underground (Group 1)	Surface (Group 2)	Total
Fall of persons	137	63	200
Strain while lifting	99	42	141
Fall of rock or ore, drilling, scaling, etc.	117	2	119
Strain while moving	77	21	98
Fall of loose rock or ore	98	.....	98
Drilling machines	96	1	97
Rock or ore at chute	89	8	97
Falling objects	71	19	90
Handling materials other than rock or ore	63	26	89
Hand tools	44	38	82
Handling or tramming mine cars	62	4	66
Flying objects, drilling, sledging, etc.	54	11	65
Tugger hoists, scrapers, etc.	48	7	55
Nails or splinters	40	13	53
Running into or striking objects	38	8	46
Crushed between two objects	32	13	45
Roll of broken rock or ore	45	.....	45
Mechanical transportation	42	1	43
Handling rock or ore	31	5	36
Machinery general	5	30	35
Mechanical loaders	30	2	32
Burns	6	21	27
Cage, skip, or bucket in shaft	18	.....	18
Explosives	10	.....	10
Dermatitis	4	2	6
Noxious gases	4	.....	4
Electricity	.....	4	4
Rock bursts	3	.....	3
Falls down shaft, winze, or stope	1	.....	1
Unclassified	6	4	10
Total	1,370	345	1,715

Metallurgical Works (Group 3)

There were 11,933 persons employed at metallurgical works in Ontario in 1954. During the year, 431 were injured, giving a non-fatal accident rate of 36 per 1,000.

CAUSES OF NON-FATAL ACCIDENTS AT METALLURGICAL WORKS

Strain while lifting or moving	88	Running into or striking objects	16
Fall of person	58	Loading, unloading, or handling cars	15
Falling objects	40	Machinery	14
Burns by slag or metal	35	Handling materials	8
Hand tools	29	Transportation	6
Burns	25	Nails or splinters	6
Flying objects, sledging, etc.	24	Noxious gases	6
Dermatitis, chemical burns, etc.	20	Electricity	1
Crushed between objects	18	Unclassified	4
Hoisting equipment, hooks, slings, blocks, etc.	18	Total	431

Quarries (Group 4)

There were 1,472 persons employed at quarries in Ontario in 1954. During the year, 106 were injured, giving a non-fatal accident rate of 72 per 1,000.

CAUSES OF NON-FATAL ACCIDENTS AT QUARRIES

Strain while lifting or moving	17	Nails or splinters	5
Fall of persons	12	Hand tools	4
Fall of material during handling	12	Fall of material from face	4
Transportation	12	Running into or striking objects	4
Falling objects	9	Flying objects, sledging, etc.	3
Machinery	8	Burns	2
Handling materials	8		
Crushed between two objects	6	Total	106

Clay, Shale, Sand, and Gravel Pits (Group 5)

There were 2,022 persons employed at clay, shale, sand, and gravel pits in Ontario during 1954. During the year, 109 were injured, giving a non-fatal accident rate of 54 per 1,000.

CAUSES OF NON-FATAL ACCIDENTS AT CLAY, SHALE, SAND, AND GRAVEL PITS

Fall of persons	16	Falling objects	6
Strain while lifting or moving	16	Burns	5
Machinery	13	Fall of material from bank	5
Transportation	11	Nails or splinters	3
Handling materials	9	Fall of material during handling	2
Hand tools	9		
Flying objects, sledging, etc.	8	Total	109
Crushed between two objects	6		

Contract Diamond-drilling (Group 6)

There were 1,201 persons employed in contract diamond-drilling in Ontario in 1954. During the year, 307 were injured giving a non-fatal accident rate of 256 per 1,000.

CAUSES OF NON-FATAL ACCIDENTS IN DIAMOND-DRILLING

Handling drill rods	47	Falling objects	16
Wire, nails, or splinters	40	Running into or striking objects	14
Fall of persons	38	Caught in moving parts	13
Strain while lifting or moving	38	Burns	9
Hand tools	32	Transportation	4
Crushed between two objects	19	Fall of loose rock or ore	2
Flying, objects, sledging, etc.	18		
Handling materials	17	Total	307

Infection (Groups 1-6)

Records show that infection followed in 150 cases out of a total of 2,668 accidents.

ANALYSIS OF ACCIDENTS FOLLOWED BY INFECTION

Location	Group	Number of accidents	Accidents followed by infection	Percent infection
Mines, underground	1	1,370	58	4.2
Mines, surface	2	345	8	2.3
Metallurgical works	3	431	28	6.5
Quarries	4	106	8	7.6
Clay, shale, sand, and gravel pits	5	109	4	3.7
Contract diamond-drilling	6	307	44	14.3
Total	.....	2,668	150	5.6

Electrical Accidents

ACCIDENTS DUE TO THE USE OF ELECTRICITY AT MINES, METALLURGICAL WORKS, QUARRIES, AND CLAY, SHALE, SAND, AND GRAVEL PITS (GROUPS 1–6), 1945–54

	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	Total
Fatal	1	.....	.....	1	1	.....	1	1	1	1	7
Non-fatal	1	7	2	2	4	2	8	2	9	5	42
Total	2	7	2	3	5	2	9	3	10	6	49

Explosives

CAUSES OF ACCIDENTS FROM EXPLOSIVES

Cause	Number of accidents	Persons injured		
		Non-fatally	Fatally	Total
Drilled into missed hole	1	.....	1	1
Premature explosive in chute blast	1	.....	1	1
Injury due to blast concussion	2	3	.....	3
Explosion of detonator	2	2	.....	2
Delayed too long at scene of blast	2	2	.....	2
Returned too soon to scene of blast	1	1	.....	1
Did not take sufficient cover	2	2	.....	2
Total	11	10	2	12

FIRES

Coniaurum Mines, Limited

No. 274

A fire occurred in the windings of the electric 25-horsepower motor in the 2,000-foot level pump-room of the Coniaurum Mines, Limited, on January 23. It was discovered at 12.20 P.M. by the pumpman, P. Lessard, who shut off the power to the motor and extinguished the flames.

The motor was removed and replaced with a spare, the wiring checked, and the pump put back in operation by 4.40 P.M. the same afternoon. Examination showed that the fire started in the stator coils of the motor.

Steep Rock Iron Mines, Limited

No. 275

A fire of uncertain origin destroyed the *G* tunnel ventilation fan-house at Steep Rock Iron Mines, Limited, at about 11.30 P.M., February 3.

On the afternoon shift (4.00 P.M. to 12.00 midnight) of February 3, three workers, Lacasse, Grams, and Purdy mucked out, drilled, and blasted a round at the face of *G* tunnel. They removed their working apparel in the fan-house at the tunnel entrance as usual and left on foot for No. B-1 shaft change-house about 11.20 P.M. after starting the small ventilation fan housed in this building. Belanger, a service-truck driver from the pit department, noticed the fan-house in flames at 11.35 P.M. Before help could be summoned, the building and contents were completely destroyed. The ventilation fan was V-belt-driven by a 40-horsepower electric motor. This building also housed the fan starter and a 5,000-watt electric unit heater.

On being questioned, Lacasse and Grams stated that everything was normal on leaving the fan-house at 11.20 P.M. on February 3. The 40-horsepower fan and unit heater were both operating, and the door was left open to help the suction of the fan. They also stated that each man lit a cigarette, from the same lighter, just before leaving the building, and that no cigarette butts or matches were thrown away in the building. Belanger, the truck driver who noticed the fire first, stated that the fire was blazing up well when he saw it, and that it would be impossible to tell how it started.

In the future, fans are to be installed in the open with motor and switch box covered in or else enclosed in a fireproof structure.

Hollinger Consolidated Gold Mines, Limited

No. 276

A small fire was the result of a short-circuit that occurred in an electric slusher-hoist cable in No. 94A E 17.1 slice-and-fill stope on the 2,900-foot level of the Hollinger mine at 9.00 A.M., February 12.

The electric cable on this hoist is fire-resistant, being a two-conductor, No. 2 rubber-insulated neoprene-jacketted trailing cable, supplying direct-current power at 250 volts to the hoist. The cable is protected by a 100-ampere fuse on the level.

The stope crew went down to the level at 8.45 A.M. to obtain material to complete a timbering operation. While they were down on the level they pushed in the circuit switch. At 9.00 A.M. the crew were still timbering when they noticed a flame shoot directly out from the cable, a distance of about 130 feet from where they were working. The runner descended the manway to the level and pulled the switch. The helper used a Fyrfyter extinguisher on the cable. This type of extinguisher is standard equipment on all electric hoists at the mine.

The report received from the electrical department states that the cable short-circuited a distance of 125 feet from the hoist and blew a 1-inch diameter hole in the cable, cutting both conductors.

The cable was temporarily spliced to put the slusher hoist back into production. It was replaced by a square length of trailing cable. The damaged cable was brought to surface for permanent repairs.

An inspection of the cable revealed a cut in the neoprene cover and insulation.

Pamour Porcupine Mines, Limited

No. 277

A minor fire resulted from a short-circuit in a battery locomotive on the 600-foot level of the Pamour Porcupine mine at about 1.30 P.M., March 2.

While pulling a load with a 3-ton battery locomotive the motorman, A. Evans, noticed smoke and sparks from under the front end of the motor. He immediately pulled out the battery connector, and the fire went out.

Electrician, Dave Veitch, was summoned and found two wires had come loose from the control resisters and had shorted.

Hollinger Consolidated Gold Mines, Limited

No. 278

A fire was discovered in the clothing lockers of the No. 11 change-house at the Hollinger mine at 6.50 A.M. on March 15.

At about 6.00 A.M. the day-shift employees began to enter the locker room. No fire was noticed until 6.50 A.M.

Four lockers seem to have been involved, three on the north side of the double row, Nos. 745, 746, and 747, and one on the south, No. 698. No. 698 adjoins No. 746, and most of the fire seemed to concentrate in these two lockers. Boots, a rubber coat, neoprene gloves, and clothing were partly consumed. A jute bag containing clothing was badly burned.

The fire, reported at 6.50 A.M., was put out by the use of extinguishers at 6.55 A.M. The plant fire-fighting equipment was called for, but the fire was under control when it arrived.

It is surmised that a lighted cigarette was probably laid down on the top of one of the lockers and then rolled down into the clothing in No. 746. The fire appears to have just spread to locker 698 when it was extinguished.

The lockers are steel boxes about 2 feet in depth that rise about 16 inches above the change-room floor. The clothing is hung down from these boxes into the storey below, which, in this dry, has merely standing room clearance between the floor and the ceiling. This lower storey is not accessible to the workmen. Consideration is being given to making this change-room a non-smoking area.

Upper Canada Mines, Limited

No. 279

A small electrical fire resulted from a short-circuit in a lamp-charger rheostat in the change-house of the Upper Canada mine at about 8.15 P.M. on April 15.

At about 8.15 P.M., P. Melesky, deckman at No. 2 shaft, went to the change-house for a drink. When he entered the building he saw smoke and flame at the top of one of the cap-lamp charging-racks.

Melesky ran back to the shaft-house and notified the second deckman, S. Liscumb, of the fire; then he returned to the dry and extinguished the fire by throwing a pail of water on it.

The fire was apparently caused by a short circuit in the wiring of one of three rheostats that sit on top of the charging-rack. There were no lamps in the rack at the time of the fire. The switches on two of the three rheostats, including the one that burned, were found to be in the "ON" position.

The hazard of putting out an electrical fire with water was pointed out to the men concerned. Proper extinguishers were readily available.

Hollinger Consolidated Gold Mines, Limited

No. 280

A fire occurred in the mine dry at the Ross mine of Hollinger Consolidated Gold Mines, Limited, at 10.50 P.M. on June 8.

Smoke coming from near the lamp-charging generator was first noticed by Mine Shift Boss W. C. Draves. Upon closer examination flames were seen in some mine clothes hanging up near the rafters of the dry.

Draves picked up a 2½ gallon soda-acid-type fire extinguisher, and another workman, Roger Gadoury, manned a water hose that is used to wash the mine dry floor, and they directed both against the flames, which were extinguished at once.

No alarm was given since there were plenty of men available to extinguish the fire. The origin of the fire is unknown.

Damage was slight; one wooden rafter was charred, and some mining clothing damaged.

Hollinger Consolidated Gold Mines, Limited

No. 281

An electrical fire resulting from a fault in a power cable at the central-shaft substation of the Hollinger mine occurred at about 12.15 A.M. on June 15.

The central-shaft substation has a 550-volt transformer bank and a 2,200-volt bank. There are four circuits off the 2,200-volt bank, one to the hoist and three to underground called "black," "white," and "red." Each has its own breaker, and the 2,200-volt circuit has a ground detector. The "black" circuit feeds five pump motors, totalling 925 horsepower, and some lighting transformers.

About 12.10 A.M. the No. 1 circuit breaker at the compressor-plant substation tripped out and was reset at about 12.15 A.M. L. Spencer, shift electrician, saw smoke coming from the central-shaft substation. He investigated and found that a dead ground was indicated on the 2,200-volt system. He then saw the "black" cable, 2,200 volts, feeding the underground pumping station, blow up. Repairs were made, and the power turned on at 4.30 A.M.

This "black" cable had a section in it extending from a splice box at the shaft collar to the breaker, which was a different cable from that in the shaft. The cable had burned out previously and shortly after this had burned out again. The rubber insulation had deteriorated. A search in the files disclosed that after the first failure a test piece had been sent to the Canada Wire and Cable Company's laboratory where it had been rated 2,000 volts in January, 1952. No action was taken at that time. The cable has now been replaced by a 3;300-volt, 2/0, 3-conductor, DSTA jute-covered, paper-insulated cable, which was given a successful high-potential test.

Steep Rock Iron Mines, Limited

No. 282

A fire caused by over-heated motor-control grids occurred at the Errington loading plant of Steep Rock Iron Mines, Limited, at about 3.45 A.M. on June 30.

Wiring on the control panel and a wooden ventilator in the roof of the control room were charred by heat from grid resisters used for controlling the speed of No. 2 conveyer motor. The fire was quickly put out with a carbon-dioxide extinguisher.

McIntyre Porcupine Mines, Limited

No. 283

A fire occurred in the crushing plant of McIntyre Porcupine Mines, Limited, at 9.15 A.M. on July 3..

Following the installation of a chute-box below the Symons rod deck screens on the lower floor of the rock house, temporary ventilation was in the process of being installed. A piece of 10-inch ventilation pipe was being brazed to the disconnected end of the main ventilation pipe, which leads to the Sly dust collector in the roof of the crushing plant. This disconnected end was lined with 1/16-inch Linatex rubber of which the welder and mechanic were unaware. This rubber ignited shortly after application of the welding torch.

Fire was not noticeable until the ventilation pipe became heated. The disconnected end was immediately covered with plate, and fire-extinguishers were applied. At the same time an alarm was telephoned in, and the Schumacher fire department immediately responded; a 2½-inch line was run up to the dust collector in the event of the canvas bags igniting. At the same time all electrical power was shut off in the crushing plant. Several quarts of carbon tetrachloride were injected at several points up the pipe. This proved effective in putting the fire out by 9.45 A.M.

The dust collector was examined and found free of fire. Damage amounted to the loss of the Linatex rubber lining and the collapse of about 10 feet of pipe at the lower end.

Cobalt Consolidated Mining Corporation, Limited

No. 284

An electrical fire of uncertain origin destroyed the main transformers and transformer house at the Agaunico mine of Cobalt Consolidated Mining Corporation, Limited, at about 11.00 P.M. on July 3.

A shift of eight men were employed underground at the Agaunico mine on the night of July 3.

At 10.58 P.M. the hoistman, W. R. St. Jean, noticed the electric lights flickering as the cage with an empty car approached the 275-foot level. When the cage reached the 275-foot level, the power and lights went off.

St. Jean went to the door of the hoist-room and saw the transformer house in flames. Intending to wet down the area around the fire he ran for the fire-hose only to find there was no water pressure owing to the power being off. The hoistman called the Cobalt fire department by telephone and informed the telephone operator to notify the mine supervision.

The deckman, A. Lileikis, noticed the loss of lights and power; then he saw the fire. Realizing there would be no air for a stench bomb he signalled a message of "Danger—Come up" to the men underground by hammering on the pipelines. By 11.15 P.M. all underground crew had reached surface.

The firemen, realizing they could not extinguish the burning oil-filled transformers, played water on the immediately adjacent buildings. The fire had burned itself out to controllable proportions by 12.30 A.M. Two men were left on duty with fire-extinguishers to watch for any embers that might ignite grass in the neighbouring area.

Reconstruction was started on the following morning (Sunday, July 4), and electric power was again available at 2.30 P.M. on Monday, July 5.

Pamour Porcupine Mines, Limited

No. 285

A fire of unknown origin occurred in the change-house of the Pamour Porcupine mine on July 8.

At 7.10 P.M. the dry man discovered clothing burning on two adjacent hanger hooks. He lowered the hangers to the floor and put out the flames with a soda-acid extinguisher and water. The clothing on both hooks was a total loss.

Algoma Ore Properties, Limited

No. 286

A fire occurred in the underground inclined conveyer-way at the Algoma Ore mine at about 4.30 P.M. on July 10.

The conveyer-way runs from the No. 1 crusher-room on the third level to surface, at an inclination of 18 degrees. A hoist car running on tracks parallel to the conveyer is used to service maintenance work on the conveyer belt.

MacDonald loaded oxygen and acetylene bottles, gauges, etc. on to the hoist car at the surface portal of the conveyer-way. The car was then lowered to No. 4 transfer station. Here MacDonald assembled the cutting torch, gauges, etc. and commenced cutting bolts on the conveyer-trough idlers. The car with the bottles was close by and sparks ignited acetylene at the bottle gauge. MacDonald attempted to shut off the main valve at the bottle but it was too hot. He used two 1-quart carbon-tetrachloride extinguishers, but they had no effect on the fire.

Hammett telephoned the hoistman at the portal to tell him of the fire.

MacDonald signalled to hoist the car to surface to get the fire out of the conveyer-way. When the car arrived at surface, L. Wood rolled the bottles out the door. The flames finally burned themselves out.

On examination it was found that the stem of the acetylene gauge was cracked, and the fusible plugs of the acetylene bottle had melted.

Madsen Red Lake Gold Mines, Limited

No. 287

At 8.40 A.M. on July 26, a small electrical fire occurred in the terminal box of the No. 3 Jeffery feeder in the Madsen Red Lake Gold Mines, Limited, crushing plant.

D. McClain, crusher foreman, discovered the fire when he was investigating a smell indicating that something was burning. He found that the insulation on the power cable in the terminal box of the No. 3 Jeffery feeder was burning, and he quickly extinguished it with a small carbon-tetrachloride extinguisher. Damage was very slight, and repairs were effected by cutting back cable and resplicing it.

On July 25, a severe electrical storm occurred at Madsen. It is thought that a charge of lightning going to ground through the power feed to the No. 3 Jeffery feeder caused a breakdown in the cable insulation, and that this condition resulted in a short circuit on July 26 causing the fire.

Sylvanite Gold Mines, Limited

No. 288

A small fire occurred on the 3,000-foot level in the No. 2 shaft at the Sylvanite mine on August 8 between the hours of 5.00 and 8.00 P.M.

The cagetender, K. Grahl, came on shift at 3.00 P.M. After hoisting muck until about 5.00 P.M. he started his mine pumps, including the 3,000-foot-level

pump, which is a 4- by 6-inch Triplex, belt-driven pump driven by a 7½-horsepower motor. After starting the pump the cagetender went back to hoisting muck. At about 8.00 P.M. he could smell smoke in the shaft and, on investigating, found the motor on the 3,000-foot level on fire and stopped. He ran for the station-level fire hose, which is nearby, and extinguished the fire in a few minutes. The base of this motor consisted of timbers. These timbers were found to be badly charred. Also, the motor belt and the motor pulley were completely burnt up.

On investigating the cause of the fire it was found that a defective 2-inch horizontal check valve on the pump-discharge line would only open to about a quarter of its capacity. This would cause the motor pulley to slip on the belt and overload the motor. On checking the starting box it was found that the overload relays were open, and the fuses were blown. There was no inflammable material at or near this motor other than the wood base.

Hollinger Consolidated Gold Mines, Limited

No. 289

A fire occurred at the central heating plant of the Hollinger mine at 3.45 A.M. on October 12.

J. Couchon, fireman, noticed flames coming into the building at a point where the steam line leaves for No. 11 shaft. He immediately informed T. Vennor, his supervisor, who had been called to the heating plant about an hour previously to repair a broken pin on the stoker.

Vennor investigated and found a wooden box on fire under the fly-ash collector. He extinguished the fire coming into the building with a water hose. He then took the hose outside, lifted a lid on the steam box outside the fly-ash collector, turned the water back into the box towards the building to prevent the fire from spreading along the box and under the roadway to No. 11 shaft, and then called J. Tiffany, plant-services supervisor.

When Tiffany arrived to assist Vennor, they made sure that the fire was out along the box toward the roadway, then made a check under the housing of the fly-ash collector where they found a portion of the box still burning. The box was partly torn down by them and the fire finally extinguished.

Investigating further, Tiffany noticed a large pile of fly ash under the clean-out door, most of which had accumulated since the end of the day shift on October 11. This fly ash was practically alive with fire.

On checking the collector closely, they found a large hole on the side of a short piece of 8-inch pipe located above the clean-out door and below the actual collector.

After switching from the large boiler stack, from which the fly-ash collector operates, to the small boiler, they extinguished the fire in the pile of fly ash.

The amount of damage done was very small.

Later investigation showed that the hole in the pipe was a result of an abrasion from the fly ash.

It has been recommended that a thorough study be made to ensure that the present clean out arrangement is proper for the installation, that wear-resisting steel be used and that the portion of the pipeline that passes under the fly-ash collector be insulated with fibre glass rather than a wood box and shavings.

Lake Shore Mines, Limited

No. 290

A small fire occurred underground at the Lake Shore mine, at about 8.15 P.M., on November 13.

The cagetender at No. 4 shaft, while engaged in clearing muck from the level loading pockets at the 7,700-foot level, smelled smoke. This shaft is an upcast airway. The cagetender went immediately to determine the cause of the smoke and found it to be on the 8,075-foot level. A coat, which was hanging on the south side of one of the station posts, and which belonged to one of the two men working on that level at the time, was burning. The fire was put out easily with the fire extinguisher that is kept at the station. Superficial damage was confined to the station post, which was slightly scorched.

Falconbridge Nickel Mines, Limited

No. 291

An electrical fire occurred in the 4,025-foot-level charging-station at No. 7 shaft of the Falconbridge mine, on November 18.

At about 1.45 A.M. smoke was noticed at No. 7 shaft in which the ventilation is upcast. H. Collison, shift boss, obtained a Chemox respirator and proceeded into the smoky area. He found about 3 feet of battery-charging cable smoldering in a section about 6 feet from the battery being charged. He shut off the power to the cable and, using a hand extinguisher, put out the fire.

Investigation revealed that the fire had started from a short circuit at a splice in the cable. A new cable has been installed.

McIntyre Porcupine Mines, Limited

No. 292

A small flash fire occurred in the No. 2 compressor (Bellis and Morcom) located at the No. 6 shaft compressor plant at 9.10 A.M. on November 30.

The compressor was shut down with the shut-off valve closed to the main air line. After arc-welding a short pipe nipple into the discharge line to install a Fenwal temperature control the pipe was left to cool about 20 minutes, then the compressor was started up. Within seconds, smoke was noticed coming from the by-pass line. The compressor was immediately stopped, and the fire burned out in a very short time. The line was dismantled, and it was found that the fire was confined solely to the 6-foot line between the high-pressure cylinder and the shut-off valve. No fire or smoke got into the receiver or the main air line.

Hollinger Consolidated Gold Mines, Limited

No. 293

A small fire occurred at the 800-foot level of the central shaft at the Hollinger mine at 6.20 P.M. on December 30.

Shortly after a previous visit, P. Violino, pumpman, smelt smoke and returned to the 800-foot level where he saw a fire in the pump station. The power was shut off on surface, and on returning he saw flames and heavy smoke. Violino and F. Prest, electrician, extinguished the blaze. The cause was attributed to water leaking on the belt drive of the pump. This belt is about 25 feet from pulley to pulley.

Damage was confined to the belt, which was replaced.

Castle-Trethewey Mines, Limited[1]

No. 294

An explosion occurred at about 11.00 A.M. on August 28, 1953, in the compressed-air system of the power plant at the Castle-Trethewey mine.

Damage was confined to the air line adjacent to the compressor. No person suffered injuries. Normal mine production was halted for five days.

Compressor-Plant Description.—The compressor, the only one in operation at the mine at the time of the mishap, is located in the surface hoist-room at the Capitol shaft. The compressor was manufactured by Babcock, Wilcox, Goldie, and McCulloch, Limited. It has a capacity of 1,500 cubic feet per minute and compresses to 100 pounds per square inch. The machine compresses in two stages and is driven directly by a 300-horsepower, 550-volt, 25-cycle, 300-revolutions-per-minute synchronous motor.

The intake for this compressor is screened with wire mesh but not filtered. Unloading is done by means of an intake unloader; thus the machine operates at two steps of load, either fully loaded or fully unloaded.

The intercooler is equipped with a valve arrangement to regulate the output of the compressor.

Safety valves are located at the intercooler, the high-pressure discharge, and at each of the two receivers. They are set at 115 pounds per square inch.

There are two air-pressure gauges indicating the high and low-stage pressures.

The cooling-water-discharge temperature is measured by a thermometer.

The air was discharged to two receivers in series through a 6-inch air line, which passed under a rock-filled road between the receivers and the hoist-room. This 6-inch line was fitted with a 6- by 6- by 4-inch, "T" connection that was directly flanged to the 6-inch discharge of the high-pressure cylinder. The 4-inch branch of this "T" was reduced to a 2-inch line supplying air to the whistle in the hoist-room.

Description of the Explosion.—C. Tassier, the hoistman on shift at the time of the explosion, reported that there seemed to be an upward movement of the horizontal, 6-inch, discharge air line adjacent to the high pressure cylinder, immediately after which the 6- by 6- by 4-inch "T" cracked. Considerable blue smoke issued from the cracked "T" and filled the hoist-room. The hoistman shut down the compressor.

Without delay the gate valve in the 6-inch line between the receivers and the shaft was closed, and the receivers blown down. Blue smoke was noted in the air issuing from the blow-down valves.

No one underground at the time reported smoke or odour from the compressed air. It is likely that most of the men underground were having lunch, and very little, if any, air was being used.

Condition of the Compressor and Lines After the Explosion.—The 6- by 6- by 4-inch cast-iron "T" was cracked on the under side. The crack was on the circumference of the 6-inch branch of the "T" and adjacent to the flange connected to the high-pressure cylinder.

No displacement of the 6-inch horizontal line was noted when the damaged "T" was disconnected and removed.

About three months previous to this explosion the high- and low-pressure valves had been removed. Considerable hard carbon was scraped from these valves. All valves were cleaned and repaired, and some parts replaced. After the explosion the valves were again found to have a considerable hard-carbon deposit. None of the valves were found to be broken, but some of the valve

[1]Complete details of this explosion were not received in time to be included in the 1953 report and are therefore given here.

springs were weakened owing to loss of temper and had to be replaced. This observation, and of course that of the smoke, seems to be the only concrete evidence of excessively high temperatures.

The high-pressure cylinder piston is equipped with three piston rings. All three rings were found broken when this piston was pulled after the explosion. The cylinder wall was worn and scuffed but not deeply scored. The wear and abrasion inflicted on the pieces of the piston rings and the ring grooves indicate that the rings, with the possible exception of the top ring, were broken for some time before the explosion. It may be possible that the top ring broke just before the explosion, thus permitting a leakage of the air back and forth between the piston and cylinder wall. This would be expected to quickly raise the temperature of the air in the cylinder and probably was the trigger to the explosion.

The low-pressure piston rod was worn considerably, which may have permitted crank-case oil to be carried into the low-pressure cylinder past the metallic gland around the piston rod, particularly when the machine was unloading at which time the low-pressure cylinder is under vacuum.

The low-pressure piston rings were badly worn but not broken.

The receivers were entered after the accident. A small amount of sludge was reported, and this was cleaned out.

No signs of excessive heat effects were noted around the safety valves or at any other part of the system.

Corrective Measures Taken.—The compressor was given a thorough overhaul.

The 6-inch line between the compressor high-pressure discharge and the receiver outside the shaft-house was re-routed from the underground to an overhead line above the roadway.

PROSECUTIONS

Regina *vs.* Donat Morin

A charge was laid against Donat Morin, a serviceman, employed at the Young-Davidson mine, as follows:

That Donat Morin, on or about the 18th day of June, 1954, in the township of Matachewan in the district of Timiskaming, did unlawfully hoist a person, to wit, Aurel Nadeau, in a steel bucket, in a raise, at the Young-Davidson mine, contrary to section 162, subsection 144, of the Mining Act of Ontario.

Without counsel, Morin pleaded not guilty on the grounds that his partner, the designated leader of the two servicemen, had instructed him to hoist him (Nadeau) in the bucket. Nadeau died from injuries when the bucket broke free from the hoisting cable and fell.

It was proven that Morin did operate the hoist at this time, and that he was aware that doing so was contrary to mine rules.

The case was heard on July 15, before Magistrate S. Atkinson. After adding up the costs of the case, $51.60, chargeable to Morin, the magistrate imposed an additional penalty of $10.00. The total amount of $61.60 was paid.

Regina *vs.* William Sylvestre

A charge was laid against William Sylvestre, an employee of Canadian Industries, Limited, at Copper Cliff, as follows:

That William Sylvestre at the town of Copper Cliff on the 9th day of September, 1954, did unlawfully enter upon the property of the International Nickel Company of Canada, Limited, to wit, the Copper Cliff smelter while under the influence of liquor, contrary to subsection 440 of Section 162, Part VIII of the Mining Act of Ontario.

Sylvestre pleaded not guilty before Magistrate W. F. Woodliffe at Sudbury on September 22. He was found guilty and a fine of $10.00 and costs was imposed. The fine was paid.

MINE RESCUE STATIONS

During the year, the training of teams in mine rescue and recovery operations was carried out in basic, standard, advanced, and supervisory classes.

The number of trained personnel available for emergencies, maintained by the mines in the various mining districts, is as follows:

Rescue station	Superintendent	Active	Reserve men	Trained supervisors	Apparatus men[1]	Total
Porcupine	A. K. Graham	147	6	28	15	
Kirkland Lake	G. E. Wilson	94	.....	43	36	.....
Cobalt	R. Eveson	40	.....	.....	.....	.....
Sudbury	H. G. Moorhouse / J. A. Peacock	173	23	96	.....	.....
Geraldton	John Lang	16	.....	7	.....	.....
Steep Rock	John Lang	22	.....	7	.....	.....
Helen	John Lang	20	.....	13	.....	.....
Renabie	John Lang	10	.....	.....	.....	.....
Red Lake	C. S. Culbert	49	.....	5	.....	.....
Pickle Lake	C. S. Culbert	9	.....	1	.....	.....
Total	.....	580	29	200	51	860

[1]Hoistmen, cagetenders, electricians, mechanics, and other specialists undergoing training in the wearing of breathing apparatus only.

The number of men who passed the necessary examinations during the year, and who were granted their Basic Certificates or Approval Seals is as follows:

Rescue station	Basic Certificate	Standard Seal	Advanced Seal	Supervisory Seal
Porcupine	43	11	.....	.....
Kirkland Lake	25	23	.....	15
Cobalt	25	8	.....	.....
Sudbury	48	4	.....	7
Geraldton[1]	25	20	.....	.....
Red Lake[2]	20	.....	.....	.....
Total	186	66	.....	22

[1]Geraldton figures include those of Steep Rock, Helen, and Renabie substations.
[2]Red Lake figures include those of Pickle Lake substation.

ONTARIO GOVERNMENT CABLE-TESTING LABORATORIES

The following table is a summary of the work accomplished during the year:

SUMMARY OF ROPE TESTS, 1954

Classification	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1954
Tests for Ontario mines	31	42	64	39	42	48	40	41	55	39	52	29	522
Special informative tests	16	.....	.....	.....	39	.....	6	1	28	7	.....	29	126
Tests for wire-rope manufacturers	14	12	34	27	14	44	24	28	23	23	35	29	307
Tests for mines outside Ontario	47	36	49	62	27	68	46	34	38	40	49	58	554
Tests for industries other than mining	.....	1	4	1	.....	5	3	.....	4	.....	12	.....	30
Other tests	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	108	91	151	129	122	165	119	104	148	109	148	145	1,539

Classes for Prospectors, 1954-55

By W. D. Harding

Interest in Classes Now Widespread

The revival of interest in prospectors' classes that marked the season of 1953–54 continued with increased vigor in 1954–55. Some of the causes of this interest are apparent; people everywhere are enthralled by the spectacular developments in uranium, and the search for this element proceeds unabated. Recent discoveries of base metals in the Manitouwadge and Tashota areas have added extra momentum to the growing interest. A record number of more than 50,000 claims was recorded in Ontario during the past year. These developments placed against Ontario's mineral background constitute a vivid reminder of the potential mining wealth of this province. The people of Ontario are more mineral conscious than ever before; interest in prospectors' classes was at a higher level than at any time since the 1930's.

Classes Held

During 1954–55, ten classes were conducted in Ontario as follows: Huntsville, Timmins, Geraldton, Port Arthur, Marathon, White River, Sudbury, Marmora, Toronto, and Kenora. The combined registration of these classes was 997. This compares favorably with the record season of 1932–33 when eighteen classes had a combined registration of 1,667.

All courses held during the past season, with the exception of those at Toronto and Geraldton, were of six days duration. At these two places the instruction was confined to five days.

The classes at Huntsville, Marathon, and White River were the first ever held in those communities. At Geraldton and Port Arthur the attendance was the highest on record for those towns. At most towns the classes were patronized by many individuals from surrounding communities. At several of the classes the registrations included people from the United States.

The accompanying table shows the towns at which the classes were held, together with details of attendance.

Particulars of Classes Held

Huntsville

The classes at Huntsville were held in response to a request from the rural community night school of that town; the preliminary arrangements were made by Mrs. Barbara Beardsley, its secretary-treasurer. It was the first time Ontario Department of Mines' prospectors' classes were held in Huntsville.

The instruction was carried out in the "Board Room" of the Ontario Department of Agriculture. This excellent accommodation was made available through the courtesy of W. D. Tupper of that department. The 53 who registered for the course exhausted the capacity of the class room. Many attended from various small communities in the surrounding area. A few had been engaged in part-time prospecting for uranium. Most members of the class were regular and punctual in attendance. Many questions were answered.

Timmins

As in former years the class at Timmins was held in the Municipal Chambers on Algonquin Avenue West. Stewart Ferguson, Ontario Department of Mines' resident geologist at Timmins, and J. Brady, president of the local branch of the Prospectors and Developers Association co-operated with the author in securing the hall and making other preparations. Dr. Ferguson also assisted with the instruction. Thirty-four registered for the course. Nearly all were from Timmins and the immediate vicinity. The largest evening attendance was 57. In view of the size of Timmins the class was small.

Geraldton

Classes were suspended during the Christmas season and were resumed at Geraldton in January. The course at Geraldton was conducted during the period January 10–14. It was held at the request of Roy Barker, well-known Manitouwadge prospector and mayor of Geraldton. The request was made on behalf of prospectors residing in Geraldton and the vicinity.

The classes were conducted in the Legion Hall. A group of 54 registered members constituted the largest class held in Geraldton since 1939. On most evenings the attendance was slightly over 100. This successful showing was probably due to the fact that Geraldton is situated close to both Manitouwadge and Marshall lakes, each the scene of recent staking rushes. The classes were attended by several well-known local prospectors.

Port Arthur

The classes at Port Arthur were an outstanding success. The attendance was the largest ever recorded in that city. Registrations totalled 168. The previous record was in 1926 when 100 persons presented themselves for instruction at a class held by the late E. L. Goodwin. Through the courtesy of the Port Arthur Library Board, the assembly room of the Public Library was again made available, without charge, as a classroom. This excellent accommodation was centrally situated, modern, and comfortable. Seats were available for more than 200. At most of the evening classes, however. all seats were filled and many remained standing. On two evenings some were turned away on account of the lack of accommodation. Many members of the class were residents of Fort William. Details of previous Ontario Department of Mines' classes held at Port Arthur show that the courses have consistently been well patronized. The residents of the Lakehead cities have for many years past shown keen interest in prospecting and mining.

E. G. Pye, Ontario Department of Mines' resident geologist at Port Arthur, gave the author every assistance in making preliminary arrangements. During one of the classes Dr. Pye gave an interesting description of the newly discovered Manitouwadge mineral field.

The final meeting of the class was devoted to a discussion of staking regulations. This discussion was ably directed by D. Cross, mining recorder at Port Arthur, who replied to numerous questions pertaining to the acquisition of mining claims.

Marathon

The first Ontario Department of Mines' prospectors classes held at Marathon (formerly the community of Peninsula) were conducted by the author during the period January 24–29, 1955.

Following the mineral discoveries in the Manitouwadge area in 1953, it was

suggested that classes at Marathon would serve a useful purpose. Marathon is a paper-mill town of about 2,000 inhabitants. It is the nearest town, of its size, to the Manitouwadge area, which, by road, lies about 60 miles distant.

The classes were held in the bright and comfortable "Lounge" of the Marathon Recreation Hall. Forty-eight registered for the course, but a much larger number attended the evening class meetings; several came from Heron Bay. The rocks and minerals of the Marathon section were discussed during the course.

The officers of the Marathon Paper company rendered every assistance to the writer and also extended many courtesies.

White River

The classes at White River were conducted at the suggestion of R. H. Hambly, resident district forester, of the Ontario Department of Lands and Forests. They were the first prospectors' classes ever held in this community. White River has a population of 500 or 600, but the attendance (53 registered) was much greater than has been recorded on many occasions in larger towns. The course was conducted in the "Board Room" of the Ontario Department of Lands and Forests warehouse situated on the outskirts of the village. Many prominent citizens of White River were in attendance. Gordon Connor, a member of the class, assisted the writer.

Sudbury

The attendance at the Sudbury classes was the highest on record; 102 were registered. This group included many residing in villages and other communities within the Sudbury area. On some evenings as many as 150 were in attendance. The previous attendance record at Sudbury was in 1954 when 85 registrations were received at a class held by the author.

The classes were conducted in the "Lounge" at the Canadian Legion Hall. The accommodation was comfortable and centrally situated but was found to be a little too small for the large number that patronized the evening classes.

At one of the evening periods, D. C. McKechnie, consulting geologist of Sudbury, described "Prospecting in Africa (Angola) and British Guiana." His interesting lecture was accompanied by coloured moving pictures depicting the prospecting methods used in each country.

J. R. McGinn, mining recorder at Sudbury, explained the staking regulations and answered many questions on the subject.

The course received considerable publicity from the local press.

Marmora

Classes were conducted by the author at Marmora during the period February 14–19, 1955. A request for a class at Marmora had been received during the fall of 1954 from H. R. Pearce, who was acting on behalf of the citizens of that community. Advertising and other arrangements were completed through the courtesy of Mr. Pearce. The class was held in the Parish Hall of St. John's Anglican Church. The location was central, and the accommodation very satisfactory. The course was well attended. Many came from outlying communities in the Marmora area, including Peterboro, Madoc, Havelock, Belleville, and Campbellford. A few members of the class came from New York and Pennsylvania. A large number had had some experience in prospecting or mining work.

PROSPECTORS' CLASSES, 1954–55

Place	Period of course	Registrations (accepted at) afternoon classes only)	Average daily attendance at afternoon classes	Average daily attendance at evening classes	Total student hours (all classes)	Number with experience in prospecting or mining	Number who have attended a previous class
	1954:						
Hunstville	Nov. 22–27	53	47.0	59.2	860	14	2
Timmins	Nov. 29–Dec. 4	34	27.3	53.4	595	29	8
	1955:						
Geraldton	Jan. 10–14	54	43.7	100.0	937	23	9
Port Arthur	Jan. 17–22	168	154.8	216.8	2,942	45	48
Marathon	Jan. 24–29	48	30.8	62.8	684	9	4
White River	Jan. 31–Feb. 5	53	29.8	39.0	551	5	2
Sudbury	Feb. 7–12	102	66.8	134.8	1,476	61	32
Marmora	Feb. 14–19	58	38.5	60.2	765	24	7
Toronto	Feb. 28–Mar. 4	338	233.2	355.2	4,098	115	53
Kenora	Mar. 14–19	89	58.8	92.6	1,165	29	21
Total		997			14,073	354	186

Toronto

The Toronto classes, as in recent years, were conducted jointly by the Ontario Department of Mines and the Prospectors and Developers Association. It attracted the largest group that has attended a class in this city since 1939. The course was conducted in the Mining Building, University of Toronto. On the opening day all seats were filled and, when the Hon. Philip T. Kelly, Minister of Mines, rose to extend a welcome, many were standing. On the same day at the evening class more than 100 were turned away through lack of seating capacity. At one of the evening classes, Viola MacMillan, President of the Prospectors and Developers Association, addressed the class on behalf of that organization.

Following the custom of past years, part of the instruction of the Toronto class was given by specialists. D. F. Hewitt, geologist, Ontario Department of Mines, delivered a lecture on "Uranium Minerals." R. V. Scott, Mining Recorder, and D. A. Moddle, Provincial Assayer, discussed respectively, "Ontario Staking Regulations" and "Assaying Methods." In addition, H. Seigel, consulting geophysicist, described the principal geophysical methods now in popular use in Ontario in the search for mineral. Also, Franc Joubin, Consulting Geologist, Toronto, and famous discoverer of the Blind River uranium ores, spoke on "Uranium in Canada."

At the conclusion of the course, many members of the class attended the convention of the Prospectors and Developers Association, which was held at the Royal York Hotel on the four days immediately following.

Kenora

As on previous occasions the classes at Kenora were held in the assembly room of the Public Library. Most of the 89 who registered for the class were residents of Kenora. Many class members however, came from surrounding places, including Keewatin, Norman, Dryden, Red Lake, Fort Frances, Minnesota, and Michigan. Considerable interest in prospecting has recently developed in the Kenora area. This interest may be attributed to mining activity relating to copper, nickel, and uranium. The reflection of this activity marked the attendance of the Kenora class, which was the largest since 1938. Many experienced prospectors were present.

INDEX, PART 1

Note.—All places referred to are in Ontario, unless otherwise designated.

A PAGE

Accidents, mining 67–83
Ackro Mines, Ltd. 56
Acmac Mining Corp., Ltd. 59
Acreage tax, revenue 62
A.D.2 gold claim, production 19
Adelaide tp., oil wells 50
Adhawl Gold Mines, Ltd. 60
Advocate Mines, Ltd. 56
Africa, gold production 39
Agaunico cobalt-silver m. 43, 78
Agawa gold m., production 16
Agricultural lime 54
Albion Pershing Gold Mines, Ltd. 60
Aldborough tp., petroleum 50
Alexander Oil and Gas Co., Ltd. 59
Algoma district.
  See also Sault Ste. Marie.
  Gold mines:
    dividends paid by 32
    labour statistics 38
    production ..... *facing* 10, 16, 17, 28
  Iron mg. 45
  Lead-zinc mg. 46
    silver from 43
Algoma Ore Properties 45, 79
Algoma Steel Corp., Ltd.
  See also Algoma Ore Properties.
  Blast furnaces 45, 46
  Silica brick 51
Algoma Summit gold m.
  See Magino g.m.
Alkins, A., gold production 18
Allstate Uranium Corp., Ltd. 56
Amalgamated Goldfields Corp., Ltd.
  Production 10
Amca gold m., production 10
American Eagle gold m., production 15
American Nepheline, Ltd. 50
American Yellowknife Mines, Ltd. 60
Amherstburg, salt 51
Anderson, R., gold production 20
Anthony Gas and Oil Explorations, Ltd. 56
Anvil Porcupine Gold Mines, Ltd. 60
Apamag Mines, Ltd. 59
Ardeen gold m., production 20
Area Mines, Ltd. 61
Argosy Drillers, Ltd. 56
Armour Uranium and Copper Mines, Ltd. 60
Arnoldi, M. G.
  Statistical Review by 1–66
Arsenic.
  Industry and statistics 2, 4, 44, 46
Asbestos.
  Industry and statistics 2, 4, 46
Ashley gold m., production 26
Asia, gold production 39
Assay fees 62
Assay Office, Provincial 64–66

PAGE

Athona Mines (1937), Ltd. 60
Atkinson, S. 83
Atlas gold m., production 26
Atlas Arsenic gold m., production 26
Atlas Steels, Ltd. 46
Atore Explorations, Ltd. 60
Aunor Gold Mines, Ltd.
  Dividends 29, 35
  Mill capacity 37
  Production ..... 10, *facing* 10
Australia, gold production 39

B

Bad (Champion) gold m., production ... 22
Baden-Powell gold m., production 22
Baldwin Kirkland gold m., production .. 14
Bamoos Lake Mines, Ltd. 56
Bankfield gold m., production 20
Bannockburn gold m., production 26
Baranouri Uranium Mines, Ltd. 59
Barclay Oil Co., Ltd. 60
Barium, production 7
Barker gold m., production 19
Barrentier Gold Mines, Ltd. 60
Barrentier Mines, Ltd. 60
Barry, P. A., gold production 24
Barry-Hollinger gold m., production 15
Base metals.
  See Copper; Lead; Nickel; Zinc.
Baseline Mines, Ltd. 56
Bathwick Mines, Ltd. 60
Bayham gas field, production 48
Beaverhouse Lake gold m., production.. 15
Becher gas and oil field 48–50
Bechuanaland, gold production 39
Belcher Mining Corp., Ltd. 60
Belgian Congo, gold production 39
Bennett tp., gold mg. 19
Berens River Mines, Ltd.
  Dividends 33, 35
  Production 24
Beryllium ore, production 4
Bethlehem Mines Corp. 61
Bickford gas field 48
Bidgood Kirkland gold m., production .. 15
Big Dipper gold m., production 26
Big Glen Mines, Ltd. 56
Big Jackpot Mines, Ltd. 60
Big Master gold m., production 22
Big Turtle River gold m., production ... 19
Bilmor Explorations, Ltd. 56, 59
Bismuth, production 4, 7, 44
Black Donald graphite m. 47
Black Jack gold m., production 22
Blast furnaces, iron 45
Blind River Uranium Mines, Ltd. 56
Blue clay 55
Bluegrass Raymond Mines, Ltd. 60
Bluegrass Uranium Mines, Ltd. 60

PAGE

Blueprints, revenue....62, 63
Bobjo gold m., production.... 24
Boerth gold m., production.... 26
Bonaventure Uranium Mines, Ltd.... 61
Bonetal gold m., production.... 11
Bonuses. *See* Dividends.
Bonwhit gold m., production....*facing* 10, 11
Book-Smith Oils, Ltd....56, 59
Botham gold m., production.... 23
Bothwell oil fields, production....49, 50
Boundary nickel m.... 42
Bourkes gold m., production.... 14
Bousquet gold m., production.... 18
Bracemac Mines, Ltd.... 56
Brady Lake silver m.... 43
Brant co.
  Natural gas.... 48
  Petroleum.... 49
Brazil, gold production.... 38
Brenbar gold m., production.... 20
Brick. *See* Clay products.
Brick, silica. *See* Silica brick.
Briscoe Bryce gold m., production.... 15
Britannia gold m., production.... 22
Britcana gold m., production.... 15
British Guiana, gold production.... 38
Brivel Explorations, Ltd....56, 59
Brooke tp., petroleum....49, 50
Broulan Porcupine Mines, Ltd.
  Dividends.... 35
Broulan Reef Mines, Ltd.
  Dividends....29, 35
  Mill capacity.... 37
  Production....*facing* 10, 11
Brownsville gas field.... 48
Brunner Mond Canada, Ltd.... 51
Buckles Algoma Uranium Mines, Ltd.... 56
Buffalo Ankerite Gold Mines, Ltd.
  Dividends....29, 35
  Mills, capacity.... 37
  Production.... 11
Buffalo Canadian Gold Mines, Ltd.... 61
Buf-Gaspe Mines, Ltd.... 56
Building industry, lime consumption.... 54
Building materials.
  See Structural materials.
Building stone. *See* Stone.
Bullet Hill Mining Co., Ltd.... 56
Burlington Steel Co., Ltd.... 46
Burning Rock Uranium Mines, Ltd.... 56
Burns gold m., production.... 13
Burrex Mines, Ltd.... 60

C

Cable testing.
  Fees, revenue.... 62
  Summary report on.... 84
Calcium....2, 4, 7, 46
Caledonia, gypsum.... 47
Calico Mines, Ltd.... 60
Calode Uranium Mining Co., Ltd.... 56
Calvan Consolidated Oil and Gas Co., Ltd.... 61
Calverly, G., gold production.... 16
Camdeck Gold Mines, Ltd.... 60
Camdeck Mines, Ltd.... 60
Camden gore, natural gas.... 48
Camden tp., petroleum.... 50
Cameron Island gold m., production.... 22
Cameroons, gold production.... 39

PAGE

Camp Bay gold m., production.... 22
Campbell Red Lake Mines, Ltd.
  Dividends....33, 35
  Mill capacity.... 37
  Production....*facing* 10, 24
Canada, gold production.... 38
Canada Cement Co., Ltd.... 53
Canada Radium Corp., Ltd.... 59
Canada Talc Industries, Ltd.... 52
Canadian Carborundum Co.... 46
Canadian Copper Co., Ltd.... 40
Canadian Electric Castings, Ltd.... 46
Canadian Furnace Co., Ltd....45, 46
Canadian Goldfields gold m.... 27
Canadian Gypsum Co., Ltd.... 47
Canadian Industries, Ltd.... 52
Canadian Johns-Manville Co., Ltd.... 46
Canadian Lithium Co., Ltd.... 60
Canadian Lithium Mining Corp., Ltd.... 57
Canadian Shell Explorations, Ltd.... 59
Canadian Silica Corp., Ltd.... 51
Can-Met Explorations, Ltd.... 60
Cantab Mines, Ltd.... 57
Canusa gold m., production.... 11
Car Lake Syndicate, gold production.... 24
Caramora Porcupine gold m., production 15
Cassmill Exploration Co., Ltd.... 57
Castle-Trethewey Mines, Ltd....45, 82
Castlebar Silver and Cobalt Mines, Ltd. 57
Cathroy Larder gold m., production.... 15
Cavendish Uranium and Mining Co., Ltd.... 57
Cavendish Uranium Mines, Ltd.... 61
Cedar Island gold m., production.... 22
Cement products.
  Industry and statistics....3, 5, 53
Central America, gold production.... 38
Central Canada gold m., production.... 19
Central Guiana Exploration Co., Ltd.... 57
Central Patricia Gold Mines, Ltd.
  Dividends....33, 35
  Mill capacity.... 37
  Production.... 24
Ceramic industry. *See* Clay products.
Champion gold m., production.... 22
Chatham tp., natural gas.... 48
Chemical fees, revenue.... 62
Chemical industries.
  Lime consumption.... 54
Chemical laboratories.
  See Provincial Assay Office.
Chesterville Larder Lake Gold Mg. Co.
  Dividends....33, 35
  Production.... 15
Chile, gold production.... 38
Chip Mines, Ltd.... 59
Chippawa, ferro-alloy plant.... 46
Chromite, statistics.... 7
Chromium Mining and Smelting Corp., Ltd.... 46
Chyka Mines, Ltd.... 57
Cinch Lake Uranium Mines, Ltd.... 60
Claims, mining, statistics....8, 9
Clark gold m., production.... 22
Clay pits, accidents in....69–74
Clay products.
  Industry and statistics....3, 5, 6, 55, 56
Claybar Uranium and Oil, Ltd.... 60
Claymac Mines, Ltd.... 57
Cleveland gold m., production.... 26

PAGE

Clifton gold m., production..... 11
Cline Lake Gold Mines, Ltd.
Dividends.....32, 35
Production..... 16
Clyne, P., gold production..... 12
Cobalt (mineral).
Industry and statistics.....2, 4, 7, 43–45
from nickel ores.....40, 41
Cobalt area, rescue station..... 84
Cobalt Chemicals, Ltd..... 43
Cobalt Coleman Mining Syndicate, Ltd. 57
Cobalt Consolidated Mining Corp., Ltd.....43, 78
Cobalt Frontenac gold m., production... 26
Cobalt Lode silver m..... 43
Cochenour Marcus Gold Mines, Ltd.... 57
Cochenour Willans Gold Mines, Ltd.
Dividends.....33, 35
Mill capacity..... 37
Production.....*facing* 10, 24
Cochrane district
Gold mg. *See* Porcupine g. belt.
Colborne Natural Gas, Ltd..... 57
Colinville gas field..... 48
Colombia, gold production..... 38
Colonial silver m..... 43
Combined gold m., production..... 22
Concor-Chibougamau Mines, Ltd..... 57
Concordia gold m., production..... 22
Cone, Russell, gold production..*facing* 10, 19
Confederation Mining Corp., Ltd..... 61
Congo, gold production..... 39
Coniaurum Mines, Ltd.
Dividends.....29, 35
Fire at mine..... 74
Mill capacity..... 37
Production.....*facing* 10, 11
Consolidated Bi-Ore Mines, Ltd..... 57
Consolidated Denison Mines, Ltd..... 60
Consolidated Dragon Oils, Ltd..... 60
Consolidated Howey Gold Mines, Ltd.
See also Howey g.m.
Dividends.....33, 35
Consolidated Matarrow Mines, Ltd..... 60
Consolidated Mosher Mines, Ltd..... 60
Consolidated Northland Mines, Ltd..... 60
Consolidated Sudbury Basin Mines, Ltd. 60
Consolidated West Dome Lake gold m.
Production..... 11
Construction contracts, statistics.....52, 53
Contact Bay gold m., production..... 23
Cook Lake gold m., production..... 20
Cook Land gold m., production..... 26
Cooper, W. D., gold production..... 24
Copa Mining Corp., Ltd..... 60
Copper.
From silver ores..... 44
Industry and statistics.....2, 4, 7, 40–42
Mines. *See* Nickel, mines.
Prices..... 8
Refineries. *See* Nickel.
Copper Cliff, acid plant..... 52
Copperanium Mines, Ltd..... 57
Cordova gold m., production..... 27
Cornucopia gold m., production..... 22
Corunna oil field.....49, 50
Cossitt Petroleums, Ltd.....57, 59
Coveney, M. J., gold production..... 20
Craig gold m., production..... 27
Craskie Mines, Ltd..... 57

PAGE

Crean Hill nickel m..... 42
Creighton nickel m..... 42
Crescent gold m., production..... 27
Cross, J. G., gold production..... 22
Crowland Gas, Ltd.....57, 59
Crown Point gold m., production..... 22
Crystal gold m., production..... 18
Culbert, C. S..... 84
Curtin Prospecting Syndicate.
Gold production..... 18

D

Damascus gold m., production..... 22
Dante oil field..... 49
Darkwater gold m., production..... 22
Darwin gold m., production..... 16
Davidson gold m., production..... 11
Dawn tp.
Natural gas..... 48
Petroleum..... 49
Declute gas field..... 48
Deep Lake gold m., production..... 16
Delmico Mines, Ltd..... 57
Delnite Mines, Ltd.
Dividends.....30, 35
Mill capacity..... 37
Production.....*facing* 10, 11
Deloro gold m., production..... 27
Deloro Smelting and Ref'g. Co., Ltd.... 46
Department of Highways.
Sand and gravel production..... 54
De Santis gold m., production..... 11
Detroit Syndicate, gold production..... 16
Devon gold m., production..... 11
Diamond-drilling operations.
Accidents in.....69, 70
Employees..... 73
Diatomite..... 4
Diatomite Minerals and Fertilizer, Ltd.....57, 59
Dickens Uranium and Development Corp..... 61
Dickenson Red Lake gold m.
See New Dickenson Mines.
Dividends and bonuses.
Gold mines.....7, 29–36
Nickel-copper mines.....7, 40, 41
Silver-cobalt mines..... 7
Dolmac Mines, Ltd..... 57
Dome Mines, Ltd.
Dividends.....30, 35
Mill capacity..... 37
Production.....*facing* 10, 11
Dominion Foundries and Steel, Ltd....45, 46
Dominion Magnesium, Ltd..... 46
Dominion Uranium Corp..... 61
Don Henry Uranium Mines, Ltd..... 57
Dover tp.
Natural gas..... 48
Petroleum.....49, 50
Dragon Oils and Gas, Ltd..... 60
Dredging, sand and gravel..... 54
Drilling. *See* Diamond-drilling.
Dunwich tp., petroleum..... 50
Dupel Mines, Ltd..... 60
Durecon Explorations, Ltd..... 57
Durham Explorations, Ltd..... 60
Durham Red Lake Gold Mines, Ltd.... 60
Dutch Guiana. *See* Surinam.
Duthill gas field..... 48

E

PAGE

East Rim Nickel Mines, Ltd.....42, 60
Eastern-Northern Explorations, Ltd..... 57
Eastern Ontario mg. division..... 9
Ebor Uranium Mines, Ltd..... 57
Ecuador, gold production..... 38
Edward, P., gold production..... 17
Edwards gold m., production..... 17
Eldorado gold m., production..... 22
Electric accidents.....72–74
Electro-Metallurgical Co. of Canada, Ltd.....46, 51
Elgin co.
  Natural gas..... 48
  Petroleum.....49, 50
Elgin Oils (Bradford), Ltd.....57, 59
Elizabeth gold m., production..... 19
Ellice tp., peat..... 51
Elmos gold m., production..... 20
Elora gold m., production..... 22
Emo Nickel Mines, Ltd..... 60
Empire gold m., production..... 22
Employment. *See* Labour statistics.
Empress gold m., production..... 20
Endeavor Mining Corp., Ltd..... 60
Energy Mines, Ltd..... 57
Enniskillen tp.
  Natural gas..... 48
  Petroleum..... 50
Ensign gold m., production..... 18
Erie Enterprises and Petroleums, Ltd..57, 59
Escarpment Oils, Ltd..... 57
Esquesing tp., natural gas..... 50
Essex co.
  Natural gas..... 48
  Petroleum.....49, 50
Ethiopia, gold production..... 39
Euphemia tp., petroleum..... 50
Europe, gold production..... 39
Eveson, R..... 84
Exchange, monetary.....7, 8
Exolon Company, Ltd..... 46
Expenditures, mining..... 62
Explosives, accidents from.....71, 72, 74
Extra-Provincial companies licensed.... 61

F

Fahralloy Canada, Ltd..... 46
Falconbridge Nickel Mines, Ltd.
  Dividends..... 40
  Fire at mine..... 81
  Operations..... 42
Fano Uranium Mines, Ltd..... 57
Farcroft Mines, Ltd..... 60
Fatalities, mining.....67–72
Fathom Drilling, Ltd..... 61
Faymar gold m., production..... 11
Fecunis Lake nickel m..... 42
Fees, recording, etc., revenue.....62, 63
Feldspar.
  Industry and statistics.....2, 4, 47
Felmont Oil Corp..... 61
Fermoy Lead Mines, Ltd..... 57
Ferro-alloys, producers listed..... 46
Fiji, gold production..... 39
Fires at mines.....74–83
Fitzpatrick Uranium Mines, Ltd..... 57
Five Canucks Exploration, Ltd..... 60
Flash Petroleums, Ltd.....57, 59
Flightway Explorations, Ltd..... 59
Floranda Mines, Ltd..... 59

PAGE

Fluorspar.
  Industry and statistics.....2, 4, 47
Foley gold m., production..... 19
Ford Motor Co. of Can., Ltd.
  Steel plant..... 46
Formosa, gold production..... 39
Fort Frances mg. division.
  Recorder's report.....9, 63
French Africa, gold production..... 39
French Cameroons, gold production.... 39
French Guiana, gold production..... 38
Frobisher, Ltd..... 47
Frood-Stobie nickel m..... 42

G

Gaff Mines, Ltd..... 57
Garnet rock, production..... 4
Garrison Creek Consolidated Mines, Ltd..... 59
Garson nickel m..... 42
Gas. *See* Natural gas.
Gatling Pearce gold m., production..... 27
Gavan Mines, Ltd..... 57
Geoil, Ltd..... 57
Geraldton.
  Classes for prospectors.....86, 88
  Mine rescue station..... 84
Gerido Lake Mines, Ltd..... 59
Gill Uranium Mines, Ltd..... 57
Gillies Lake–Porcupine gold m.
  Production..... 11
Gilmour gold m., production..... 27
Glass Reef gold m., production..... 22
Glencoe oil field.....49, 50
Goderich, salt..... 51
Gold.
  Industry and statistics....1, 2, 4, 7, 10–39
    labour..... 38
    milling, lime consumption..... 54
      plants, capacities..... 37
    price..... 8
    production and value.....2, 4, 7
      by areas.....*facing* 10, 11–29
      from nickel-copper ores.....*facing* 10, 41, 42
      world.....38, 39
  Mines:
    dividends paid by.....7, 29–36
    non-producing, notes on..... 10
    production. *See above.*
Gold Coast, gold production..... 39
Gold Eagle Gold Mines, Ltd.
  Dividends.....33, 35
  Production..... 24
Gold Hill gold m., Ken., production.... 22
Gold Hill gold m., Tim., production.... 15
Gold Panner gold m., production..... 22
Gold Pyramid gold m., production..... 14
Gold Range gold m., production..... 20
Gold Reef gold m., production..... 11
Gold Rock gold m., production..... 22
Gold Winner gold m., production..... 19
Golden Crescent gold m., production.... 19
Golden Horn gold m., production..... 23
Golden Reed gold m., production..... 17
Golden Star gold m., production..... 19
Golden Summit gold m., production.... 14
Golden Whale gold m., production..... 23
Goldhawk gold m., production..... 11
Gomak gold m., production..... 18

PAGE

Grace gold m., production 22
Graham, A. K. 84
Granite. *See* Stone.
Graphite.
  Industry and statistics 2, 4, 47
Gravel. *See* Sand and gravel.
Great Shield Uranium Mines, Ltd. 57
Great Sweet Grass Oils, Ltd. 60
Greenray gold m., production 18
Greenstone Mines, Ltd. 57
Greenwich Lake Uranium Mines, Ltd. 57
Gripp Lake Mines, Ltd. 57
Guelph, steel plant 46
Guiana (British; Dutch; French).
  Gold production 38
Gunnar Mines, Ltd. 60
Gusto Mines, Ltd. 57
Gypsum, industry and statistics 2, 4, 47

H

Hagersville, gypsum 47
Halcrow-Swayze gold m., production 18
Haldimand co. natural gas 48
Haley Station, magnesium plant 46
Hallnor Mines, Ltd.
  Dividends 30, 35
  Mill capacity 37
  Production ..... *facing* 10, 12
Halo Uranium Mines, Ltd. 57
Halton co., natural gas 50
Hamason Mines, Ltd. 57
Hamilton, iron industry 45, 46
Hammond Reef gold m., production 19
Hard Rock Gold Mines, Ltd.
  Dividends 32, 35
  Production 20
Harding, W. D. 85
Hardy nickel m. 42
Harkness-Hays gold m., production 20
Harold Lake gold m., production 19
Harrison-Hibbert Mines, Ltd. 43
Harvey Kendrick Development, Ltd. 57, 59
Harwich tp., natural gas 48
Hasaga gold m., production 24
Hastings co.
  Fluorspar mg. 47
  Gold mg. *See* Craig, Gilmour, Old Diamond g. mines.
  Talc mg. 52
Havilah gold m., production 17
Haydite, production 3, 5, 55, 56
Hayward Tyler of Canada, Ltd. 46
Helen iron m. 45
  Rescue station 84
Hermiston, N. A., gold production 12
Hiawatha gold m., production 17
Higgins Uranium Mines, Ltd. 57
Hill Gold gold m., production 12
Hollinger Consolidated Gold Mines, Ltd.
  See also Hollinger, Ross, Young-Davidson g. mines.
  Dividends 30, 35
Hollinger gold m.
  See also Hollinger Consol. Gold Mines.
  Fires at 75–77, 80, 81
  Mill capacity 37
  Production ..... *facing* 10, 12
Hosco Gold Mines, Ltd. 60
Howard Roberts Exploration, Ltd. 57

PAGE

Howard tp.
  Natural gas 50
  Petroleum 50
Howey gold m.
  See also Consol. Howey Gold Mines.
  Production 24
Hoyle gold m., production 12
Hucamp Mines, Ltd. 59
Huddlestone, J., gold production 12
Hudson Bay lowlands.
  Gas and oil leases 50
Hudson Patricia gold m., production 24
Hugh-Pam Porcupine Mines, Ltd.
  Dividends 30, 35
  Production ..... *facing* 10, 12
Hughes gold m., production 12
Huntingdon Fluorspar Mines, Ltd. 47
Huntsville, classes for prospectors 85, 88
Husky Oil and Refining, Ltd. 61

I

Incorporations of mining companies 56–61
Independence gold m., production 19
India, gold production 39
Intercounty Natural Gas Co., Ltd. 59
International Lithium Mining Corp., Ltd. 57
International Nickel Co. of Can., Ltd.
  Dividends 40
  Operations 42
Iridium, production 42
Iron and steel industry 45, 46
  Lime consumption 54
  Statistics 2, 4, 7, 45
Iron Bay Mines, Ltd. 57
Iron Bridge Explorations, Ltd. 57
Iron mines.
  Fatal accidents in 71
  Operations 45

J

Jackpot Uranium Mines, Ltd. 60
Jalaweg Explorations, Ltd. 57, 59
Jamestown, sinter plant 45
Japan, gold production 39
Jardun Mines, Ltd. 43, 46
Jason Mines, Ltd. *See* New Jason Mines.
Jellicoe gold m., production 20
Jem Exploration Corp., Ltd. 57
Jerome gold m., production 18
J-M Consol. gold m., production 24
Jonsmith Mines, Ltd. 42

K

Kelly-Desmons Mining Corp., Ltd. 57
Kemp Uranium Mines, Ltd. 61
Kendrick Development, Ltd., Harvey 57, 59
Kenlew Mines, Ltd. 57
Kenmac Chibougamau Mines, Ltd. 61
Kennedy, Wm., and Sons, Ltd. 46
Kenora, classes for prospectors 88, 89
Kenora district.
  See also Patricia portion.
  Gold mines:
    dividends paid by 32
    production ..... *facing* 10
    statistics 22, 23, 29
Kenora mining division.
  Recorder's report 9, 63
Kenricia gold m., production 22

PAGE
Kent co.
Natural gas ... 48
Petroleum ... 49, 50
Kenty gold m., production ... 18
Kenty, Martin, gold m., production ... 23
Kenya, gold production ... 39
Kerr-Addison Gold Mines, Ltd.
Dividends ... 33, 35
Mill capacity ... 37
Production ... *facing* 10, 16
Kerr Lake silver m. ... 43
Killala Lake Mines, Ltd. ... 57
Killarney, quartzite ... 51
Kimball gas and oil field ... 48–50
Kingsville gas field ... 48
Kinloch Mines, Ltd. ... 57
Kinmount Uranium Mines, Ltd. ... 57
Kirkland Golden Gate g. m., production 14
Kirkland Lake, rescue station ... 84
Kirkland Lake gold belt.
Dividends paid by mg. companies ... 31, 34
Gold production ... *facing* 10
statistics ... 14, 15, 27
Labour statistics ... 38
Mills, capacities ... 37
Silver production ... *facing* 10
Kirkland Lake Gold Mining Co., Ltd.
Dividends ... 31, 35
Mill capacity ... 37
Production ... *facing* 10, 14
Kitchener, steel plant ... 46
Korea, gold production ... 39
Kowkash mining division ... 9
Kremzar gold m., production ... 17

L

Labour statistics.
Asbestos ... 2, 46
Calcium and magnesium ... 2, 46
Cement ... 3, 53
Clay products ... 3, 55
Diamond-drilling ... 73
Feldspar ... 2
Fluorspar ... 2, 47
Gold ... 2, 10, 38
Graphite ... 2
Gypsum ... 2, 47
Iron industry ... 2, 45
Lead-zinc ... 2, 46
Lime ... 3, 53
Mica ... 2
Mines ... 67, 72
Natural gas ... 2
Nepheline syenite ... 2, 50
Nickel-copper mines, smelters, and refineries ... 2, 40, 41
Peat ... 2
Petroleum, crude ... 2
Quartz and quartzite ... 2, 51
Salt ... 3, 51, 52
Sand and gravel ... 3, 54, 73
Sand-lime products ... 3, 54
Silica brick ... 2, 51
Silver-cobalt mines, smelters, and refineries ... 2, 43
Stone ... 3, 55
Structural materials ... 3, 73
Talc ... 3, 52
Laco Mines, Ltd. ... 57
Ladoric Mines, Ltd. ... 61
Lake Cinch Mines, Ltd. ... 60

PAGE
Lake Huron.
Gas and oil leases ... 50
Lake Kaginu Mines, Ltd. ... 57
Lake Lauzon Mines, Ltd. ... 58
Lake Nordic Uranium Mines, Ltd. ... 58
Lake St. Clair.
Gas and oil leases ... 50
Lake Shore Mines, Ltd.
Dividends ... 31, 35
Fire at mine ... 81
Mill capacity ... 37
Production ... *facing* 10, 14
Lake Superior Iron, Ltd. ... 61
Lakeland Natural Gas, Ltd. ... 59
Lambton co.
Natural gas ... 48
Petroleum ... 49, 50
Landover Oils and Mines, Ltd. ... 60
Lang, John ... 84
Lapaska Mines, Ltd. ... 60
Larder Lake gold area.
Dividends paid by mg. companies ... 33, 34
Gold production ... *facing* 10, 15, 16, 27
Labour statistics ... 38
Milling plant, capacity ... 37
Silver production ... *facing* 10
Larder Lake mining division.
Recorder's report ... 9, 63
Larkspur Oil Co., Ltd. ... 58
La Rose silver m. ... 43
Laurentian gold m., production ... 22
Lawson silver m. ... 43
Lead.
Production ... 2, 4, 7, 46
from silver ores ... 44
Leamington gas field ... 48
Leases, mining, revenue ... 62, 63
Lebel Oro gold m., production ... 18
Ledyard gold m., production ... 27
Leitch Gold Mines, Ltd.
Dividends ... 32, 35
Mill capacity ... 37
Production ... *facing* 10, 20
Le Moyne Explorations, Ltd. ... 59
Levack nickel m. ... 42
Liberia, gold production ... 39
Licences.
Miners' ... 9, 62, 63
Of occupation ... 62, 63
Sand and gravel ... 62
Lime, industry and statistics ... 3, 5, 53, 54
Limestone, statistics ... 3, 5, 45, 55
Lincoln co., natural gas ... 48
Lionite Abrasives, Ltd. ... 46
Little Doris gold m., production ... 27
Little Long Lac Gold Mines, Ltd.
Dividends ... 32, 35
Mill capacity ... 37
Production ... *facing* 10, 20
Longvack nickel m. ... 42
Lucky Coon gold m., production ... 19
Lunward gold m., production ... 22
Lyndhurst Mining Co., Ltd. ... 61

M

Macassa Mines, Ltd.
Dividends ... 31, 35
Mill capacity ... 37
Production ... *facing* 10, 14
Mac-Auer gold m., production ... 18
McDonald, N., gold production ... 24

PAGE

McDonald, R., gold production 24
Mace gold m., production 12
McIntyre Porcupine Mines, Ltd.
Dividends 30, 35
Fires at mine 78, 81
Mill capacity 37
Production ..... *facing* 10, 12
McKenzie Red Lake Gold Mines, Ltd.
Dividends 33, 35
Mill capacity 37
Production ..... *facing* 10, 24
McKim nickel m., operations 42
McLaren-Porcupine g. m., production ... 12
MacLeod-Cockshutt Gold Mines, Ltd.
Dividends 32, 35
Mill capacity 37
Production ..... *facing* 10, 20
McMarmac Red Lake Gold Mines, Ltd.
Dividend 33, 36
Production 24
McMartin, J. B., gold production 20
McMillan gold m., production 18
Macu Mines, Ltd. 58
Madasgascar, gold production 39
Madsen Red Lake Gold Mines, Ltd.
Dividends 33, 36
Fire at mine 79
Mill capacity 37
Production ..... *facing* 10, 24
Magino gold m., production 17
Mag-Iron Mining and Milling, Ltd. 45
Magnesium.
Industry and statistics 2, 4, 7, 46
Magnet Consolidated Mines, Ltd.
Dividends 32, 36
Mill capacity 37
Production 20
Magoma Mines, Ltd. 58
Malahide gas field 48
Maloney Sturgeon g. m., production 20
Mancore Explorations, Ltd. 59
Man-Echo Mines, Ltd. 58
Manilake Mines, Ltd. 60
Manitou gold m., production 19
Manitoulin Island, quartzite 51
Man-Lun Mines, Ltd. 58
Marathon, classes for prospectors 85–88
Marble. *See* Stone.
Marbuan gold m., production 12
Marban Lake Uranium Mines, Ltd. 58
Marmora, classes for prospectors 87, 88
Martin Kenty gold m., production 23
Matachewan Consolidated Mines, Ltd.
Dividends 31, 36
Mill capacity 37
Production ..... *facing* 10, 26
Matachewan gold area.
Copper 40
Gold mg.:
dividends paid by companies 31
labour statistics 38
mills, capacities 37
production ..... *facing* 10, 26, 28
Silver ..... *facing* 10, 43
Matarrow Mines, Ltd. 60
Matinenda Uranium Mines, Ltd. 59
Mauranium Metal Mining Synd., Ltd. ... 58
Mayboro gold m., production 27
Maygill Petroleum Co., Ltd. 61
Maylac gold m., production 20

PAGE

Mensilvo Mines, Ltd. 43
Merchants Gas Co., Ltd. 58, 59
Metallic minerals.
Industry and statistics 1–46
Metallurgical works.
Accidents in 68–74
Employees 73
Lime consumption 54
Metcalfe tp., petroleum 50
Metro Minerals, Ltd. 60
Mexico, gold production 38
Mica, industry and statistics 2, 4, 48
Mi-Con Exploration and Consultant, Ltd. 58, 59
Middlesex co.
Natural gas 48
Petroleum 49, 50
Mikado gold m., production 23
Mildred Exploration and Investments, Ltd. 58, 59
Miller Independence gold m. 16
Milmine Mining Syndicate, Ltd. 58
Milnet Mines, Ltd. 42
Mine rentals, revenue 62, 63
Mine rescue stations 84
Mineral water.
Industry and statistics 2, 4, 48
Miner's licences and permits.
Statistics 9, 62, 63
Minerva gold m., production 23
Mining accidents, report on 67–83
Mining claims, statistics 8, 9, 62, 63
Mining company incorporations 56–61
Mining divisions.
Claims recorded in 9
Revenue from 62, 63
Mining expenditure 62
Mining lands, sales, of, revenue 62, 63
Mining revenue 62, 63
Minnesota Mining and Manufacturing of Canada, Ltd. 61
Minto gold m., production 17
Miramichi Mines, Ltd. 58
Moddle, D. A. 65, 89
Moffatt-Hall gold m., production 14
Mogul Gold Mines, Ltd. 60
Mogul Mining Corp., Ltd. 60
Molybdenum, production 7
Moncton Mining Corp., Ltd. 59
Mond Nickel Co. 40
Moneta Porcupine Mines, Ltd.
Dividends 30, 36
Production 12
Montoco Petroleums, Ltd. 60
Montreal River mining division.
Recorder's report 9, 63
Moon Lake Uranium Mines, Ltd. 58
Moore tp., petroleum 50
Moorhouse, H. G. 84
Morin, Donat 83
Morris Kirkland gold m., production ... 14
Mosa tp., petroleum 50
Mosald gas field 48
Mount Nickel nickel m. 42
Mount Petroleum Corp. of Canada, Ltd. 61
Multiwin Explorations, Ltd. 58
Munro Croesus gold m., production 12
Munro tp., asbestos 46
Murray nickel m. 42

N PAGE

Nakhodas gold m., production 12
Nama Creek Mines, Ltd. 58
Naneek Mines, Ltd. 60
Natural gas.
  Industry and statistics 2, 4, 48–50
  Revenue from leases and permits 62
Naybob Gold Mines, Ltd.
  Dividend 30, 36
  Production 12
Nellie Lake Metal Mines, Ltd. 58
Nello Mining, Ltd. 60
Neoscope Explorations, Ltd. 58, 59
Nepheline syenite.
  Industry and statistics 2, 4, 50
Nesnorm Explorations, Ltd. 59
New Athona Mines, Ltd. 60
New Dickenson Mines, Ltd.
  Dividends 33, 36
  Mill capacity 37
  Production ..... *facing* 10, 25
New Golden Rose g. m., production 18
New Guinea, gold production 39
New Hosco Mines, Ltd. 60
New Jason Mines, Ltd.
  Dividends 33, 36
  Mill capacity 37
  Production 25
New Morrison Mines, Ltd. 45
New Mosher Longlac Mines, Ltd. 60
New Ryan Lake Mines, Ltd. 40, 43
New Taku Mines, Ltd. 60
New Telluride g. m., production 16
New Vinray Mines, Ltd. 60
New York, U.S.
  Funds, buying rate for 8
  Metal prices at 8
New Zealand, gold production 39
Newray gold m., production 13
Niagara Falls, ferro-alloy plants 46
Nickel.
  From silver ores 44
  Industry and statistics 2, 4, 7, 40–42
  Mines:
    dividends paid by 7, 40, 41
    fatal accidents in 71
    operations 42
  Refineries:
    precious metals from ..... *facing* 10, 42
    statistics 2, 41
Nickel Offsets, Ltd. 42
Nickel Rim Mines, Ltd. 42, 60
Nigeria, gold production 39
Night Hawk Peninsular gold m. 13
Nipissing-O'Brien Mines, Ltd. 43
Non-metallic minerals.
  Industry and statistics 1–6, 46–52
Norart Uranium and Gold Mines, Ltd. 58
Noreagle Uranium Mines, Ltd. 58
Norfolk co., natural gas 48
Norgold gold m., production 17
Normingo Mines, Ltd. 58
North Denison Mines, Ltd. 60
North Lake Mines, Ltd. 58
North Rankin Nickel Mines, Ltd. 60
North Shores gold m., production 21
North Star Oil, Ltd. 61
Northcrown gold m., production 13
Northdale Mining and Exploration, Ltd. 58

PAGE

Northern Empire Mines Co., Ltd.
  Dividends 32, 36
  Gold production 20
Northern Ontario Natural Gas Co., Ltd. 59
Northern Turnbull g. m., production 13
Northern Uranium Mines, Ltd. 58
Northland Mines (1940), Ltd. 60
Northwestern Ontario.
  See also Kenora dist.; Patricia portion; Rainy River, Thunder Bay dists.
  Gold mg. companies, dividends paid by 34
Norton Co. 46
Norwalk gold m., production 17
Norwich gas field, production 48
Nueva Exploration Co. 61
Numalake Mines, Ltd. 60

O

Oceania, gold production 39
Oceanic Iron Ore of Canada, Ltd. 58
Oil. *See* Petroleum.
Oil Springs oil field 49, 50
Oka Rare Metals Mining Co., Ltd. 58
Okleco Mines, Ltd. 59
Old Diamond gold m., production 27
Olive gold m., production 19
Olympia gold m., production 23
Omega gold m., production 16
Onondaga tp., petroleum 49
Ontario Cable-Testing Laboratories 84
Ontario-Kirkland g. m., production 14
Ontario Pyrites Co., Ltd. 60
Ontario Rare Metal Mines, Ltd. 58
Opasatika Iron Mines, Ltd. 61
Oreland Mining Corp. 61
Orford tp., petroleum 50
Orillia, iron industry 46
Ormsby Mines, Ltd. 58
Owen Sound, iron industry 46
Oxford co., natural gas 48

P

Pago Mining, Ltd. 58
Palladium, production 42
Pamour Porcupine Mines, Ltd.
  Dividends 30, 36
  Fires at mines 76, 79
  Mill capacity 37
  Production ..... *facing* 10, 13
Panel Consolidated Uranium Mines, Ltd. 58
Parbar Mines, Ltd. 58
Parkhill gold m., production 17
Parry Sound mining division 9
Partanen Malartic Gold Mines, Ltd. 60
Pato Mines (Columbia), Ltd. 61
Patricia mining division 9, 63
Patricia portion of Kenora.
  Gold mg.:
    dividends paid by companies 33
    labour statistics 38
    mills, capacities 37
    mines, production ..... *facing* 10
    statistics 24, 25, 29
Paul-Liane Explorations, Ltd. 58
Pauloski, W., gold production 21
Paving brick, production 55

PAGE

Paymaster Consolidated Mines, Ltd.
Dividends....30, 36
Mill capacity.... 37
Production....*facing* 10, 13
Payne gas and oil field....48, 50
Peacock, J. A.... 84
Peat, industry and statistics....2, 4, 5, 50
Pelly River Mines, Ltd.... 58
Pepperess Mines, Ltd.... 60
Perlite Mining Corp., Ltd....58
Peru, gold production.... 38
Peter-Rock Mining Co., Ltd.... 58
Peterborough co.
Gold mg. *See* Cordova g. m.
Nepheline syenite.... 50
Petroleum.
Industry and statistics....2, 5, 49, 50
Petrolia oil field....49, 50
Philippines Republic.
Gold production.... 39
Phosphate, production.... 5
Pickering Metal Mines, Ltd.... 60
Pickering Uranium Mines, Ltd.... 60
Pickle Crow Gold Mines, Ltd.
Dividends....33, 36
Mill capacity.... 37
Production....*facing* 10, 25
Pickle Lake, rescue station.... 84
Pig iron, production....7, 45
Pileggi Mining Syndicate.
Gold production.... 18
Pilon, A., gold production.... 21
Platinum metals.
Industry and statistics....2, 4, 7, 40–42
Platte Uranium Mines, Ltd.... 60
Pleno Mines, Ltd.... 58
Plympton tp., petroleum.... 50
Plympton Uranium and Metal Mines, Ltd.... 58
Porcupine Crown Mines, Ltd.
See also Northcrown g. m.
Dividends....30, 36
Porcupine gold belt.
Dividends paid by mg. companies....29, 30, 34
Gold production....*facing* 10
statistics....10–13, 28
Labour statistics.... 38
Mills, capacities.... 37
Silver production....*facing* 10
Porcupine Lake gold m., production.... 13
Porcupine mine rescue station.... 84
Porcupine mining division....9, 63
Porcupine Pet gold m., production.... 13
Porcupine Reef Gold Mines, Ltd.
Dividends.... 36
Porphyry Hill gold m., production.... 13
Port Arthur.
Classes for prospectors....86, 88
Port Arthur mining division....9, 63
Port Colborne, blast furnace....45, 46
Portland cement, statistics....3, 5, 53
Pottery, statistics....3, 5, 55, 56
Power Uranium Co., Ltd.... 61
Preston East Dome Mines, Ltd.
Dividends....30, 36
Mill capacity.... 37
Production....*facing* 10, 13
Profit tax, statistics.... 62
Prosecutions.... 83

PAGE

Prospectors, classes for....85–89
Prospecting activity....8, 9
Provincial Assay Office.
Report....64–66
Revenue....62, 66
Pye, E. G.... 86
Pyrochlore Uranium Exploration Co., Ltd....59, 60

Q

Quarries.
Accidents in....69–74
Employees.... 73
Licences, revenue.... 62
Quarry Island gold m., production.... 23
Quartz and quartzite.
Industry and statistics....2, 5, 51
Quartz crystals, statistics.... 5
Quicklime, statistics....3, 5, 53, 54

R

Rainy River dist.
Gold production....*facing* 10, 19, 28
Randex Uranium Mines, Incorporated.. 61
Ranger Lake Uranium Co., Ltd.... 61
Rankin Inlet Nickel Mines, Ltd.... 60
Ranson gold m., production.... 17
Raven River gold m., production.... 16
Rayrock Mines, Ltd.... 60
Rea Consolidated Gold Mines, Ltd.
Dividends....30, 36
Recording fees, revenue....62, 63
Red Crest gold m., production.... 25
Red Lake, mine rescue station.... 84
Red Lake Gold Shore gold m.
Production.... 25
Red Lake mining division....9, 63
Refineries.
Nickel-copper:
precious metals from....*facing* 10, 42
statistics....41, 42
Silver-cobalt, statistics....43, 44
Refinery licences, revenue.... 62
Regina gold m., production.... 23
Regnery gold m., production.... 17
Renabie gold m.
Mill capacity.... 37
Production....*facing* 10, 18
Rescue station.... 84
Renabie Mines, Ltd.
See also Renabie g. m.
Dividends....34, 36
Renfrew co., light metals plant.... 46
Rentals, revenue....62, 63
Rescue stations, report on.... 84
Revenue, mining....62, 63
Rhodesia, Southern, gold production.... 39
Rhodium.... 42
Richards, M., gold production.... 21
Ridley Uranium Mines (Canada), Ltd... 58
Right-of-Way silver m.... 43
Roberts Exploration, Ltd., Howard.... 57
Rock-Echo Mines, Ltd.... 58
Rodney oil field....49, 50
Ronda gold m., production.... 26
Rope tests.
Fees, revenue.... 62
Summary report on.... 84
Rosita Mines, Ltd.... 59

PAGE

Ross gold m.
Fire at ... 77
Mill capacity ... 37
Production ... *facing* 10, 13
Rowan, G. A., gold production ... 25
Royal Sovereign gold m., production ... 23
Royalties, revenue ... 62
Rush Bay gold m., production ... 23
Russia, gold production ... 39
Ruthenium ... 42

S

Sabine Uranium Mines, Ltd ... 58
Sachigo River gold m., production ... 25
St. Anthony gold m., production ... 21
St. Mary's Cement Co., Ltd ... 53
Sakoose gold m., production ... 23
Salt, industry and statistics ... 3, 5, 51, 52
Sand and gravel.
Industry and statistics ... 3, 5, 54
Pits, accidents in ... 69–74
Royalties and licences, revenue ... 62
Sand-lime brick.
Industry and statistics ... 3, 5, 54
Sand River gold m., production ... 21
Sandstone, statistics ... 3, 55
Sandwich, salt ... 51
Sandybeach Lake gold m., production ... 23
Sarnia, salt ... 51
Sarnia tp., petroleum ... 50
Saskalon Uranium and Oils, Ltd ... 60
Saudi Arabia, gold production ... 39
Sault Ste. Marie.
Iron industry ... 45, 46
Silica brick ... 51
Sault Ste. Marie mining division ... 9, 63
Saundary gold m., production ... 19
Savannah Oils and Mines, Ltd ... 60
Sawbill gold m., production ... 19
Saxon Uranium Mines, Ltd ... 58
S. B. Smith gold m., production ... 17
Schreiber Pyramid gold m., production ... 21
Schumacher gold m., production ... 13
Seckerton gas and oil field ... 48, 50
Selenium, statistics ... 2, 4, 7, 41
Sewer brick, statistics ... 3, 5, 55, 56
Sewer pipe, statistics ... 3, 5, 55, 56
Shakespeare Uranium Mines, Ltd ... 58
Sheepbridge Engineering (Can.) Ltd ... 46
Shell Oil Co ... 61
Shenango gold m., production ... 17
Shim Explorations, Ltd ... 59
Shirley Lake Mining Co., Ltd ... 58
Shoreland Mines, Ltd ... 60
Sierra Leone, gold production ... 39
Silica brick.
Industry and statistics ... 2, 5, 51
Silver.
Industry and statistics ... 2, 4, 7, 43–45
production ... 2, 43
from gold ores ... *facing* 10
from nickel-copper ores ... 41, 42
Mines:
accidents in ... 71
dividends paid by ... 7
Price ... 8
Silver Crater Mines, Ltd ... 43
Silver Miller Mines, Ltd ... 43

PAGE

Silverclaim Lake Mines, Ltd ... 58
Singleton, G., gold production ... 25
Sioux Lookout, recording office ... 9
Siscoe Metals of Ontario, Ltd ... 45
Smelters.
Iron. *See* Blast furnaces.
Lime consumption ... 54
Nickel-copper:
fatal accidents in ... 71
statistics ... 40, 41
Silver ... 43, 44
Smith, S. B., gold production ... 17
Socanium Mines, Ltd ... 58
Socony-Vacuum Oil Co. of Canada, Ltd. 61
Sol D'Or gold m., production ... 25
Sombra tp.
Natural gas ... 48
Petroleum ... 50
Soo Mining and Prospecting Syndicate.
Gold production ... 17
Sophia gold m., production ... 27
South Africa, gold production ... 39
South America, gold production ... 38
South Norwich gas field ... 48
Southeastern Ontario.
Gold mines, production ... 26, 27
Southern Union Oils, Ltd ... 60
Southwestern Ontario.
Gas and oil. *See* Natural gas; Petroleum.
Salt industry ... 51
Sovereign gold m., production ... 27
Spanish American Mines, Ltd ... 58
Spence, J., gold production ... 13
Spodateenah Mines, Ltd ... 60
Spot Uranium Mines, Ltd ... 58
Spragge Uranium and Exploration Corp. 61
Squaw River Uranium Mines, Ltd ... 58
Stancan Uranium Corp., Ltd ... 61
Stanleigh Uranium Mining Corp., Ltd ... 58
Stanley gold m., production ... 17
Stanol Minerals, Ltd ... 58
Staples oil field ... 49, 50
Star of the East g. m., production ... 27
Starfire Uranium Mines, Ltd ... 58
Starratt Olsen Gold Mines, Ltd.
Mill capacity ... 37
Production ... *facing* 10, 25
Steel Co. of Canada, Ltd ... 45, 46
Steel industry.
See Iron and steel industry.
Steep Rock Iron Mines, Ltd.
Fires at mines ... 75, 77
Mine rescue station ... 84
Operations ... 45
Stelba Uranium Mines, Ltd ... 58
Sterling, exchange value of ... 8
Stone.
Industry and statistics ... 3, 5, 55
Stone, W. E., gold production ... 19
Straw Lake Beach g. m., production ... 23
Structural materials.
Industry and statistics ... 1, 3, 5, 6, 52–56
Sturgeon Lake Mining Synd., Ltd ... 58
Sturgeon River Gold Mines, Ltd.
Dividends ... 32, 36
Production ... 21
Sudbury.
Classes for prospectors ... 87, 88
Mine rescue station ... 84

PAGE

Sudbury dist.
Gold mg.:
dividends paid by companies....34, 36
labour statistics.... 38
mill, capacity.... 37
mines, production....*facing* 10
statistics....18, 28
Nickel-copper industry....40–42
Platinum metals....40–42
Sudbury mining division....9, 63
Sulphuric acid, production....3, 5, 52
Sultana gold m., production.... 23
Sunbeam gold m., production.... 19
Super Sonic Exploration Co., Ltd....58, 60
Surety Oils and Minerals, Ltd.... 61
Surinam, gold production.... 38
Surpass Petrochemicals, Ltd.... 60
Swastika gold m., production.... 14
Sweet Grass Oils, Ltd.... 60
Swift Copper Mines, Ltd.... 58
Sylvanite Gold Mines, Ltd.
Dividends....31, 36
Fire at mine.... 79
Mill capacity.... 37
Production....*facing* 10, 14
Sylvestre, William T.... 83
Systematic Explorations, Ltd.... 60

T

Talc.
Industry and statistics....3, 5, 52
Talmora Longlac g. m., production.... 21
Talvey Metal Mines, Ltd.... 58
Tandem Mines, Ltd.... 58
Tanganyika, gold production.... 39
Tarbell Mines, Ltd.... 58
Tashota gold m., production.... 21
Taxes, mining, revenue.... 62
Tazin Mines, Ltd.... 61
Teck-Hughes Gold Mines, Ltd.
Dividends....31, 36
Mill capacity.... 37
Production....*facing* 10, 14
Tecumseh Developments, Ltd.... 60
Tellurium, production....2, 4, 7, 41
Temagami Mining Co., Ltd.... 58
Thamesville oil field, production....49, 50
Theresa gold m.
Mill capacity.... 37
Production.... 21
Thorncrest Explorations, Ltd.... 61
Thorncrest Oil and Gas Co., Ltd.... 61
Thorold, ferro-alloys plant.... 46
Thunder Bay dist.
Gold mg.:
dividends paid by companies.... 32
labour statistics.... 38
mills, capacities.... 37
mines, production....*facing* 10
statistics....20, 21, 28
Tide Lake Lithium Mines, Ltd.... 58
Tilbury gas field, production.... 48
Tilbury W. tp., petroleum.... 50
Tile, statistics....3, 5, 55, 56
Timiskaming dist.
Gold mg. *See* Kirkland Lake g. belt; Larder Lake, Matachewan g. areas.
Silver-cobalt mg....43, 45
Timiskaming mining division....9, 63

PAGE

Timmins, classes for prospectors....86, 88
Tingley, J., gold production.... 25
Tionaga fold m., production.... 18
Toburn Gold Mines, Ltd.
Dividends....31, 36
Production.... 14
Toff Uranium Mines, Ltd.... 58
Tombill Gold Mines, Ltd.
Dividends....32, 36
Production.... 21
Tommy Burns gold m., production.... 13
Toronto.
Classes for prospectors....88, 89
Mining claims recorded.... 9
Provincial Assay Office.... 64
Tory Hill Uranium and Rare Minerals, Ltd.... 60
Tough-Oakes Gold Mines, Ltd.
Dividends....31, 36
Towle-Humpage Mines, Ltd.... 58
Transator Explorations, Ltd.... 60
Trans-Dominion Mining and Oils Corp.. 61
Treasure gold m., production.... 23
Trio Petroleum Corp., Ltd.... 61
Trio Uranium Mines, Ltd.... 61
Triton Uranium Mines, Ltd.... 59
Trout Creek gold m., production.... 14
Tungsten, production....4, 7
Twentieth Century gold m., production. 23
Tyranite gold m., production.... 26

U

Uchi gold m., production.... 25
Uganda, gold production.... 39
Union Carbide Canada, Ltd.
See Electro Metallurgical Co.
United Cement and Mining, Ltd.... 59
United Cobalt Mines, Ltd.... 43
United States.
Gold production.... 38
Metal prices.... 8
Unwrought metal sales licences.... 62
Upper Canada Mines, Ltd.
Dividends....31, 36
Fire at mine.... 76
Mill capacity.... 37
Production....*facing* 10, 15
Upper Seine gold m., production.... 19
Uranium King Corp., Ltd.... 61

V

Van Houten gold m., production.... 23
Venezuela, gold production.... 38
Vermilion Lake gold m., production.... 23
Victoria Algoma Mineral Co., Ltd.... 60
Victoria Consolidated Silver Mining Co., Ltd.... 61
Victoria iron m....45
Vinray Malartic Mines, Ltd.... 60
Vipond Consolidated Mines, Ltd.
Dividends....30, 36

W

Wabigoon-Contact Bay gold m.
Production.... 23
Wadge Mines, Ltd....59
Wallacetown oil field....49, 50
Warwick, salt.... 51
Warwick tp., petroleum....49, 50

PAGE

Waterways Iron and Uranium Mines, Ltd. 61
Watford-Kerrwood oil field 49, 50
Waubuno gas field 48
Welland, iron industry 46
Welland co.
Natural gas 48
Peat 51
Welland Electric Steel Foundry 46
Wells, oil. *See* Petroleum.
Wendigo Gold Mines, Ltd.
Dividends 32, 36
Production 23
Wentworth co.
Natural gas 48
Peat 51
Werner Lake Nickel Mines, Ltd. 59
West Indies, gold production 38
West Maygill Gas and Oil, Ltd. 61
West Penn Oil Co. (Canada), Ltd. 59, 60
West Shiningtree gold area.
Gold production 26
Mills, capacities 37
Westwadge Mines, Ltd. 59
White, G. L., gold production 17
White Lilly gold m., production 19
White Owl Prospectors, Ltd. 60
White River.
Classes for prospectors 85, 87, 88
White Rock gold m., production 26
Whitney Uranium Mines, Ltd. 61
Wildnest Mines, Ltd. 59

PAGE

Wm. Kennedy and Sons, Ltd. 46
Williams, M. C., gold production 21
Wilson, G. E. 84
Windsor, iron industry 46
Wintern Mining Corp. 61
Wire-rope tests.
Fees, revenue from 62
Summary report on 84
Woodliffe, W. F. 83
Wright-Hargreaves Mines, Ltd.
Dividends 31, 36
Mill capacity 37
Production *facing* 10, 15

X

X-Ray Assay Laboratories, Ltd. 59, 60

Y

Young, C. T., gold production 18
Young-Davidson Mines, Ltd.
Dividends 31, 36
Mill capacity 37
Production *facing* 10, 26
Yreka Mines, Ltd. 59

Z

Zinc.
Industry and statistics 2, 4, 7, 46
Mines, accidents in 71
Zone gas field, production 48
Zone tp., petroleum 50

Mine	Ore raised	Material discarded (sorted)	Ore milled	Bullion produced				Total value of bullion, Canadian funds
				Gold content		Silver content		
				Quantity	Value, Canadian funds	Quantity	Value	
	tons	tons	tons	ounces		ounces		
PORCUPINE BELT								
Aunor	167,388	.....	167,388	62,361.000	$ 2,125,797	4,531	$ 3,762	$ 2,129,559
Bonwhit	61,716	.....	61,716	20,859.503	710,561	.....	.....	710,561
Broulan Reef	90,991	.....	79,551	16,684.387	564,499	2,951	2,409	566,908
Coniaurum	118,180	.....	118,180	28,159.982	960,192	4,981	4,137	964,329
Delnite	144,504	.....	144,431	38,051.916	1,297,162	2,864	2,379	1,299,541
Dome	697,600	.....	697,600	171,399.000	5,838,723	34,604	28,707	5,867,430
Hallnor	119,630	.....	119,630	43,409.714	1,479,709	5,355	4,450	1,484,159
Hollinger	1,067,954	.....	1,069,689	303,638.000	10,347,949	52,103	42,851	10,390,800
Hugh-Pam	61,562	.....	61,562	10,543.051	359,114	.....	.....	359,114
McIntyre Porcupine	750,570	.....	750,570	203,554.237	6,933,796	41,050	34,059	6,967,855
Pamour	637,012	23,862	637,012	55,865.000	1,902,340	5,054	4,193	1,906,533
Paymaster Consolidated	30,726	.....	28,135	5,704.898	193,273	1,130	933	194,206
Preston East Dome	211,112	.....	209,510	58,186.000	1,983,485	6,754	5,608	1,989,093
Ross (Hollinger)	112,751	.....	112,728	20,409.000	695,366	41,293	34,016	729,382
Miscellaneous[1]	.....	.....	.....	93.000	3,169	19	16	3,185
Total	4,271,696	23,862	4,257,702	1,038,918.688	$35,395,135	202,689	$167,520	$35,562,655
KIRKLAND LAKE AREA								
Kirkland Lake Gold	117,137	.....	117,137	39,572.473	$ 1,348,186	3,489	$ 2,895	$ 1,351,081
Lake Shore	252,455	.....	252,455	85,212.225	2,903,146	28,279	23,467	2,926,613
Macassa	145,286	.....	145,286	50,358.058	1,714,613	6,948	5,763	1,720,376
Sylvanite	171,572	.....	171,854	53,716.900	1,829,699	10,649	8,833	1,838,532
Teck-Hughes	237,174	.....	237,050	37,529.244	1,278,416	6,779	5,622	1,284,038
Upper Canada	196,978	.....	196,978	46,987.391	1,600,893	21,436	17,788	1,618,681
Wright-Hargreaves	193,900	.....	193,900	79,403.409	2,704,425	13,501	11,200	2,715,625
Miscellaneous	.....	.....	.....	8.000	273	.....	.....	273
Total	1,314,502	.....	1,314,660	392,787.700	$13,379,651	91,081	$ 75,568	$13,455,219
LARDER LAKE AREA								
Kerr-Addison	1,658,293	.....	1,659,298	363,139.396	$12,391,598	20,119	$ 16,683	$12,408,281
Total	1,658,293	.....	1,659,298	363,139.396	$12,391,598	20,119	$ 16,683	$12,408,281
MATACHEWAN AREA								
Matachewan Consolidated (clean-up)	.....	.....	.....	447.039	$ 15,231	56	$ 47	$ 15,278
Young-Davidson	312,791	.....	312,217	30,224.000	1,029,139	9,865	8,198	1,037,337
Total	312,791	.....	312,217	30,671.039	$ 1,044,370	9,921	$ 8,245	$ 1,052,615
SUDBURY DISTRICT								
Renabie	167,257	.....	166,982	42,727.873	$ 1,455,637	13,020	$ 10,804	$ 1,466,441
Total	167,257	.....	166,982	42,727.873	$ 1,455,637	13,020	$ 10,804	$ 1,466,441
KENORA AND RAINY RIVER DISTRICTS								
Russell C. Cone	.....	.....	.....	2.432	$ 83	.....	.....	$ 83
Total	.....	.....	.....	2.432	$ 83	.....	.....	$ 83
THUNDER BAY DISTRICT								
Leitch	51,632	10,700	39,205	33,607.614	$ 1,144,407	1,082	$ 897	$ 1,145,304
Little Long Lac (clean-up)	.....	.....	.....	1,360.574	46,106	20	17	46,123
MacLeod-Cockshutt	556,525	.....	553,400	61,397.276	2,090,436	6,624	5,493	2,095,929
Total	608,157	10,700	592,605	96,365.464	$ 3,280,949	7,726	$ 6,407	3,287,356
PATRICIA PORTION								
Campbell Red Lake	227,804	32,463	196,059	101,269.617	$ 3,449,052	7,159	$ 5,934	$ 3,454,986
Cochenour Willans	96,286	30,241	66,045	24,768.753	844,111	910	756	844,867
McKenzie Red Lake	84,260	.....	84,260	17,321.147	589,879	8,296	6,880	596,759
Madsen Red Lake	286,246	.....	286,246	82,344.215	2,804,082	17,165	14,236	2,818,318
New Dickenson	131,422	.....	131,554	63,531.082	2,163,343	4,487	3,721	2,167,064
Pickle Crow	112,282	966	110,711	46,705.457	1,589,473	6,010	4,981	1,594,454
Starratt Olsen	98,898	.....	99,375	14,636.360	498,913	2,379	1,975	500,888
Total	1,037,198	63,670	974,250	350,576.631	$11,938,853	46,406	$ 38,483	$11,977,336
Miscellaneous[1]	.....	.....	.....	23.949	$ 816	.....	.....	$ 816
Total for gold mines	9,369,894	98,232	9,277,714	2,315,213.172	$78,887,092	390,962	$323,710	$79,210,802
Nickel-copper refining	.....	.....	.....	45,735.000	$ 1,558,192	.....	.....	.....
Copper-gold-silver ores	.....	.....	.....	439.300	14,967	.....	.....	.....
Total gold output, 1954	.....	.....	.....	2,361,387.472	$80,460,251	.....	.....	.....
CALENDAR YEAR 1953								
Porcupine Belt	3,630,655	36,310	3,631,960	876,812.922	$30,283,375	171,044	$144,692	$30,428,067
Kirkland Lake Area	1,273,635	.....	1,274,590	404,902.115	13,912,311	100,008	83,689	13,996,000
Larder Lake Area	1,642,008	.....	1,643,298	334,246.834	11,687,199	7,744	6,458	11,693,657
Matachewan Area	372,680	.....	373,321	31,172.886	1,078,082	8,668	7,576	1,085,658
Sudbury District	168,043	.....	168,243	41,264.067	1,419,146	13,238	11,093	1,430,239
Algoma District	.....	.....	.....	226.820	7,598	336	269	7,867
Thunder Bay District	592,855	11,302	578,880	113,712.436	3,914,415	9,475	7,935	3,922,350
Patricia Portion	1,028,759	57,464	973,360	340,113.274	11,709,653	45,037	37,789	11,747,442
Miscellaneous[1]	.....	.....	.....	10.000	344	.....	.....	.....
Total for gold mines, 1953	8,708,635	105,076	8,643,652	2,142,461.354	$74,012,123	355,550	$299,501	$74,311,624
Nickel-copper refining	.....	.....	.....	39,726.000	$ 1,367,645	.....	.....	.....
Copper-gold-silver ores	.....	.....	.....	226.670	7,802	.....	.....	.....
Copper-lead-zinc ores	.....	.....	.....	21.412	737	.....	.....	.....
Total gold output, 1953	.....	.....	.....	2,182,435.436	$75,388,307	.....	.....	.....

[1]High-grading and recovery from scrapped machinery.



PROVINCE OF ONTARIO

DEPARTMENT OF MINES

HON. PHILIP T. KELLY, *Minister of Mines* H. C. RICKABY, *Deputy Minister*

SIXTY-FOURTH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. LXIV, PART 2, 1955

Mining Operations in 1954

Compiled by
D. J. FIELD

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO
Printed and Published by Baptist Johnston, Printer to the Queen's Most Excellent Majesty
1956

TABLE OF CONTENTS

Vol. LXIV, Part 2

MINES — PAGE

ASBESTOS:
Canadian Johns-Manville Ontario, Ltd. ... 1

COPPER:
C. H. Cameron (Cam Copper Mine) .. 1
Ex-Mother Lode Mines, Ltd. ... 2
Kristina Copper Mines, Ltd. ... 2
New Ryan Lake Mines, Ltd. ... 3

COPPER-LEAD-ZINC:
Consolidated Sudbury Basin Mines, Ltd. ... 3
Errington Mine ... 4
Vermillion Lake Mine ... 4
Geco Mines, Ltd. ... 5

FELDSPAR:
Russell Van Meter (Cameron or Ox Lake Mine) ... 5

FLUORSPAR:
Huntingdon Fluorspar Mines, Ltd. ... 5

GARNET:
Cubar Uranium Mines, Ltd. ... 6

GOLD:
Aunor Gold Mines, Ltd. ... 6
Bonwhit Mines, Ltd. ... 8
Broulan Reef Mines, Ltd. ... 9
Reef Mine ... 10
Bonwhit Mines, Ltd. ... 10
Campbell Red Lake Mines, Ltd. ... 11
Central Porcupine Mines, Ltd. ... 14
Cochenour Willans Gold Mines, Ltd. .. 14
Coniaurum Mines, Ltd. ... 17
Consolidated Mosher Mines, Ltd. ... 21
Delnite Mines, Ltd. ... 21
Dome Mines, Ltd. ... 24
Hallnor Mines, Ltd. ... 27
Hollinger Consolidated Gold Mines, Ltd. ... 29
Hollinger Mine ... 30
Ross Mine ... 32
Hugh-Pam Porcupine Mines, Ltd. ... 33
Kerr-Addison Gold Mines, Ltd. ... 34
Kirkland Lake Gold Mining Co., Ltd. . 37
Lake Shore Mines, Ltd. ... 41
Leitch Gold Mines, Ltd. ... 46
Macassa Mines, Ltd. ... 48
McIntyre Porcupine Mines, Ltd. ... 52
McKenzie Red Lake Gold Mines, Ltd. ... 55
MacLeod-Cockshutt Gold Mines, Ltd. 58
Madsen Red Lake Gold Mines, Ltd. 60
Midcamp Mines, Ltd. ... 63
New Dickenson Mines, Ltd. ... 64
Pamour Porcupine Mines, Ltd. ... 65
Paymaster Consolidated Mines, Ltd. . 67

PAGE

GOLD:—*Continued*
Pickle Crow Gold Mines, Ltd. ... 71
Plator Gralouise Gold Mines, Ltd. ... 75
Preston East Dome Mines, Ltd. ... 75
Renabie Mines, Ltd. ... 79
Starratt Olsen Gold Mines, Ltd. ... 82
Sylvanite Gold Mines, Ltd. ... 84
Teck-Hughes Gold Mines, Ltd. ... 87
Upper Canada Mines, Ltd. ... 91
Wright-Hargreaves Mines, Ltd. ... 93
Young-Davidson Mines, Ltd. ... 96

GRAPHITE:
Frobisher, Ltd. (Black Donald Graphite Division) ... 97

GYPSUM:
Canadian Gypsum Co., Ltd. ... 98
Gypsum Lime and Alabastine, Canada, Ltd. ... 98

IRON:
Algoma Ore Properties, Ltd. ... 98
Bethlehem Mines Corp. ... 100
Caland Ore Co., Ltd. ... 100
Mag-Iron Mining and Milling, Ltd. .. 101
Stanol Minerals, Ltd. ... 101
Steep Rock Iron Mines, Ltd. ... 102

LEAD:
Jardun Mines, Ltd. ... 105

MAGNESIUM:
Dominion Magnesium, Ltd. ... 105

MICA:
J. C. Donnelly (Otty Lake Mine) ... 106

MOLYBDENUM:
Detta Minerals, Ltd. ... 106

NEPHELINE SYENITE:
American Nepheline, Ltd. ... 106

NICKEL AND COPPER:
Falconbridge Nickel Mines, Ltd. ... 107
International Nickel Co. of Canada, Ltd. ... 110
Jonsmith Mines, Ltd. ... 115
Milnet Mines, Ltd. ... 116
Nickel Offsets, Ltd. ... 117
Nickel Rim Mines, Ltd. ... 118
Quebec Nickel Corp, Ltd. ... 119

NIOBIUM (COLUMBIUM):
Beaucage Mines, Ltd. ... 119

RADIUM:
Canada Radium Corp., Ltd. ... 120

SALT:
Canadian Rock Salt Co., Ltd. ... 120

PAGE

SILVER AND COBALT:
Castle-Trethewey Mines, Ltd. 120
Coballoy Mines and Refiners, Ltd. . . . 124
Cobalt Consolidated Mining Corp., Ltd. 124
Agaunico Mine 125
Christopher Mine 125
Cobalt Lode Mine 125
Colonial Mine 126
Crown Reserve–Kerr Lake–Penn-Canadian–Foster Group 126
Right-of-Way Mine 126
Colonial Mill 127
The "104" Mill 127
Cordon Cobalt Mines, Ltd. 128
Harrison-Hibbert Mines, Ltd. 128
Juno Metals Corp., Ltd. 129
Langis Silver and Cobalt Mining Co., Ltd. 129
Lost Lake Mines, Ltd. 129
Mayfair Mines, Ltd. 130
Mensilvo Mines, Ltd. 131
Nipissing-O'Brien Mines, Ltd. 131
Ramardo Mines, Ltd. 132
Roy Silver Mines, Ltd. 132
Silver Crater Mines, Ltd. 133
Silver-Miller Mines, Ltd. 134
Brady Lake Mine 134
Chamber-Ferland Mine 134
Fisher-Eplett Mine 135
La Rose Mine 135
La Rose Extension Mine 135
Lawson Mine 135
University Mine 136
Siscoe Metals of Ontario, Ltd. 136
United Cobalt Mines, Ltd. 137

PAGE

TALC:
Canada Talc Industries, Ltd. 137

URANIUM:
Algom Uranium Mines, Ltd. 137
Beaucage Mines, Ltd. 139
Buckles Algoma Uranium Mines, Ltd. 139
Cardiff Uranium Mines, Ltd. 139
Centre Lake Uranium Mines, Ltd. 140
Croft Uranium Mines, Ltd. 140
Faraday Uranium Mines, Ltd. 141
Pronto Uranium Mines, Ltd. 141

METALLURGICAL WORKS

Algoma Steel Corp., Ltd. 142
Canadian Furnace Co., Ltd. 142
Canadian Industries, Ltd. 142
Cobalt Chemicals, Ltd. 142
Deloro Smelting and Refining Co., Ltd. 143
Dominion Foundries and Steel, Ltd. . . . 143
Noranda Mines, Ltd. 143
Sulphur Iron Division (Port Robinson Plant) 144
Steel Co. of Canada, Ltd. 144

INDEX 145

Mining Operations in 1954

Compiled by D. J. Field

Only those mines or mining properties that have reported actual mining or development operations in the year 1954 are included in this report.

ASBESTOS

Canadian Johns-Manville Ontario, Limited

Canadian Johns-Manville Ontario, Limited, was incorporated in March, 1950, with an authorized capitalization of 1,000 shares of $100 par value, all of which have been issued. The company is a wholly owned subsidiary of the Canadian Johns-Manville Company, Limited. The officers and directors are: L. M. Cassidy, chairman of the board; A. R. Fisher, president; H. M. Ball, secretary; Roger Hackney, treasurer; A. Brown, W. R. Wilkinson, K. V. Lindell, K. W. Huffine, and C. F. Rassweiler, all vice-presidents and directors; R. D. Baker, director. The secretary's office is at 22 East Fortieth Street, New York 16, N.Y. The head office and mine office are at Matheson.

The company operates the property known as the Munro mine in Munro and Beatty townships, Porcupine area, district of Cochrane.

There is a vertical, two-compartment shaft, 314 feet deep, on claim L.25634, Beatty township, with 1,176 feet of drifting and 2,972 feet of crosscutting at a depth of 300 feet. No underground work has been done from this shaft since 1951.

Mining and milling operations continued throughout 1954. About 360,696 tons of overburden were stripped from the *A* orebody, in Munro township. The sinking of a vertical, four-compartment shaft, known as No. 1 Main, on claim P.1152, in Munro township, was begun. The shaft had reached a depth of 30 feet by the end of the year.

There were 523,654 tons of ore mined from the open pit on the *A* orebody. The mill treated 552,415 tons, at an average daily rate of 2,227 tons.

The construction of a hoist-room and electric-control room was begun during the year. A six-room house and 11 new garages were built in Matheson.

Considerable work was done on dust-control installations in the mill.

R. D. Baker is mine manager. An average of 250 men was employed, of whom 84 were in the mine and 166 in the mill.

COPPER

C. H. Cameron (Cam Copper Mine)

The property formerly known as the Trethewey-Ossian mine, in Pacaud township, district of Timiskaming, was operated from September 23 to December 31, 1954, by C. H. Cameron, of Boston Creek, under the name of Cam Copper Mine. The mine had been operated in 1953 by Consolidated Golden Arrow Mines, Limited.

The vertical, two-compartment shaft is 220 feet deep, with levels at 125 and 200 feet. The following development work was done on the 200-foot level in 1954: drifting, 15 feet; crosscutting, 30 feet; raising, 15 feet. No work was done on the 125-foot level.

About 28 tons of copper ore were mined and shipped to Noranda, Quebec, for treatment.

Four men were employed during the period of operation.

Ex-Mother Lode Mines, Limited

Ex-Mother Lode Mines, Limited, was incorporated in November, 1951, with an authorized capitalization of 4,000,000 shares of $1 par value, of which 2,063,000 have been issued. The officers and directors are: A. Demers, president and manager; A. Poulin, secretary-treasurer; J. L. Beland, A. Leguerrier, directors. The head office is at 900 Third Avenue, Val d'Or, Quebec. The mine address is Elk Lake.

The company owns 17 claims and has an option on 20 claims in the townships of James and Tudhope, Elk Lake area, district of Timiskaming.

Operations were carried on from July 7 to September 17, 1954. A copper-bearing vein was exposed. About 200 feet of surface trenching, 42 feet deep, was done, and 47 tons of copper ore were shipped to Noranda, Quebec.

Seven men were employed during the period of operation.

Kristina Copper Mines, Limited

Kristina Copper Mines, Limited, was incorporated in May, 1952, with an authorized capitalization of 3,500,000 shares of $1 par value, of which 3,205,007 have been issued. The officers and directors are: Aaron Gold, president; D. G. Taylor, secretary-treasurer; M. J. Burn and Ernest Hawker, directors. The head office is at 200 Bay Street, Toronto. The mine address is Searchmont.

The company's property in township 24, range 11, district of Algoma, was formerly known as the Superior mine. It was operated between 1903 and 1907 by the Superior Copper Company, which sank several shafts and did considerable development work. The holdings of Kristina Copper Mines, Limited, include the old Nos. 2, 3, 5, and 6 shaft workings, but not Nos. 1 and 4 shafts.

The inclined, two-compartment No. 6 shaft is about 337 feet deep with three levels at 100-foot intervals. No underground development work has been done by the present operators. The following table shows the development work done by the previous operators:

Level	Drifts	Crosscuts	Raises
	feet	feet	feet
1st	510	32	80
2nd	255	.....	.....
3rd	120	.....	.....

In December, 1953, the present operators dewatered the No. 6 shaft to the third level, and did some diamond-drilling from surface.

Work in January, 1954, consisted of 18 diamond-drill holes, totalling 9,293 feet, from surface; 7 holes, totalling 674 feet, from underground; and about 300 feet of surface-trenching, 2 feet deep. Operations were suspended on February 2, 1954.

H. J. Logan was manager.

New Ryan Lake Mines, Limited

Ryan Lake Mines, Limited, was incorporated in March, 1947. In October, 1951, the name was changed to New Ryan Lake Mines, Limited. The authorized capitalization is 3,500,000 shares of $1 par value, of which 3,229,103 have been issued. The officers and directors are: G. S. Welsh, president and manager; R. D. Cumming, vice-president; H. A. Campbell, secretary-treasurer; H. L. Simons and Ethel Welsh, directors. The address of the head office and the mine is Matachewan.

The company's property consists of 10 claims, held under lease, in Powell township, Matachewan area, district of Timiskaming.

Mining operations continued throughout 1954. The vertical, two-compartment shaft, on claim M.R. 12548, is 459 feet deep. The following table shows the development work done in 1954 and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
92-foot	.....	1,105	.....	25	.....	326
192-foot	.....	1,809	.....	579	80	580
317-foot	66	705	.....	232	449	639
442-foot	548	548	.....	36	658	658

Diamond-drilling consisted of 8 holes totalling 2,801 feet, from surface, and 28 holes totalling 5,011 feet, from underground.

A new powder house was built.

A total of 49,416 tons of copper ore was mined. The mill treated 47,738 tons. In January and February the concentrates were shipped to the American Metal Company, in New Jersey, for treatment. During the rest of the year they were sent to Noranda Mines, Limited, in Quebec.

An average of 58 men was employed, of whom 35 were underground and 23 on the surface.

COPPER-LEAD-ZINC

Consolidated Sudbury Basin Mines, Limited

The Ontario Pyrites Company, Limited, was incorporated in July, 1942. The authorized capitalization was 6,000,000 shares of $1 par value. In December, 1954, the company was reorganized, and the name was changed to Consolidated Sudbury Basin Mines, Limited. The authorized capitalization is now 6,500,000 shares of $1 par value, of which 2,976,243 have been issued. The officers and directors are: Thayer Lindsley, president; J. M. Cunningham-Dunlop, vice-president and general manager; F. C. Sullivan, secretary-treasurer; A. G. Fulton and W. S. Morlock, directors. The head office is at 25 King Street West, Toronto. The mine address is Chelmsford.

The company's main holdings are the old Errington mine in Creighton township and the Vermillion Lake property in Fairbank township, both in the district of Sudbury.

ERRINGTON MINE

Operations at the Errington mine continued throughout 1954. There are five vertical shafts on the property, all sunk during previous operations. The following table shows the depths of the shafts and the number of compartments in each:

Shaft	Number of compartments	Depth
		feet
No. 1	3	619
No. 2	3	1,571
No. 3	3	409
Irwin	1	70
River[1]	1	85

The mining plant is at No. 2 shaft. Underground development work in 1954 consisted of 110 feet of crosscutting on the 500-foot level. The following table shows the total amount of development work that has been done from Nos. 1, 2, and 3 shafts:

Level	Drifts	Crosscuts	Raises
	feet	feet	feet
Nos. 1 and 2 Shafts:			
300-foot	5,107	4,370	2,002
500-foot	8,879	4,126	1,278
No. 2 Shaft:			
750-foot	.....	420	.....
1,000-foot	.....	15	.....
1,500-foot	4,784	1,538	77
No. 3 Shaft:			
400-foot	245	1,725	105

Four diamond-drill holes, totalling 1,605 feet, were drilled from underground.

A small addition to the pilot mill was built, and metallurgical tests on the complex ore were continued.

Other construction work during the year included a building for storing concentrates, a pump-house, a boiler house at No. 1 shaft, and a two-family dwelling. A 2,200-volt power line, half a mile long, and an 8-inch water-supply line, 1,800 feet long, were built. A 20-horsepower boiler and a 60-cycle, three-phase, 2,200/550-volt transformer were installed.

VERMILLION LAKE MINE

Operations at the Vermillion Lake mine were continued in 1954. The vertical, three-compartment No. 4 shaft is 930 feet deep. The following table shows the development work done in 1954, and the total at the end of the year:

Level	Drifts		Crosscuts	
	1954	Total	1954	Total
	feet	feet	feet	feet
300-foot (station only)	.....	.....	.....	.....
450-foot	.....	.....	.....	49
600-foot	333	663	51	440
750-foot	238	794	.....	257
900-foot	.....	305	.....	11

[1]Sometimes called the Leckie shaft.

Diamond-drilling in 1954 consisted of 2 holes totalling 400 feet, from surface, and 14 holes totalling 3,202 feet, from underground.

A three-phase, 60-cycle, 19-kilovolt-ampere, 550-volt Canadian General Electric generator was installed.

An average of 17 men was employed at the two properties, of whom 2 were underground and 15 on the surface. J. C. Kirkland is manager.

Geco Mines, Limited

Geco Mines, Limited, was incorporated in October, 1953, with an authorized capitalization of 3,000,000 shares of $1 par value, of which 2,155,007 have been issued. The officers and directors are: N. C. Urquhart, president; J. A. H. Paterson, vice-president and managing diractor; P. D. P. Hamilton, vice-president; W. Harrison, secretary-treasurer; D. A. Foster, assistant secretary-treasurer; R. T. Birks, J. R. Bradfield, R. M. P. Hamilton, and P. H. McCloskey, directors. The head office is at 44 King Street West, Toronto. The mine address is Hemlo.

The company owns 46 claims, containing 1,843 acres, in the Manitouwadge Lake area, district of Thunder Bay.

During 1954 a camp was built and preparations for the development of the copper-zinc orebody were begun. Eighty-five diamond-drill holes, totalling 41,933 feet, were drilled. A five-compartment shaft was collared and sunk a distance of 14 feet.

The buildings erected in 1954 included a power-house, boiler house, hoist-house, pump-houses at the plant and camp, powder magazine, cap-and-fuse house, assay office, core house, fire house, driller's warehouse, storage warehouse, timber-framing shed, three bunk-houses, cook-house and dining hall, office and staff-house, and the following temporary buildings: warehouse, machine shop, four dwellings, dry-house, and engineering office. A used Canadian Ingersoll-Rand KH500 portable compressor was installed. The site for a mill was cleared.

J. A. Graham is manager. An average of 39 men was employed.

FELDSPAR

Russell Van Meter (Cameron or Ox Lake Mine)

Russell Van Meter of Whitney bought the property known as the Cameron or Ox Lake mine on the north half of lot 22, concession VII, Murchison township, district of Nipissing, and carried on operations during June, July, and August, 1954. A total of 187 tons of feldspar was mined from the pit.

One man was employed.

FLUORSPAR

Huntingdon Fluorspar Mines, Limited

Huntingdon Fluorspar Mines, Limited, was incorporated in June, 1953, with an authorized capitalization of 40,000 preferred shares of $10 par value, and 500,000 common shares of no par value. The number of shares issued at December 31, 1953, was as follows: preferred, 750; common, 100,003. The officers and directors are: W. J. Symon, president and mine manager; Mrs. Alein Symon, vice-president and secretary-treasurer; Mrs. Jane Parker, director. The head office and mine office are at Madoc.

The company holds a lease on the east half of lot 9, concession XIV, Huntingdon township, Hastings county.

Mining operations were carried on from May 17 to October 7, 1954. The vertical, two-compartment shaft was sunk a further 21 feet to a total depth of 84 feet, and a second level was established at 80 feet from surface. The shaft is sunk in the ore zone, and all the ore northwest and southeast of the shaft is being mined out before further sinking is done. The following table shows the development work done in 1954, and the total:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
50-foot	.....	117	.....	.....	.....	.....
80-foot	267	267	.....	.....	60	60

A total of 1,907 tons of ore was hoisted. The mill operated from July 21 to October 6 and treated 1,507 tons.

An average of 6 men was employed, of whom 3 were underground and 3 on the surface.

GARNET

Cubar Uranium Mines, Limited

Cubar Uranium Mines, Limited, was incorporated in April, 1953, with an authorized capitalization of 3,500,000 shares of $1 par value, of which 1,192,384 have been issued. The officers and directors are: W. E. Custis, president; K. C. Dike, vice-president; R. H. Barhoff, secretary-treasurer; E. A. Tilley, director. The head office is at 80 King Street West, Toronto. The mine address, when operations are being carried on, is River Valley.

In the late summer of 1954 the company leased three claims near River Valley, in the southeast corner of Dana township, district of Nipissing, on which the Niagara Garnet Company mined some garnet several years ago. A lease was also taken on an old mill building in Sturgeon Falls with some machinery in it that had formerly been used for the production of crushed garnet powder. A rock cut was started on the Dana township property, and about 400 tons of material was mined from it, some of which was treated in the mill. There were several hundred pounds of powdered garnet on hand when the mill was destroyed by fire on November 28.

L. A. Savage was manager.

GOLD

Aunor Gold Mines, Limited

Aunor Gold Mines, Limited, was incorporated in May, 1939, with an authorized capitalization of 2,000,000 shares of $1 par value, all of which have been issued. The officers and directors are: J. Y. Murdoch, president; J. R. Bradfield, vice-president; C. H. Windeler, secretary; R. G. Rudolf, treasurer; W. S. Row, N. C. Urquhart, and K. C. Gray, directors. The head office address is Bank of Nova Scotia Building, Toronto. The mine address is Box 2001, Timmins.

The company owns nine claims and holds a 99-year lease on two others, in Deloro township, Porcupine area, district of Cochrane.

Operations, which had been suspended on October 13, 1953, because of a labour strike, were resumed on January 28, 1954, and continued for the rest of the year.

The mine is served by a vertical, three-compartment shaft, 3,082 feet deep. Early in 1954 a connection with the adjoining Delnite workings was made between Aunor's 2,900-foot and Delnite's 2,875-foot level. Later in the year short drifts were run into Aunor ground from Delnite's 2,375-, 2,500-, and 2,625-foot levels, as a preliminary step towards driving a raise from the 2,900- to the 2,125-foot levels of the Aunor mine.

The following table shows the development work done during 1954, and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
250-foot	.....	.....	.....	412	.....	.....
500-foot	.....	.....	.....	150	.....	.....
625-foot	.....	3,501	.....	1,594	.....	2,860
750-foot	.....	4,710	.....	1,248	.....	1,127
875-foot	.....	6,384	.....	1,759	.....	1,361
1,000-foot	.....	11,055	.....	1,801	56	3,752
1,125-foot	.....	4,180	.....	807	.....	1,965
1,250-foot	.....	5,115	.....	968	.....	1,938
1,375-foot	864	4,113	.....	751	.....	2,110
1,500-foot	179	4,023	.....	958	.....	1,543
1,625-foot	61	2,186	49	1,472	628	2,500
1,750-foot	.....	1,322	.....	158	.....	248
1,875-foot	19	5,601	.....	540	331	3,608
2,000-foot	.....	1,407	.....	262	.....	108
2,125-foot	.....	5,837	.....	898	.....	3,201
2,375-foot	[1]61	61	.....	.....	.....	.....
2,500-foot	[1]67	406	.....	.....	.....	.....
2,625-foot	[1]51	51	.....	.....	.....	.....
2,900-foot	1,483	3,770	76	1,012	244	244

Diamond-drilling in 1954 consisted of 335 holes, totalling 28,321 feet, from underground.

A new Mather and Platt centrifugal pump was installed on the 1,125-foot level to handle an influx of water from the flooded workings of the adjoining Buffalo-Ankerite mine.

The following is taken from the manager's report for the year ending December 31, 1954:

Production

Mining was carried on between the 1,250-foot and 2,125-foot levels.

Underground operations were resumed, following the strike, on January 28. During the remainder of the year the mining rate was 515 tons per calendar day. The average grade was 0.383 ounces of gold per ton as compared with 0.403 ounces for 1953.

Development

Drifting west on the 2,900-foot level was completed to the Aunor-Delnite boundary; the total advance was 1,238 feet. Present indications from this drift and incomplete diamond-drilling are that this level will prove at least up to the mine average.

As an alternative to connecting the future 2,300-, 2,500-, and 2,700-foot levels to the main shaft, they will be serviced from a raise being driven from the 2,900- to the 2,125-foot levels and

[1]Work done from Delnite workings.

located near the west boundary of the property. At the year end this main service had reached the 2,700-foot horizon.

A new system of backfill raises and ventilation-manway raises was laid out from the 2,000-foot level to surface. These have been completed from the 1,875- to the 1,375-foot levels.

Other development work consisted of drifting, raising, and diamond-drilling between the 1,000- and the 2,125-foot levels for further examination of the ore zone and preparation for mining.

Ore Reserves

At the end of the year, the ore reserves above the 2,125-foot level, were as follows:

	Tons	Percent	Ounces of gold per ton
Broken	8,000	1.1	0.233
Proved	711,500	96 1	0.373
Probable	20,500	2 8	0.315
Total	740,000	100.0	0 371

New ore developed during the year was 181,000 tons. Ore sent to the mill was 167,388 tons.

Mill

	1954[1]	1953[2]	To date
Milled, tons	167,388	139,759	2,432,138
Milled per calendar day, tons	515.0	492.0	445.2
Average gold content per ton, ounces	0.383	0.403	0.355
Average tailings loss per ton, ounces	0.0103	0.0115	0.0091
Total recovery, percent	97.30	97.13	97.43
Total production, ounces	62,361.5	54,663.8	840,277.5
Value of total production	$2,129,461	$1,889,589	$30,893,888
Recovery per ton	$12.72	$13.52	$12.70

Sources of Ore Milled, 1954

	Tons	Percent
Development	10,688	6.4
Drawn from 1,250-foot level	600	0.4
Drawn from 1,375-foot level	5,950	3.5
Drawn from 1,500-foot level	32,100	19.2
Drawn from 1,625-foot level	17,250	10.3
Drawn from 1,750-foot level	21,050	12.6
Drawn from 1,875-foot level	23,900	14.3
Drawn from 2,000-foot level	26,150	15.6
Drawn from 2,125-foot level	29,700	17.7
Total	167,388	100.00

An average of 334 men was employed, of whom 235 were underground and 99 on the surface. R. E. Findlay is manager.

Bonwhit Mines, Limited

Bonwhit Mines, Limited, was incorporated in September, 1951, with an authorized capitalization of 100,000 shares of no par value. The company was operated as a wholly owned subsidiary of Broulan Reef Mines, Limited, until December 31, 1954, when it was absorbed by the parent company.

[1] 10½ months' operation.
[2] 9½ months' operation.

The Bonwhit property, in Whitney township, Porcupine area, district of Cochrane, consists of that part of the former Bonetal mine that was developed from the Reef shaft. It forms part of the group operated by Broulan Reef Mines, Limited. All present operations are conducted through the Reef shaft. Further information regarding development and production appears under Broulan Reef Mines, Limited, below.

Mining operations continued throughout 1954. The following table shows the amount of underground development work done during 1954, and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
500-foot	.....	466	137	137	.....	.....
650-foot	.....	1,083	.....	143	.....	305
800-foot	.....	928	.....	77	.....	363
970-foot	470	2,022	.....	83	75	795
1,120-foot	205	1,044	206	378	254	276
1,270-foot	551	551	.....	.....	.....	.....

Diamond-drilling in 1954 consisted of 64 holes, totalling 8,267 feet, from underground.

A total of 61,716 tons of ore was mined and it was treated in the Broulan Reef mill.

W. F. Brown is mine manager. The employment figures given for Broulan Reef Mines, Limited, include those for the Bonwhit mine.

Broulan Reef Mines, Limited

Broulan Reef Mines, Limited, was incorporated in June, 1951, with an authorized capitalization of 6,000,000 shares of $1 par value, of which 5,961,142 have been issued. The officers and directors are: B. W. Lang, president; W. F. James and F. G. Lawson, vice-presidents; D. R. Michener, secretary-treasurer; J. B. Streit, F. H. Snyder, and F. J. Bowley, directors. The head office is at 372 Bay Street, Toronto. The mine address is Pamour.

The company owns the Broulan Reef mine and part of the old Bonetal mine in Whitney, Murphy, and Tisdale townships, Porcupine area, district of Cochrane. It also operates the property of its wholly owned subsidiary company, Bonwhit Mines, Limited,[1] and that of Hugh-Pam Porcupine Mines, Limited,[2] all in the same group.

Mining operations in the Reef shaft area of the Broulan Reef mine continued throughout 1954. No mining was done in the Broulan or Bonetal shaft areas, nor on the property of Banner Porcupine Mines, Limited.

The vertical, three-compartment No. 1 Reef shaft was sunk a further 270 feet to a total depth of 2,041 feet. A new level was established at a depth of 1,870 feet, and a new loading-pocket was cut at 1,954 feet below the collar.

[1]Bonwhit Mines, Limited, was absorbed by Broulan Reef Mines, Limited, at the end of 1954. See page 8.

[2]See page 33.

The following table shows the development work done during 1954 and the total at the end of the year from the Reef shaft:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
200-foot	.....	1,139	.....	579	.....	416
350-foot	162	2,338	.....	467	.....	1,205
500-foot	77	2,642	.....	604	271	1,423
650-foot	.....	2,499	.....	689	.....	1,134
800-foot	.....	2,234	.....	684	21	1,009
970-foot	306	2,895	.....	734	.....	947
1,120-foot	42	1,776	.....	496	88	451
1,270-foot	1,003	1,787	.....	441	340	340
1,420-foot	1,314	1,314	536	549	253	253
1,570-foot	67	67	418	505	205	205
1,720-foot (station only)	.....	.....	.....	.....	.....	.....
1,870-foot (station only)	.....	.....	.....	.....	.....	.....

Diamond-drilling in the Reef shaft area in 1954 consisted of 113 holes, totalling 9,983 feet, from underground.

The following is taken from the mine manager's report for the year ending December 31, 1954:

REEF MINE

Production and Treatment

During the year 83,840 tons of ore were mined and milled. Production was 16,684.765 ounces of fine gold valued at $571,080.25 in addition to which it is estimated that $117,324.77 will be received under the terms of the Emergency Gold Mining Assistance Act. Average recovery was 0.199 ounces of gold or $6.81 per ton milled.

Mining

In addition to the exploration and development work done during the year, the following work was done for other companies:

1) *Hugh-Pam Porcupine Mines, Limited.*—692 feet of drifting, 632 feet of raising, 450 tons of slashing, 7,007 feet of diamond-drilling, and the mining and hoisting of 57,272 tons of ore for Hugh-Pam Porcupine Mines, Limited.
2) *Bonwhit Mines, Limited.*—Considerable work, which is detailed under a separate heading in this report, for the wholly owned subsidiary Bonwhit Mines, Limited.

Ore Reserves

Proven ore reserves are calculated to be 294,448 tons, having an average uncut grade of 0.43 ounces of gold per ton or a cut grade of 0.24 ounces per ton.

BONWHIT MINES, LIMITED

Production and Treatment

During the year 61,716 tons of ore were mined and milled. Production totalled $710,560.02, representing 20,859.503 ounces of fine gold, in addition to which it is estimated that $33,427.35 will be received under the terms of the Emergency Gold Mining Assistance Act. Average recovery was 0.338 ounces of gold or $11.51 per ton milled.

Ore Reserves

Proven ore reserves are calculated to be 76,530 tons, having an average uncut grade of 0.53 ounces of gold per ton or a cut grade of 0.31 ounces per ton.

MILLING FOR ALL MINES

During the year the mill treated 202,830 tons of ore, from which were recovered 48,087.32 ounces of gold and 2,950.67 ounces of silver. Recovery averaged 97.9 percent.

General

The Reef shaft was deepened 270 feet during the year to a depth of 2,041 feet. On completion of the present sinking program, to a depth of 2,100 feet early in 1955, lateral development work will be carried out on the 1,570-, 1,720-, and 1,870-foot levels.

Costs

Operating costs for the full 202,830 tons of ore mined and milled from all sources during the year, including head office administration and general expense, amounted to $6.69 per ton.

W. F. Brown is manager. An average of 186 men was employed, of whom 109 were uderground and 77 on surface. These figures include the men employed at all the properties operated by the company.

Campbell Red Lake Mines, Limited

Campbell Red Lake Mines, Limited, was incorporated in August, 1944. The authorized capitalization is 4,000,000 shares of $1 par value, 3,999,500 of which have been issued. The company is controlled by Dome Mines, Limited, which owns 2,265,105 shares of the stock. The officers and directors are: C. W. Michel, president; J. B. Redpath, vice-president; C. C. Calvin, secretary; E. J. Andrecheck, treasurer; J. K. McCausland and W. F. James, directors. The head office is at 50 King Street West, Toronto. The mine address is Balmertown.

The company owns 27 claims, approximately 1,175 acres, in Balmer township, Red Lake area, Patricia portion of Kenora district.

Mining and milling operations continued throughout 1954. The mine is served by a vertical, four-compartment shaft 2,240 feet deep, on claim K.R.L. 20071. The following table shows the development work done during 1954, and the total:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
1st	27	4,977	.....	1,388	.....	466
2nd	.....	5,331	.....	1,718	15	1,403
3rd	.....	6,739	41	2,028	326	1,877
4th	1,168	7,915	73	1,477	230	2,009
5th	1,608	6,256	23	2,075	622	2,064
6th	348	4,738	.....	998	650	1,754
7th	1,059	6,722	.....	863	82	1,438
8th	232	232	631	667	77	77
9th	.....	.....	194	217	121	121
10th	.....	.....	148	167	219	219
11th	.....	.....	150	163	241	241
12th	.....	.....	154	173	214	214
13th	.....	.....	117	136	274	274
14th	41	41	288	309	517	549
15th	.....	.....	6	44	.....	.....

Diamond-drilling in 1954 consisted of 236 holes, totalling 36,851 feet, from underground.

The new 40- by 62-foot hoist-room and the 27- by 82-foot addition to the mill were completed during the year. A 10- by 6½-foot double-drum Bertram Nordberg hoist, driven by a 450-horsepower, 2,200-volt English Electric motor, was installed. New mill equipment included twelve No. 21 Denver flotation

cells, a 60-inch Duplex Akins classifier, a 7- by 12-foot rod mill, and a 300 horsepower, 2,200-volt General Electric motor.

The following is taken from the general manager's report for the year ending December 31, 1954:

During the year 227,804 tons were hoisted, of which 195,341 tons were ore, and 32,463 tons were waste. In addition 718 tons of ore from the surface stockpile were sent to the mill.

The 196,059 tons of ore milled yielded bullion containing 101,269.617 ounces of gold, the average yield being 0.51653 ounces or 10.331 pennyweights per ton. All grades of ore will be expressed in pennyweights (dwt.) throughout this report. One pennyweight equals one-twentieth of an ounce troy weight. The price paid by the Royal Canadian Mint is based on $35 per ounce U. S. funds, and settlements are made in equivalent Canadian funds at current exchange rates. Thus a premium on the Canadian dollar has an unfavourable effect on prices received from the Mint. The average price received was $34.06 per ounce as compared to $34.44 received in 1953.

The following statement gives particulars of revenue and expenditures for the year under review:

OPERATING STATEMENT
(For the year ended December 31, 1954)

REVENUE:		
Bullion		$3,455,871
EXPENDITURES:		
Development	$ 283,431	
Mining	700,689	
Reduction	416,080	
Refining and marketing	30,132	
General and administrative	170,257	
Taxes other than income	6,624	
	$1,607,213	
Less estimated income under the Emergency Gold Mining Assistance Act	249,000	
		1,358,213
Profit before depreciation, amortization of deferred development and preproduction expenditures, provision for tax under The Mining Tax Act, loss on disposal of capital assets, and estimated stock exchange listing expenses		$2,097,658

Mining

Broken ore totalling 206,500 tons remains in the stopes and on the surface ore dump, an increase of 62,300 tons from the previous year.

In all, 178,771 tons of a grade of 11.76 dwt. were drawn from the stopes and sent to the mill.

All major stoping operations are above the 7th level or the 1,000-foot horizon.

Diamond-Drilling

The diamond-drilling program carried out on the 8th, 10th, and 14th levels was most satisfactory. This work to date has indicated the downward extension of ore zones and has returned a few interesting intersections in new areas.

Ore Production

The mine produced 195,341 tons of ore during the year, which averaged 11.68 dwt. The stopes produced 178,771 tons, averaging 11.76 dwt., and the development work produced 16,570 tons, averaging 10.76 dwt. In addition, 718 tons, averaging 4.94 dwt., from the surface stockpile were sent to the mill.

Ore Reserves

The ore reserves are estimated at 817,500 tons, an increase of 53,300 tons over last year. The ore reserves include 206,500 tons of broken ore in the stopes and on the surface stockpile.

A summary of the distribution of ore in place, broken ore, and total ore mined to the end of 1954, is as follows:

SUMMARY OF ORE RESERVES AND EXTRACTION BY LEVELS

	Ore in place	Average grade	Broken ore	Total ore extracted from stopes to end of 1954
	tons	dwt.	tons	tons
Ore dump, surface			15,600	
Surface to 1st level	27,000	11.23	49,000	153,702
1st to 2nd level	40,500	11.62	15,900	178,174
2nd to 3rd level	54,000	11.22	28,400	162,579
3rd to 4th level	52,900	12.53	10,400	157,785
4th to 5th level	123,500	13.04	36,200	45,400
5th to 6th level	111,100	12.17	29,200	28,727
6th to 7th level	163,000	11.99	21,800	31,628
7th to 8th level	39,000	12.28		
Total	611,000	12.18	206,500	757,995

Mill

The following are the results of milling operations:

Treated	tons	196,059
Average grade of ore treated	dwt. per ton	11.654
Recovery	dwt. per ton	10.331
Recovery percentage	percent	88.65

The milling rate for the year is shown in the following data:

Period	Total milled	Average milled per day
	tons	tons
1st quarter	46,438	516
2nd quarter	49,487	544
3rd quarter	44,125	479
4th quarter	56,009	609
Average		537

Costs

The expenditure on mining was $700,689, or $3.574 per ton milled; the expenditure on development was $283,431, or $1.446 per ton milled; and operating costs, including mint handling charges, were $8.197 per ton milled.

Capital Expenditure

Capital expenditure for the year amounted to $912,776. Major expenditures were for the new hoisting plant, which will have an ultimate capacity of 4,000 feet, and the increase in the capacity of the milling plant.

Five eight-man bunk-houses, designed to be used as private dwellings when their use as bunk-houses is finished, were built.

A water-supply system is being built and will be operated in co-operation with New Dickenson Mines, Limited.

A medical centre was built on the townsite to house medical and dental offices and to provide living quarters for a dentist. This is being financed jointly by the company and New Dickenson Mines, Limited.

Four employee dwellings were built on the townsite.

Joseph Chisholm is general manager. An average of 275 men was employed, of whom 142 were underground and 133 on surface.

Central Porcupine Mines, Limited

Central Porcupine Mines, Limited, was incorporated in December, 1933, with an authorized capitalization of 5,000,000 shares of $1 par value, of which 3,695,118 have been issued. The officers and directors are: C. H. E. Stewart, president; W. Samuel, vice-president; H. D. Poole, secretary-treasurer; J. M. Cunningham-Dunlop, W. H. Woods, and T. M. Mungovan, directors. The head office is at 25 King Street West, Toronto. The mine address is Schumacher.

The property consists of 14 claims adjoining the south boundary of the Coniaurum mine, in Tisdale township, Porcupine area, district of Cochrane.

The present operation is a joint effort by Central Porcupine Mines, Limited, and Coniaurum Mines, Limited. An internal shaft is being sunk in Central Porcupine ground from an extension of the Coniaurum 5,500-foot level. By the end of 1954 it had reached a depth of 1,018 feet below the level. The work is under the direction of Coniaurum Mines, Limited, and further reference to it appears on page 17 of this report.

The employment figures are included in those given for Coniaurum Mines, Limited. W. O. Lafontaine was acting manager for Coniaurum.

Cochenour Willans Gold Mines, Limited

Cochenour Willans Gold Mines, Limited, was incorporated in April, 1936, with an authorized capitalization of 3,000,000 shares of $1 par value, of which 2,961,655 have been issued. The officers and directors are: E. C. Cochenour, president; W. M. Cochenour, vice-president; F. J. Mills, secretary-treasurer; M. C. Mosher and R. M. Elliott, directors. The head office is at Suite 203, 2281 Yonge Street, Toronto. The mine address is Cochenour.

The mine is in Dome township, Red Lake area, Patricia portion of Kenora district. The company also has an option on the adjoining property of Marcus Gold Mines, Limited.

Mining and milling continued throughout 1954. There are two vertical, three-compartment shafts on the property. Operations are conducted through No. 1 shaft, which is 1,207 feet deep. No. 2 shaft, 446 feet deep, is not being used.

The following table shows the development work done during 1954, and the totals at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
150-foot	.....	8,085	.....	4,408	.....	2,124
275-foot	59	9,306	98	4,251	190	4,534
375-foot	112	10,914	320	5,313	531	5,166
475-foot	284	12,221	223	4,859	552	4,458
575-foot	324	5,563	950	3,928	1,465	4,180
675-foot	297	2,112	2,808	6,321	771	1,649
775-foot	498	960	1,364	3,543	442	1,161
875-foot	99	140	1,446	3,237	389	515
975-foot	.....	.....	99	99	166	166
1,075-foot	.....	.....	39	39	.....	.....
1,175-foot	.....	.....	.....	136	114	114

The following is taken from the manager's report for the year ending December 31 1954:

The accelerated program of development and exploration approved last year to investigate previously unexplored sections of the mine has produced very encouraging results.

Three new ore zones were discovered:

1) The South zone discovered on the sixth level, and developed on the seventh and eighth levels, known as the Ten structure.

2) The East zone developed on the fourth, fifth, and sixth levels, and known as the 13, 14, 15, 16, and 17 blocks.

3) The West zone located by diamond-drilling and partly developed on the sixth level. The sixth-level crosscut is continuing west, and drives on the fifth and seventh horizon into this west area have been started.

The ore passes from the sixth level to the ninth level, and from the tenth level to the eleventh level, were completed and in use at the year's end. The last ore pass not completed between the ninth and tenth levels was started and completed early in 1955.

A new dam was constructed in 402 North crosscut. This dam has successfully sealed off the water problem from this section of the mine, which had accounted for about forty percent of the total water pumped by the mine.

Mine ventilation is good. The required raises between the sixth and eighth levels were driven, and all levels are now tied in.

Acid treatment of the precipitate was introduced prior to refining and has successfully eliminated the formation of speiss on the gold bars produced, which increased the fineness of our bullion to 920 fine; the speiss is formed because of the presence of nickel in the precipitate.

The announcement that the mine, for the third consecutive year, won the Ontario award of the John T. Ryan trophies for mine safety for the year 1954, as well as the Dominion award is very gratifying and a tribute to all employees of the company.

The Cochenour Willans Mines rescue team won the District Mine Rescue Competition held in the Red Lake mining district for the year 1954.

Production

During the year 96,286 tons were hoisted, of which 66,045 tons were ore, and 30,241 tons were waste. Mining produced 54,733 tons of the ore milled, and the balance of 11,312 tons came from development.

The 66,045 tons of ore milled yielded 24,768.753 ounces of fine gold and 910.470 ounces of fine silver. The value of this bullion was $844,866.65, and the average recovery per ton milled was $12.79.

The average price received for gold sold to the Royal Canadian Mint during the year was $34.07967 per fine ounce. This price was $0.37638 per fine ounce less than the price received in 1953, and the lowest price received in any previous year. The average price received for silver was $0.83008

Costs

Details of the company's operating costs are outlined in the following tables:

Cost Per Ton Milled

	Total cost	Cost per ton milled		
		1954	1953	1952
Development and exploration	$362,905.41	$ 5.494	$ 4.865	$ 2.896
Mining	325,589.80	4.930	4.132	4.525
Milling	157,812.35	2.390	2.497	2.306
General mine expense	63,004.72	0.954	0.933	0.883
Head office expense	30.552.92	0.463	0.578	0.534
Marketing charges	7,516.15	0.114	0.143	0.229
Total operating costs	$947,381.35	$14.345	$13.148	$11.373
Deduct estimated return under Emergency Gold Mining Assistance Act	$154,000.00	$ 2.332	$ 1.861	nil
Net operating costs	$793,381.35	$12.013	$11.287	$11.373
Tons milled		66,045	61,680	67,361

COST PER OUNCE PRODUCED

	Total cost	Cost per ounce		
		1954	1953	1952
Development and exploration	$362,905.41	$14.651	$10.926	$ 5.686
Mining	325,589.80	13.145	9.280	8.885
Milling	157,812.35	6.371	5.607	4.528
General mine expense	63,004.72	2.545	2.096	1.733
Head office expense	30,552.92	1.234	1.298	1.038
Marketing charges	7,516.15	0.304	0.321	0.451
Total operating costs	$947,381.35	$38.250	$29.528	$22.321
Deduct estimated return under Emergency Gold Mining Assistance Act	$154,000.00	$ 6.218	$ 4.179	nil
Net operating costs	$793,381.35	$32.032	$25.349	$22.321
Ounces produced (gold)		24,769	27,467	34,309

Development and Exploration

COMPARISON TABLE

	1954	1953	1952
	feet	feet	feet
Shaft-sinking	....	.....	519
Drifting	2,943	3,412	4,023
Crosscutting	7,208	4,700	1,918
Raising	5,221	3,820	2,814
Total	15,372	11,932	8,755
Diamond-drilling:			
Underground	69,861	50,298	38,126
Surface	1,210	.....	3,317
Marcus	.....	5,439	13,300
Test holes	7,451	8,068	8,605

It will be noted that the amounts of crosscutting, drifting, raising, and diamond-drilling accomplished in the last year are considerably higher than the previous year and almost double that of 1952.

The success of this exploration program has been referred to earlier in this report.

The South zone, located 800 feet south of No. 1 shaft, is being developed on three levels, the sixth, seventh, and eighth. The dip of this ore is south 80 degrees and rakes to the west. Of particular significance is the increase in grade of ore on the eighth level; 549 tons from developing and raising on the first structure produced 549 tons averaging 0.74 ounces per ton.

The East zone, located 900 feet east of No. 1 shaft, dips to the southeast at 45 degrees This ore area is being developed over a favourable length of 800 feet. Development ore and stoping in this area provided 26,354 tons of ore with an average grade of 0.492 ounces per ton. The area was discovered from the new drive on the sixth level and is being explored on the fifth and fourth levels above. At present drilling on the seventh level is being carried out.

The West zone was located from exploratory drilling from the new 308 West area. A drive was put out on the sixth horizon, and the first ore was intersected 600 feet west of No. 1 shaft and is being explored and developed over a length of 650 feet west of the first ore. The ore dips 80 degrees southwest.

Diamond-drilling from the 605 West crosscut has returned good values down to the eighth level and up to the fourth horizon. Exploration drives on the fifth and seventh levels have started into this new mine area and will be followed by the eighth level. This area gives every indication of becoming a very important area to the mine. Development mucks from ore intersected in the crosscut returned ore averaging 0.67 ounces per ton.

Mining

	Tons
Ore broken from stopes	54,733
Ore from development	11,312
	66,045

Such 66,045 tons averaged 0.41617 ounces per ton and, at $34.07967 per ounce, showed a value of $14.18 per ton for a gross value of $936,719.02

Milling and Metallurgy

Details of mill operations are shown in the following summary:

	1954	1953	1952
Milled.....tons	66,045	61,680	67,361
Operating time.....percent	96.2	95.4	97.9
Milled daily.....tons	180.9	169	184
Average millhead (gold).....ounces	0.41617	0.4899	0.5671
Average flotation tail (gold).....ounces	0.02343	0.0220	0.0312
Average calcine tail (gold).....ounces	0.17720	0.0222	0.0264
Recovery.....percent	90.11	90.98	89.87

General

Expenditures on the Marcus property were held to a minimum. A road survey was run from No. 1 shaft to the new shaft site in the northeastern part of the property, and the right-of-way was cut.

During the year four separate groups of claims were investigated, two of which were uranium, one base metal, and one gold. None of these were considered of sufficient importance fo follow up.

The year has been one of considerable advance in respect to development and exploration at the mine. The intensive development program of the past year has placed the mine in a most satisfactory shape and the wisdom of the directors of this company in approving of such a program last year is most apparent now.

More knowledge of the ore habits was gained during the year, and it has been of special benefit in planning new development and exploration. A well-substantiated theory has proven that the majority of orebodies have a definite relationship to two rock formations that form the host rocks. The ore is localized at the contacts of these formations. A rock sequence has been established in the Precambrian Keewatin lavas of the mine area and has been of great aid in controlling exploration and development, and ore finding.

An average force of 156 men was employed, of whom 77 were underground and 79 on the surface. J. E. J. Fahlgren is mine manager.

Coniaurum Mines, Limited

Coniaurum Mines, Limited, was incorporated in July, 1929, with an authorized capitalization of 3,000,000 shares of no par value, of which 2,766,743 have been issued. The officers and directors are: J. M. Cunningham-Dunlop, president; A. L. Bishop, vice-president; A. G. Fulton, secretary; W. B. Malone, treasurer; Thayer Lindsley, W. S. Morlock, T. H. Rea, and F. D. Reid, directors. The head office is at 25 King Street West, Toronto. The mine address is Schumacher.

The main property consists of 22 claims, adjoining the McIntyre Porcupine mine, in Tisdale township, Porcupine area, district of Cochrane. It includes the former Goldale, Newray, Armstrong-Booth, and Strong Bow properties. The company has an agreement with Central Porcupine Mines, Limited, under which work on the adjoining Central Porcupine mine is done as a joint effort of the two companies. The operation is directed by Coniaurum Mines, Limited.

Mining operations, which had been suspended since September 25, 1953, because of a labour strike, were resumed on January 27, 1954, and continued for the rest of the year. The mill operated from February 3 to the end of the year.

The mine is operated through a system of vertical shafts and winzes, as shown in the following table:

Shaft or winze	Number of compartments	Total depth from surface
		feet
Bishop shaft	3 to 2,000 feet 4 below 2,000 feet	3,666
Bishop subshaft (below 3,250-foot level)	4	5,641
Goldale shaft	2 to 400 feet 3 below 400 feet	1,020
No. 1 winze (below 2,000-foot level)	2	2,533
No. 2 winze (below 3,000-foot level)	2 to 3,500 feet 3 below 3,500 feet	5,028
No. 3 winze (below 2,000-foot level)	2	2,755

The following table shows the development work done during 1954, and the total:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
100-foot		71		90		91
150-foot		414		732		
200-foot				171		490
250-foot				484		167
400-foot		7,168		3,831		907
500-foot		94		548		207
600-foot				55		323
650-foot		78				
700-foot		3,390		3,710		1,988
770-foot		5				
800-foot				304		485
850-foot		497		1,189		209
900-foot		174		1,430		1,230
950-foot			168	457	108	108
975-foot				101		
1,000-foot	116	8,634	46	7,083	32	6,969
1,100-foot		43		141		61
1,125-foot		229		529		
1,250-foot		4,881		3,660		2,716
1,300-foot		71		42		121
1,375-foot				247		
1,400-foot					30	30
1,425-foot					221	221
1,450-foot			92	92		
1,500-foot	31	8,070	213	5,915	547	3,149
1,625-foot				469		8
1,725-foot			85	85	5	5
1,750-foot	79	4,111	205	2,915	313	1,604
1,950-foot				27		
1,975-foot				68		19
2,000-foot		5,884	48	5,340	154	4,058
2,100-foot	350	350	286	286	173	173
2,125-foot				340		
2,200-foot				83		
2,250-foot		335		1,198		539
2,300-foot		1,701		949		1,388
2,350-foot				77		29
2,450-foot		761		1,024		2,718
2,500-foot		689		1,278		173
2,525-foot		86		335		259
2,600-foot		693		1,164		2,012
2,750-foot		2,653		2,604		3,647

(UNDERGROUND DEVELOPMENT WORK—*Continued*)

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
2,800-foot	.....	.....	.....	140	.....	20
2,825-foot	.....	.....	.....	147	.....	18
2,875-foot	.....	224	.....	101	.....	510
2,900-foot	.....	.....	.....	163	.....	242
2,950-foot	.....	.....	.....	82	.....	169
3,000-foot	.....	6,346	.....	2,644	.....	6,035
3,225-foot	.....	.....	.....	157	.....	105
3,250-foot	.....	3,072	.....	2,626	.....	3,874
3,300-foot	.....	.....	.....	156	.....	.....
3,375-foot	.....	110	.....	338	.....	188
3,400-foot	.....	.....	.....	136	.....	37
3,425-foot	.....	.....	53	53	34	34
3,450-foot	.....	.....	.....	.....	.....	13
3,500-foot	15	11,342	245	4,211	.....	5,589
3,550-foot	.....	127	.....	90	.....	119
3,750-foot	.....	4,077	597	6,081	601	6,475
3,800-foot	.....	.....	.....	188	.....	112
3,900-foot	.....	255	73	539	.....	286
3,925-foot	.....	.....	.....	223	.....	.....
4,000-foot	114	2,696	168	5,952	317	6,526
4,050-foot	.....	.....	.....	117	.....	49
4,075-foot	.....	.....	.....	178	.....	136
4,100-foot	.....	.....	91	1,121	23	929
4,150-foot	.....	303	.....	1,514	22	1,647
4,250-foot	80	2,725	125	3,205	21	4,504
4,325-foot	.....	.....	.....	124	.....	24
4,375-foot	.....	.....	72	185	126	296
4,400-foot	.....	.....	.....	852	.....	326
4,425-foot	.....	.....	.....	117	.....	38
4,500-foot	.....	5,539	.....	2,429	5	4,933
4,750-foot	83	3,920	148	2,731	536	2,736
4,925-foot	.....	.....	.....	163	.....	18
4,950-foot	.....	.....	.....	262	7	368
5,000-foot	.....	11,783	275	3,685	278	4,348
5,025-foot	.....	.....	22	186	.....	17
5,100-foot	.....	.....	54	159	.....	.....
5,250-foot	.....	5,137	99	4,007	72	4,454
5,300-foot	.....	.....	.....	50	.....	.....
5,325-foot	.....	45	.....	291	.....	182
5,400-foot	.....	.....	.....	515	.....	277
5,500-foot	.....	10,810	35	2,142	50	4,359
5,500-foot loading pocket	.....	.....	.....	.....	.....	349

The following is taken from the mine manager's report for the year ending December 31, 1954:

Exploration and Development

Exploratory development work was carried out in sections of the mine where diamond-drilling or geological conditions indicated a possibility of ore being found. The amount of work was equal to that done in 1953 but less than in former years and was confined to extending and enlarging the existing ore zones. No new exploratory drives were started during the year.

Crosscutting, drifting, and raising for the year amounted to 8,147 feet of advance as compared to 6,678 feet in 1953. Ore trammed to the mill from development amounted to 8,852 tons and accounted for 7.5 percent of the total ore milled.

The No. 68 vein zone from above the 1,000-foot level down to the 2,100-foot sublevel again received the major part of the attention. Except for No. 68B vein on the 950-foot level, which is 230 feet long but low grade, the ore shoots in this zone are short, of limited vertical extent, and require considerable sublevel work and stope development. Ore shoots of this type have been opened up and are currently being mined on the 1,500,- 1,750-, 2,000-, and 2,100-foot levels.

During the latter part of the year a new vein, designated as No. 61A, was drifted on the 3,500-foot level in the west end of the mine, and 225 feet of average grade ore over a narrow width was developed. The vertical extent of this ore is not yet known.

In that section of the mine east of the shaft on the lower levels, no new ore has been developed. Stope development has extended the ore in Nos. 66 and 67 veins, but No. 51 vein, which has produced ore of a good grade for a number of years, is close to exhaustion.

The following is a summary of the principal ore sections developed in drifting and raising during the year:

Level	Heading	Vein No.	Length	Width	Grade
			feet	feet	ounces per ton
950-foot	Drift	68B	70	3.9	0.30
	Raise	68B	90	4.0	0.27
1,500-foot	Drift	68A	77	3.0	0.62
	Raise	68A	188	3.7	0.34
1,725-foot	Drift	68D	66	3.8	0.26
	Raise	68D	64	3.6	0.26
2,100-foot	Drift	68	36	4.2	0.23
	Raise	68	94	4.0	0.21
3,500-foot	Drift	61A	225	3.9	0.35
4,750-foot	Drift	66	104	3.4	0.32

Diamond-Drilling

A total of 21,398 feet of underground diamond-drilling in 131 holes was completed during the year.

The greater part of the drilling was done in No. 68 vein zone from the 1,000-foot to the 2,100-foot level.

Stoping

During the eleven months of the year in which the mine operated, ore broken in the stopes amounted to 99,439 tons, having an average grade of 0.255 ounces per ton.

Distribution of production from the mine is given in the following table:

Levels	Trammed	Percentage of tonnage	Value	Percentage of value
	tons		ounces	
From above 1,000-foot	16,924	15.5	3,933	14.3
From 1,000- to 3,000-foot	13,904	12.7	3,453	12.4
From 3,000- to 4,500-foot	47,025	43.0	12,146	43.9
From 4,500- to 5,500-foot	31,475	28.8	8,134	29.4
Total	109,328	100.0	27,666	100.0

Ore Reserves

Although the total amount of development work done during the year was greater than in 1953, the ore reserves continued to decline in tonnage as well as grade.

Broken ore reserves as at December 31, 1954, were calculated to be 68,832 tons, with an average gold content of 0.235 ounces. This is an increase of 917 tons, with a decrease in grade of 0.006 ounces per ton.

Unbroken ore reserves as at December 31, 1954, were estimated at 141,225 tons, having an average grade of 0.238 ounces per ton, as compared with 156,275 tons, with an average grade of 0.240 ounces per ton at the end of 1953.

Operations

On January 27 the mine was re-opened following settlement of the strike. When mining operations returned to normal, work was concentrated on getting the joint Coniaurum-Central Porcupine internal shaft-sinking program started.

Installation of equipment for this project was completed, and actual sinking operations commenced on April 9. At the end of the year the shaft had advanced to a point 1,018 feet below the 5,500-foot level.

The average price received for gold produced in 1954, not including Emergency Gold Mining Assistance Act returns, was $34.09 per fine ounce compared with $34.52 the previous year.

Milling

During the past year 118,180 tons of ore were treated in the mill, resulting in a production of 28,160 ounces of fine gold and 4,981 ounces of fine silver. This represented a recovery of 96.9 percent of the gold content of the ore.

An average of 215 men was employed, of whom 142 were underground and 73 on the surface. This number includes the men employed in the Central Porcupine mine. W. O. Lafontaine was acting manager.

Consolidated Mosher Mines, Limited

New Mosher Longlac Mines, Limited, was incorporated in June, 1950, to succeed Mosher Long Lac Gold Mines, Limited. In February, 1954, the name was changed to Consolidated Mosher Mines, Limited. The authorized capitalization is 5,000,000 shares of $2 par value, of which 3,220,410 have been issued. The officers and directors are: Thayer Lindsley, president; Baptist Johnston, vice-president; F. C. Sullivan, secretary-treasurer; H. E. Nauss, assistant secretary-treasurer; J. M. Cunningham-Dunlop, M. C. Mosher, A. K. Roberts, T. H. Rea, and J. C. Allen, directors. The head office is at 25 King Street West, Toronto. The mine address is Geraldton.

The main property consists of 21 claims, to the west of the MacLeod-Cockshutt mine, in Errington township, district of Thunder Bay. The company also owns the former Hard Rock property, consisting of 17 claims in Errington township, and has an 80 percent interest in 6 claims in Jordan township, district of Kenora.

Operations at the main property continued throughout 1954. The vertical three-compartment No. 1, or Mosher, shaft was sunk a further 28 feet to a total depth of 2,069 feet. The following table shows the development work done during 1954, and the total amount at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
250-foot (station only)	.....	.....	.....	.....	.....	.....
500-foot (station only)	.....	.....	.....	.....	.....	.....
750-foot (station only)	.....	.....	.....	.....	.....	.....
1,000-foot (station only)	.....	.....	.....	.....	.....	.....
1,250-foot (station only)	.....	.....	.....	.....	.....	.....
1,500-foot	400	400	.....	.....	.....	.....
1,740-foot	197	1,258	13	365	.....	.....
1,890-foot	1,045	1,045	464	464	.....	.....
2,040-foot	2,925	2,925	996	996	17	17

Diamond-drilling consisted of 71 holes, totalling 19,410 feet, from underground.

An average force of 43 men was employed, of whom 19 were underground and 24 on the surface. A. E. Cave was manager.

Delnite Mines, Limited

Delnite Mines, Limited, was incorporated in October, 1934, with an authorized capitalization of 3,000,000 shares of $1 par value, of which 2,978,767 have been issued. The officers and directors are: W. V. Moot, president; K. C. Gray, vice-president; W. S. Walton, secretary-treasurer; L. R. Gulick, Harry Yates, James Savage, A. H. Sharpe, and A. F. Osborn, directors. The address of both the head office and the mine is Box 590, Timmins. The secretary's office is at 44 King Street West, Toronto.

The company's property consists of 16 claims in Deloro township, Porcupine area, district of Cochrane, three miles southeast of Timmins.

Mining operations, which had been suspended on September 25, 1953, because of a labour strike, were resumed on February 11, 1954. Milling was resumed on February 19, 1954, and both mine and mill continued to operate for the rest of the year.

The following table shows the depths and the number of compartments of the shafts on the property, all of which are vertical:

Shaft	Number of compartments	Depth from surface
		feet
No. 1[1]	2	391
No. 2	3	3,031
No. 3 internal (below 2,875-foot level)	4	4,512

The following table shows the development work done in 1954, and the totals at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
125-foot		1,938		1,164		601
250-foot		5,000		1,908	158	1,215
375-foot		2,024		1,119		1,223
500-foot		5,671		1,410		1,427
625-foot		3,287		1,106		575
750-foot		5,022		2,451		1,495
875-foot		2,749		453		521
1,000-foot		4,120		1,205	147	2,059
1,125-foot		1,657		131	140	762
1,250-foot		4,240		1,407		1,875
1,375-foot		1,395		226		690
1,500-foot		4,465		1,505		2,845
15 loading-pocket						67
1,625-foot		1,539		530		643
1,750-foot		2,326		2,653		1,468
1,875-foot		460		518		519
2,000-foot		1,758		1,801		838
2,125-foot		927		800		568
2,250-foot		3,126		2,348		1,433
2,375-foot		2,263	24	951		1,569
2,500-foot		3,872	36	3,078	158	1,866
25 loading-pocket						73
2,625-foot	242	2,383	79	1,174	637	2,490
2,750-foot		1,765		1,114	367	1,302
2,875-foot		943		2,484	250	1,577
28 loading-pocket						202
3,000-foot	310	1,027	42	324	226	569
3,125-foot		788		267	251	619
3,250-foot	95	828		321	180	597
3,375-foot	333	1,104	34	312	162	537
3,500-foot	178	687	36	401	172	570
3,625-foot	1,111	1,505	238	623	235	667
36 loading-pocket						66
3,750-foot	130	130	426	453	191	191
3,875-foot	153	153	440	468	404	404
4,000-foot	137	137	512	536	369	369
40 loading-pocket						11
4,125-foot	98	98	531	564	385	385
4,250-foot	502	502	572	682	358	370
4,375-foot	718	718	706	764	263	485
43 loading-pocket						68

[1]Not being used.

Diamond-drilling in 1954 consisted of 244 holes, totalling 18,191 feet, from underground.

The following is taken from the general manager's report for the year ending December 31, 1954:

Production

Ore treated	tons	144,431
Gross value		$1,364,982
Bullion recovered:		
Gold (38,051.916 ounces at $34.089273)	$1,297,162	
Silver (2,864.11 ounces at $0.830432)	$2,379	
Total value		$1,299,541
Value per ton		$9.451
Recovery per ton		$8.998
Recovery	percent	95.206

Ore and Waste Hoisted

Shaft	Ore	Waste	Total
	tons	tons	tons
No. 2	144,504	21,997	166,501
No. 3	29,069	26,105	55,174

Some 52,186 tons of backfill were placed in stopes (24,493 tons purchased).

Broken Ore Reserves

Broken ore reserves are estimated at 49,734 tons, a decrease of 19,576 tons in the year.

Costs

	Total costs	Cost per ton milled		Cost per ounce fine gold produced 1954
		1954	1953	
OPERATING COSTS (before cost-aid):				
Development and exploration[1]	$ 334,217	$ 2.314	$ 2.744	$ 8.783
Mining	708,561	4.906	4.852	18.621
Milling	190,401	1.318	1.439	5.004
General mine charges after deducting sundry revenue	97,412	0.674	0.838	2.560
Administrative expense (partly mine)	51,541	0.357	0.505	1.354
Bullion marketing expense, including mint handling and refining charges	9,915	0.069	0.075	0.261
	$1,392,047	$ 9.638	$10.453	$36.583
OTHER COSTS:				
Depreciation	$ 50,807	$ 0.352	$ 0.585	$ 1.335
Tax recovery			[2] 0.337	
Outside exploration	34,542	0.239	0.236	0.908
	$ 85,349	$ 0.591	$ 0.484	$ 2.243
TOTAL COSTS	$1,477,396	$10.229	$10.937	$38.826

Additions to Plant Buildings and Equipment

There were no additions to plant buildings.

Additions to equipment cost $25,174. The major item was the purchase of a 1,000-cubic-foot air compressor to replace one of the same size that was obsolete and worn out. Other items included

[1] Includes shaft sinking costs of $9,441 in 1954 as against $9,393 in 1953.
[2] Credit.

a ventilating fan for underground and equipment for making drill rods and for sharpening tungsten carbide drill bits.

Development

Some development work was done on the four bottom levels of No. 2 shaft, and some work remains to be done on these and other levels to test areas where drill holes have indicated veins of ore grade.

In the No. 3 internal-shaft area the main crosscuts from the shaft to the ore zone have been completed on all twelve levels. The ore and waste passes serving these levels have also been completed. The initial drifting is fairly well completed on the top six levels and has started on the bottom six levels. By the year's end a total of 3,407 feet of ore had been developed on these twelve levels in 6,367 feet of drifting.

During the year a drift advance of 4,007 feet gave 134 feet of ore in the No. 2 shaft area and 2,152 feet of ore in the No. 3 shaft area for a total of 2,286 feet of ore of average width and grade.

Subdrifting developed a further 1,049 feet of ore in small blocks out of a total advance of 1,544 feet.

Mining

Stoping was done on a number of levels from the 500- to the 3,625-foot. Most of the ore mined came from stopes on the 2,500-, 2, 625-, 2,750-, and 2,875-foot levels (the four bottom levels from the No. 2 shaft).

The percentage of ore broken in cut-and-fill stopes increased from 79 to 96 percent.

The broken ore reserves decreased by 19,576 to 49,734 tons and will continue to decrease since it is expected that most stoping will now be done by the cut-and-fill method.

Milling

For the operating period the milling rate was slightly higher at 457 tons as compared with 447 tons for the operating period in 1953. The percentage recovery dropped slightly from 95.79 to 95.21. This decrease was largely due to the drop in grade of the ore from 0.290 ounces in 1953 to 0.263 ounces in 1954. In several of the better-grade stopes there was a decrease in both tonnage and grade, and higher-grade replacements were not readily available to compensate for the change.

General

In July, the first connection underground between Aunor and Delnite was made when the bottom-level drift of Aunor was broken into the east end of Delnite's 2,875-foot level. This connection is important since it provides an excellent emergency exit for both mines. Towards the end of the year Delnite advanced headings on the 2,375-, 2,500-, and 2,625-foot levels to facilitate the raising of an internal shaft from the bottom level to the 2,100-foot level of Aunor.

Operating costs per ton milled decreased by 81.5 cents to $9.638 reflecting in part the shorter strike period in 1954 as compared with 1953 and the completion of the main crosscuts and the ore and waste passes in the No. 3 shaft area.

An average force of 214 men was employed, of whom 147 were underground and 67 on the surface. John Beattie is general manager.

Dome Mines, Limited

Dome Mines, Limited, was incorporated in July, 1923, to succeed the Dome Mines Company, Limited. The authorized capitalization is 2,000,000 shares of no par value, all of which have been issued; 55,332 shares are held in trust for the company. The officers and directors are: C. W. Michel, president and treasurer; J. H. Stovel, vice-president and consultant; J. B. Redpath, executive vice-president; C. C. Calvin, secretary; M. F. Stern, F. W. Pershing, B. C. Foy, J. L. Carson, H. C. Brunie, and A. B. Matthews, directors. The head office and mine office are at South Porcupine. The secretary's office is at 36 Toronto Street, Toronto.

The company owns 62 claims and the beds of Porcupine and Simpson lakes, in Tisdale, Whitney, and Shaw townships, Porcupine area, district of Cochrane.

Mining and milling operations continued throughout 1954. The mine was not affected by the labour strikes that occurred in the Porcupine area.

The following table shows the depths of the shafts and winzes on the property, and the number of compartments in each:

Shaft or winze	Number of compartments	Total depth from surface
		feet
No. 1 shaft[1]	3	105
No. 2 shaft[1]	3	805
No. 3 or main shaft	4 to 10th level 6 below 10th level	2,456
No. 4 internal shaft (below 13th level)[1]	3	2,052
No. 5 internal shaft (below 16th level)[1,2]	3	3,146
No. 6 internal shaft (below 16th level)[2]	5	4,097
No. 1802 winze (below 18th level)[1]	2	2,870
No. 2309 winze (below 23rd level)[1]	3	[3] 3,775

The following table shows the development done during 1954, and the totals:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
Not separated [from very old records]	.....	3,386	.....	2,077	.....	892
1st	.....	1,580	.....	2,486	.....	2,329
2nd	.....	49	.....	144	.....	26
3rd	.....	7,285	.....	5,737	.....	6,549
4th	.....	904	.....	867	.....	584
5th	.....	10,467	.....	8,230	.....	6,860
6th	.....	9,896	.....	6,543	.....	6,072
7th	.....	11,718	.....	6,053	144	7,017
8th	.....	11,975	84	7,118	29	9,551
9th	420	14,039	122	5,797	175	5,995
10th	.....	17,115	.....	7,407	156	9,927
11th	1,037	22,036	192	8,484	259	11,883
12th	736	23,239	379	9,165	625	11,734
13th	1,482	22,609	296	8,213	903	10,239
14th	1,472	27,632	410	10,641	1,834	15,738
15th	1,745	26,436	461	12,607	1,649	20,326
16th	701	27,870	269	11,610	795	24,372
17th	537	13,562	92	4,169	1,272	9,548
18th	153	14,148	375	9,519	358	11,066
19th	134	3,954	.....	468	216	1,516
20th	.....	4,245	.....	926	.....	1,447
21st	.....	993	.....	36	.....	503
22nd	180	2,229	.....	1,775	.....	649
23rd	3,430	18,690	1,961	7,225	210	3,859
24th	93	6,859	592	2,676	.....	2,782
25th	262	6,973	57	4,504	138	6,883
26th	316	4,093	226	2,882	421	2,631
27th	93	2,879	.....	1,730	.....	2,202
28th	296	2,471	.....	1,233	54	1,754
29th	.....	3,974	.....	2,201	.....	986

Diamond-drilling during 1954 consisted of 8 holes totalling 6,446 feet, from surface, and 493 holes totalling 91,836 feet,[4] from underground.

The following is taken from the general manager's report for the year ending December 31, 1954:

During the year 697,600 tons of ore were treated in the mill. In the course of mining operations 64,500 tons of waste rock were excavated, most of which was used as fill underground.

[1]Not being used for hoisting.
[2]Connected with the main shaft on the 16th and 18th levels.
[3]This winze has been partially stoped out.
[4]Of this footage, 2,699 feet was drilled into Dome ground from Preston East Dome ground.

The 697,600 tons of ore milled yielded 171,399 ounces of gold, the yield being 0.2457 ounces, or 4.91 dwt. per ton.

All grades of ore will be expressed in pennyweights (dwt.) throughout this report. One pennyweight equals one-twentieth of an ounce troy weight. The average price received for gold was $34.07 per ounce as compared with $34.42 per ounce for the previous year.

Costs

The expenditure on development was $962,041 or $1.38 per ton as compared with $1.52 per ton milled in 1953.

The expenditure on mining was $3,138,291 or $4.50 per ton as compared with $4.31 per ton milled in 1953.

The total operating charges for the year were $7.66 per ton as compared with $7.67 per ton milled in 1953.

Development

The total development work at 32,758 feet compares with 36,316 feet done in the previous year. The total of development work done below the 16th level was 13,061 feet as compared with 16,292 feet done in the previous year. The 98,281.5 feet of core diamond-drilling accomplished compares with 100,576.0 feet done in 1953.

Mining

The 697,600 tons of ore milled during the year were produced as follows:

Source of ore	Tonnage	Average grade
		dwt. per ton
From stopes	585,800	5.40
From development	111,800	3.53
Total	697,600	5.10

The following tabulation is presented to indicate the parts of the mine from which the ore came:

Source of ore	Tonnage	Average grade
		dwt. per ton
5th level to surface	7,680	4.15
Ankerite veins	225,820	4.69
Area serviced by No. 6 shaft	204,900	5.02
Remainder of mine	259,200	5.54
Total	697,600	5.10

Ore Reserves

Ore reserves at the close of the year were estimated at 2,461,000 tons, a net decrease of 9,000 tons for the year. The following tabulation is presented to indicate the change:

	1954	1953
	tons	tons
Unbroken ore	2,091,000	2,093,000
Broken ore	370,000	377,000
Total	2,461,000	2,470,000

Ankerite ore makes up 27 percent of the ore reserves.

Mill

Following are the milling results:

Ore treated	tons	697,600
Average grade treated	dwt. per ton	5.10
Recovery	percent	96.39

Capital Expenditure

The details of changes in Plant Buildings and Equipment are as follows:

Additions:	
Mine buildings and equipment	$ 9,307
Reduction buildings and equipment	15,215
Surface buildings and equipment	79,097
Increase	$103,619
Less retirements	24,572
Net increase	$ 79,047

General

In spite of higher wage rates and increases in price of some supplies, operating costs were lowered by one cent per ton owing to the greater tonnage treated, combined with improvements in operating efficiency. The mill treated 697,600 tons or 1,938 tons per operating day, which is the highest in our history.

It will be noted that the unbroken ore reserve total was slightly below the figure at the end of the previous year. The lower broken-ore reserve tonnage is owing to the considerable increase in cut-and-fill mining in recent years. During the past year 86 percent of the ore from stopes was mined by cut-and-fill methods.

An average of 988 men was employed, of whom 630 were underground and 358 on the surface. C. P. Girdwood is general manager.

Hallnor Mines, Limited

Hallnor Mines, Limited, was incorporated in April, 1936, with an authorized capitalization of 2,000,000 shares of $1 par value, all of which have been issued. The officers and directors are: J. Y. Murdoch, president; H. L. Roscoe, vice-president; C. H. Windeler, secretary; R. G. Rudolf, treasurer; Russell Horsfall, assistant secretary; Harold Pinnock, assistant treasurer; F. M. Connell, L. H. Timmins, and J. R. Bradfield, directors. The head office and mine office are at Pamour.

The property is in Whitney township, Porcupine area, district of Cochrane, adjoining the west boundary of the Pamour Porcupine mine.

Mining, which had been suspended since July 11, 1953, because of a labour strike, was resumed on February 3, 1954. The mill resumed operation on February 8. Both mine and mill operated for the rest of the year.

The mine is served by a vertical, three-compartment shaft, 3,156 feet deep. Preparations were being made at the end of 1954 for further sinking. The following table shows the development work done during 1954, and the totals at the end of the year:

Level	Depth below collar	Drifts		Crosscuts		Raises	
		1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet	feet
1st	211	317	3,566	.....	1,237	.....	328
2nd	361	.....	3,505	.....	1,508	100	1,863
3rd	561	.....	4,959	.....	1,701	.....	2,050
4th	762	.....	3,601	.....	353	28	1,919
5th	962	.....	3,826	.....	845	156	2,086
6th	1,112	195	4,082	.....	641	.....	1,025
7th	1,262	29	5,054	.....	1,086	.....	1,480
8th	1,412	753	2,326	55	243	484	1,308
9th	1,560	.....	2,603	.....	208	130	225

(UNDERGROUND DEVELOPMENT WORK—*Continued*)

Level	Depth below collar	Drifts		Crosscuts		Raises	
		1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet	feet
10th[1]							
11th	1,860	44	44	267	363	386	386
12th[2]	2,010						
13th[1]							
14th	2,160		2,587	16	166	62	199
15th[1]							
16th[1]							
17th	2,612		1,235		522		
18th	2,759	208	2,964		943	28	42
19th	2,909	995	2,226	210	877	551	675
20th	3,059	490	3,597	409	1,838	198	198

The following is taken from the manager's report for the year ending December 31, 1954:

Drifting

A total of 1,675 feet of drifting was done on the upper levels to further the main ore zone, and on the 11th level to explore values indicated by diamond-drilling north of the shaft. The latter proved to be of no importance.

On the lower levels, 2,311 feet of drifting was done in exploring the ore zone located on the 18th, 19th, and 20th levels. On the western end of these levels, a quartz vein 4 feet in width was opened up. Raises were driven connecting these three levels. The work showed vertical continuity of ore from the 18th to the 20th level, with horizontal lengths of 248, 459, and 270 feet, respectively, on the 18th, 19th, and 20th levels. Erratic high values encountered prevent the accurate determination of average grade; however, it will be above mine average. The vein occurs in lavas well to the north of the sediments, and being the first lava ore of any importance found at Hallnor, it opens interesting possibilities for general lava exploration at greater depth.

Of the total drifting completed, 1,119 feet was in ore averaging 0.60 ounces per ton cut grade.

Raising

Raising amounted to 3,411 feet comprising 3,150.5 feet of ventilation and fill raises and 260.5 feet of box-hole raises.

Diamond-Drilling

Diamond-drilling amounted to 28,616 feet comprising 3,970 feet of test holes necessary for mining on the upper levels and 24,646 feet of exploratory drilling. Of the latter, 11,699 feet was done on the lower levels mostly in exploration of the new vein.

Summary

Drifting	feet	3,986
Sublevel and stope drifts	feet	1,193.5
Raising	feet	2,122
Stope fill raises	feet	1,028.5
Box-hole raises	feet	260.5
Slashing	cubic feet	31,803
Diamond-drilling	feet	28,616

Stoping[3]

Ore broken amounted to 115,336 and ore drawn off was 112,307 leaving a balance of 3,029 tons. The broken ore reserve was increased to 26,543 tons.

Of the ore drawn, 102,585 tons came from cut-and-fill stopes, 8,959 tons from shrinking stopes and 7,879 tons from development headings.

[1]No station has been cut.
[2]Station only.
[3]11 months' operation.

The production from the various levels was as follows:

Level	1954	Total to Dec. 31, 1954
	tons	tons
1st	1,221	61,175
2nd	11,231	235,062
3rd	.....	285,092
4th	16,667	304,626
5th	18,162	372,573
6th	10,895	248,979
7th	31,295	263,736
8th	21,466	43,480
18th	.....	1,807
19th	607	607
Miscellaneous and development	8,904	161,761
Total	120,448	1,978,898

Backfill placed in stopes amounted to 83,225 tons.

Ore Reserves

At December 31, 1954, the ore reserves were 368,603 tons of average cut grade of 0.40 ounces of gold per ton. New ore found during the year amounted to 120,096 tons of which approximately half was due to greater mining widths than estimated in the upper mine, and the remainder was the new ore developed on the lower levels.

Mill

The mill was in continuous operation from February 8 to the end of the year with short shutdowns for repairs and inspections. For this period the 8- by 8-foot ball mill was in operation for 7,789 hours or 99.5 percent of possible running time.

Tonnage milled averaged 366 tons per day of operation compared with 363 tons per day in 1953.

The mill treated 119,630 tons of ore from which were recovered 42,676 ounces of fine gold and 3,067 ounces of fine silver, having a combined value of $1,457,246. The average recovery decreased from $13.12 per ton in 1953 to $12.18 per ton owing mainly to the drop in the price of gold.

To December 31, 1954, the mill has treated 1,974,206 tons of ore from which have been recovered 832,515 ounces of fine gold and 65,412 ounces of fine silver, having a combined value of $30,882,202.

General

Preparations are under way for sinking the main shaft below the 20th level (3,059 feet) to a depth of about 3,470 feet. This will provide for two new levels at 150-foot intervals for exploration of a zone of irregular values indicated by diamond-drilling north of the shaft, and for investigation of the downward extension of the new lava vein.

An average of 166 men was employed, of whom 99 were underground and 67 on the surface. W. J. Marshall is manager.

Hollinger Consolidated Gold Mines, Limited

Hollinger Consolidated Gold Mines, Limited, was incorporated in January, 1916. The authorized capitalization is 5,000,000 shares of $5 par value, of which 4,920,000 have been issued. The officers and directors are: J. R. Timmins, president; L. H. Timmins, vice-president; L. S. Weldon, executive vice-president; P. C. Finlay, secretary; J. I. Rankin, treasurer; A. A. McMartin, D. M. Dunlap, N. A. Timmins, Jr., Hon. Alphonse Raymond, J. A. McDougald, and J. Y. Murdoch, directors. E. A. Perry is manager of the Hollinger mine. The mine office and head office are at Timmins. The general office is at 44 King Street West, Toronto.

The main property operated by the company is in Tisdale township, Porcupine area, district of Cochrane, and includes part of the ground underlying

the town of Timmins. The company has numerous other holdings and interests. It owns and operates the Ross mine in Hislop township, district of Cochrane, and controls and operates the Young-Davidson mine,[1] in Powell township, Matachewan area, district of Timiskaming.

HOLLINGER MINE

Mining and milling operations were carried on throughout 1954.

The depths of the principal shafts and winzes on the property, and the number of compartments in each, are shown in the following table:

Shaft	Number of compartments	Depth from surface
		feet
Main	4	2,770
Central	6	3,195
No. 11	3	2,756
No. 26	5	3,063
No. 24 internal (below 2,750-foot level)	3	3,950
No. 25 internal (below 3,800-foot level)	4	5,150
No. 27 internal (below 2,450-foot level)	4	5,277

The following table shows the development work done during 1954:

Level	Drifts	Crosscuts
	feet	feet
100-foot	106	.....
200-foot	15	124
300-foot	210	16
425-foot	.....	.....
550-foot	.....	.....
675-foot	220	.....
800-foot	133	420
950-foot	69	59
1,100-foot	162	59
1,250-foot	94	.....
1,400-foot	.....	27
1,550-foot	.....	121
1,700-foot	303	39
1,850-foot	65	.....
2,000-foot	.....	.....
2,150-foot	.....	.....
2,300-foot	.....	.....
2,450-foot	.....	.....
2,600-foot	47	.....
2,750-foot	231	255
2,900-foot	46	.....
3,050-foot	134	76
3,200-foot	664	.....
3,350-foot	33	23
3,500-foot	21	.....
3,650-foot	389	232
3,800-foot	.....	.....
3,950-foot	.....	683
4,100-foot	.....	.....
4,250-foot	56	682
4,400-foot	.....	159
4,550-foot	.....	.....
4,700-foot	.....	.....
4,850-foot	192	18
5,000-foot	.....	.....
5,150-foot	623	510
5,300-foot	493	427
5,450-foot	436	327

[1]See account on page 96.

Diamond-drilling in 1954 consisted of 11 holes totalling 2,260 feet, from surface, and 1,479 holes totalling 160,368 feet, from underground.

There were 1,067,954 tons of ore hoisted.

The following is taken from the manager's report for the year ending December 31, 1954:

Bullion Statement

INVENTORY, JANUARY 1, 1954:		
Gold in process ($20.67)	$ 49,983	
Premium on gold in process	32,226	
Silver on hand	19,977	
		$ 102,186
GROSS VALUES PRODUCED, 1954:		
Ore milled	$11,480,068	
Tailings loss	359,886	
		11,120,182
		$11,222,368
INVENTORY, DECEMBER 31, 1954:		
Gold in process ($20.67)	$ 231,408	
Premium on gold in process	146,614	
Silver on hand	22,959	
		$ 400,981
BULLION SHIPPED DURING 1954		10,821,387
		$11,222,368

Milling

Total ore milled	tons	1,182,417
Average value per ton		$9.71
Gross value	$11,480,068.01	
Deduct loss in tailings	359,886.01	
Net value recovered		$11,120,181.74
Average per day	tons	3,907
Proportion of possible running time	percent	86.2
Milled per 100 percent running time	tons	4,532
Solutions precipitated per ton of ore	tons	1.2
Value per ton of tailings		$0.30
Cyanide consumed per ton of ore	pounds	0.562
Zinc consumed per ton of ore	pounds	0.050
Zinc consumed per ton of solution	pounds	0.042
Lime consumed per ton of ore	pounds	2.241
Lead acetate consumed per ton of ore	pounds	0.009
Average value of pregnant solutions		$7.81
Average value received per ounce of gold sold		$34.09

Ore Reserves (Hollinger and Ross Mines)

The ore reserves on December 31, 1954, consisted of 4,630,390 tons, averaging 0.308 ounces of gold, or $6.36 per ton, giving a total value of $29,453,014.

The ore reserves on December 31, 1953, consisted of 4,703,531 tons, averaging 0.309 ounces of gold, or $6.38 per ton, giving a total value of $30,002,050.

In the calculations dealing with ore reserves the price of gold at $20.67 per ounce has been taken as the basis of value. Taking the price of gold at $35 per ounce as the basis of value, the ore reserves had a total value of $49,867,634 at the end of the year, a decrease of $929,586 from the 1953 figure of $50,797,220.

Hollinger Mine

The rapid rehabilitation of the plant in January, following the reopening of the mine at the end of 1953, coupled with the surplus mill capacity, made it possible to meet the milled tonnage requirements of a full year's operation. A reorganization of some of the work resulted in a further increase in efficiency, so that the number of employees has been reduced from an average of 1,645 in 1953, to an average of 1,534 in 1954, while maintaining the same tempo of operation. The demand for labour was relatively low, and the supply was adequate. Labour turnover for the year was the lowest in more than eight years and amounted to 12.42 percent.

The underground exploration program of crosscutting and long-hole diamond-drilling was returned to schedule and should be nearly completed by the end of 1955. Nothing of a spectacular nature has been discovered. The methodical execution of the mining program in concentrating on the balancing of mining sequence and ore distribution, although permitting sufficient flexibility to explore and develop workings that were previously opened up when gold was $20.67 per ounce, has resulted in the discovery of considerable tonnages of ore. The cumulative effect of these additions has been successful to the extent that, although the milled tonnage was over 1,067,000 tons, the ore reserve was depleted by less than 70,000 tons.

The decrease in the amount of ore milled from above the 800-foot level to 30.7 percent compared with 33.5 percent in 1953, is in keeping with the plan to mine the lower levels at a higher rate and so maintain a more strategic disposition of the supply of ore. By this means it is expected to provide greater flexibility to operations in the years to come.

The estimated ore reserves at the Hollinger mine on December 31, 1954, were 4,010,455 tons, with a gold content of 0.321 ounces per ton. This is a decrease from the December 31, 1953, figure of 69,636 tons and a decrease in value of $773,760, taking the price of gold at $35 an ounce.

Employees

The average number of men employed during the year was 1,655, distributed as follows:

MINERS:		
Exploration	22	
Development	21	
Production	811	
		854
MECHANICS:		
Operation	56	
Maintenance	117	
		173
GENERAL:		
Mill and refinery	128	
Technical	140	
Clerical	67	
Miscellaneous	172	
Ross mine	121	
		628
TOTAL		1,655

Young-Davidson Mine

Work at the Young-Davidson mine has progressed according to schedule with both operating costs and gold recovery being slightly better than anticipated. The last blocks of ore were blasted in August, 1954, and tonnage broken, which amounted to 87,840 tons, was both complete and satisfactory.

Ore milled amounted to 312,217 tons, being an average of 862 tons per 362 days' operation, with a recovery of $3.41 per ton (gold at $35 per ounce).

Broken ore in stopes on December 31, 1954, is estimated at 170,271 tons.

General Exploration

A large group of claims in western Ontario were staked jointly with The Mining Corporation of Canada, Limited. Prospecting, sampling, and test drilling were done. The results did not warrant further work at the present time, and some claims are still being held by the two companies. Properties and mineral showings were examined in a number of areas throughout Ontario. Three examinations were made in Quebec. No options were taken. Prospecting and geological parties carried out field work in Ontario. Nothing of commercial interest was disclosed.

ROSS MINE

The Ross mine consists of approximately 456 acres, owned by the company, in Hislop township, district of Cochrane.

Operations continued throughout 1954.

The mine is served by a vertical shaft, and winze, as shown in the following table:

Shaft	Number of compartments	Depth from surface
		feet
No. 1	3	1,598
No. 2 (winze, below 300-foot level)	2	1,535

The following table shows the development work done during 1954, and the total:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
150-foot	.....	2,350	.....	1,573	.....	936
300-foot	.....	6,153	.....	2,413	.....	2,624
450-foot	1,467	8,517	334	5,523	251	3,674
600-foot	.....	4,310	.....	2,382	.....	2,647
750-foot	16	2,405	.....	2,330	102	2,674
900-foot	450	3,756	34	3,855	416	2,120
1,050-foot	724	1,907	.....	2,007	60	918
1,200-foot	728	1,743	800	3,173	204	832
1,350-foot	704	1,182	687	2,971	210	813
1,500-foot	.....	543	.....	1,853	.....	819
1,650-foot	.....	.....	.....	13	.....	.....

Diamond-drilling in 1954 amounted to 8 holes totalling 6,211 feet, from surface, and 97 holes totalling 9,629 feet, from underground.

There were 112,772 tons of ore hoisted. The mill treated 112,728 tons, an average of 313 tons per day.

A 100-gallon water tank, a new mine dry-house to accommodate 150 men, and a building to hold a new crushing plant were erected during the year. The machinery in the new crushing plant will be installed in 1955.

The following is taken from the company's report for the year ending December 31, 1954:

> The necessity to replace or repair some of the capital equipment at the Ross mine, and an economic study of the operating conditions, resulted in the decision to build a new mine dry and a crushing plant. The new plant is expected to increase the mill capacity by 10 percent and should reduce unit cost per ton by about 70 cents.
>
> Several new ore possibilities were explored by underground development and were found to be marginal.
>
> The ore reserves as of December 31, 1954, were 619,935 tons, with a gold content of 0.223 ounces per ton. These figures compare with 623,440 tons with an average gold content of 0.229 ounces per ton at the end of 1953. This is a decrease of 3,505 tons and a decrease in total value of $155,826, making a total value of $4,840,209 with gold at $35 per ounce.

The employment figures are included in those given for the Hollinger mine. J. J. Caty is resident manager. The mine address is Holtyre.

Hugh-Pam Porcupine Mines, Limited

Hugh-Pam Porcupine Mines, Limited, was incorporated in 1935, with an authorized capitalization of 4,000,000 shares of $1 par value, of which, 3,999,399 have been issued. The officers and directors are: R. A. Cranston, president; J. B. Streit, vice-president; W. H. Maedel, secretary-treasurer; J. A. Hackett and George Scott, directors. The head office is at 50 King Street West, Toronto. The mine address is Pamour.

The company owns 15 claims in Whitney township, Porcupine area, district of Cochrane. The mine is operated under the management of Broulan Reef Mines, Limited, and the ore is treated in the Broulan mill. Further details regarding the work appear in the report on Broulan Reef Mines, Limited, on page 9.

There are two vertical, two-compartment shafts on the property, the Mulholland and the Hughes, each about 200 feet deep. A two-compartment winze, 110 feet deep, runs at an angle of 70 degrees from the 200-foot level of the Hughes shaft. Considerable lateral work was done from these two shafts some years ago. The present work being done on the property is through extensions of the Reef workings of Broulan Reef Mines, Limited. All ore is hoisted through the Reef shaft. The following table shows the work done in the area in 1954, and the total:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
200-foot	44	283	.....	.....	62	229
350-foot	.....	187	.....	35	.....	145
500-foot	23	801	.....	46	54	194
650-foot	.....	2,174	.....	44	.....	157
800-foot	.....	915	.....	57	171	473
970-foot	320	1,389	.....	418	345	345
1,120-foot	.....	335	.....	.....	.....	.....
1,270-foot	305	487	.....	.....	.....	.....

Diamond-drilling in 1954 consisted of 68 holes, totalling 7,007 feet, from underground.

The following is taken from the mine manager's report for the year ending December 31, 1954:

Production and Treatment

During the year, 57,273 tons of ore were mined and milled. Production totalled $359,113.52 representing 10,543,051 ounces of fine gold, in addition to which it is estimated that $59,515.52 will be received under the terms of the Emergency Gold Mining Assistance Act. Average recovery was 0.184 ounces of gold or $6.27 per ton milled.

Mining

During the year stopes on the 200-, 350-, 500-, 800-, 970-, and 1,120-foot levels were in operation, and stope preparation was carried out on the 650-foot level.

Costs

Operating costs, exclusive of charges by Broulan Reef Mines, Limited, for use of shaft, plant, etc., were $5.88 per ton, or $6.72 per ton including these charges.

W. F. Brown is mine manager. Employment figures for the year are given in the report on Broulan Reef Mines, Limited.

Kerr-Addison Gold Mines, Limited

Kerr-Addison Gold Mines, Limited, was incorporated in April, 1936, with an authorized capitalization of 5,000,000 shares of $1 par value, 4,730,301 of which have been issued. The officers and directors are: J. Y. Murdoch, president; J. H. Rattray, vice-president; G. A. Cavin, secretary; James Ingram, treasurer; André Dorfman, H. H. Leather, F. M. Connell, W. D. Smith, and H. L. Roscoe, directors. The head office is at 44 King Street West, Toronto. The mine address is Virginiatown.

The company's main property consists of 34 claims, about 1,102 acres, in McGarry township, Larder Lake area, district of Timiskaming.

Mining and milling continued throughout 1954. The mine is operated through the vertical, five-compartment No. 3 shaft, 3,995 feet deep.

The following table shows the development work done in 1954, and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
60-foot[1]	.....	283	.....	1,248	.....	.....
175-foot	.....	7,545	.....	901	.....	2,773
300-foot	16	9,639	48	2,179	348	6,748
500-foot	.....	9,398	.....	2,628	244	8,067
700-foot	.....	11,618	.....	1,920	217	8,374
850-foot	.....	7,290	.....	2,300	171	4,264
1,000-foot	.....	14,344	.....	3,954	303	5,632
1,150-foot	.....	10,032	.....	2,481	.....	5,607
1,300-foot	201	13,803	.....	2,258	12	6,836
1,450-foot	.....	8,512	.....	2,991	573	5,329
1,600-foot	.....	9,996	91	3,323	179	8,215
1,750-foot	.....	5,568	.....	2,922	228	5,301
1,900-foot	157	7,955	60	1,963	280	5,543
2,050-foot	213	6,302	38	3,045	487	3,492
2,200-foot	310	7,726	.....	2,061	642	4,710
2,350-foot	101	7,171	.....	1,602	475	2,915
2,500-foot	57	[2]10,302	38	2,071	992	6,408
2,650-foot	1,276	4,732	113	1,406	1,726	3,144
2,800-foot	1,095	3,123	826	1,739	928	1,391
2,950-foot	774	2,067	850	1,759	1,544	1,987
3,100-foot	2,657	4,463	370	1,253	1,224	1,662
3,250-foot	130	1,495	159	1,209	279	820
3,400-foot	1,437	1,613	103	922	62	508
3,550-foot	1,005	1,669	67	1,128	152	626
3,700-foot	310	1,530	55	1,186	136	641
3,777-foot	.....	62	22	22	.....	248
3,850-foot	1,747	1,747	933	1,117	184	463

Diamond-drilling in 1954 consisted of 991 holes, totalling 165,487 feet, all from underground.

There were 1,658,293 tons of ore hoisted; the mill treated 1,629,298 tons.

The following is taken from the manager's report for the year ending December 31, 1954:

Production

In terms both of ore tonnage milled and ounces of gold extracted, production was at an all-time high. The dollar value of production was greater than for 1953 but less than for 1952 because of the reduced price of gold. Dollar production per ounce of gold amounted to $36.10 in 1952, $35.01 in 1953, and $34.17 in 1954. Extraction of gold in milling was 94.1 percent.

Summary of Production, 1954

Total milled (average per day, 4,546 tons).....tons	1,659,298
Total gold recovered.....ounces	355,473.24
Total silver recovered.....ounces	20,119.44
Average gold recovered per ton (0.2142 ounces at $35 per ounce).....	$7.4970
Average tailings loss per ton (0.0135 ounces at $35 per ounce).....	$0.4725
Average mill head value per ton (bullion plus tails) (0.2277 ounces at $35 per ton).....	$7.9695
Total realized value of bullion (Canadian funds).....	$12,146,148.87
Realized value of bullion per ton (Canadian funds).....	$7.320

[1]From an old adit, not from No. 3 shaft.

[2]Includes 465 feet on Arjon property.

Costs

	Total	Per ton
Development	$1,288,420.87	$0.777
Stope development	371,868.75	0.224
Mining	2,029,888.44	1.223
Haulage	838,685.09	0.505
Hoisting	316,990.57	0.191
Crushing and conveying	178,374.37	0.108
Milling	1,109,127.42	0.668
General expense	551,880.92	0.333
Bullion marketing	101,115.68	0.061
Total operating costs at mine	$6,786,352.11	$4.090
Net operating profit at mine (before provision for depreciation, taxes, and head office expense)	$5,359,796.76	$3.230

The increase of $0.23 per ton in operating costs, owing mainly to the change-over to cut-and-fill mining methods, was less than anticipated.

Mining and Mine Development

In the block of levels now under development from the 2,800- to the 3,850-foot levels inclusive, drifts were driven as far as the known east limit of No. 21 orebody on the 3,400-, 3,550-, and 3,850-foot levels in preparation for the blocking out of ore by diamond-drilling. From the main crosscuts, drifts were driven west 1,100 feet on both the 2,800- and 3,100-foot levels, and 700 feet on the 3,850-foot level, and diamond-drilling from these has so far failed to develop any ore.

In the ore-pass system, construction of control chutes was completed. At the 3,777-foot crusher level the ore-crusher station was excavated, and the crusher, transferred from the 1,300-foot level, installed.

Major development programs in direct preparation for stoping were underway on the 2,650-, 2,800-, 2,950-, and 3,100-foot levels.

In mining, the emphasis was on the conversion to cut-and-fill stoping. During the year 381,891 tons were broken in these stopes. This tonnage represented 23 percent of the mill feed and 35.5 percent of tonnage broken. The objective for 1955 is to mine 1,000,000 tons by cut-and-fill methods.

Of the total break of 1,075,494 tons, 592,815 tons or 55.2 percent were broken in the 600-foot block of ground between the 2,050- and 2,650-foot levels.

Of the 1,659,298 tons of mill feed, 62.2 percent was drawn from the 900-foot block of ground between the 1,750- and 2,650-foot levels and 25.8 percent from between the 1,000- and the 1,750-foot levels.

The rate of backfilling, mainly of old stopes, was increased by 60 percent over that of the previous year. During 1954, 991,614 cubic yards were placed in the mine, of which 584,910 cubic yards were hydraulic sand extracted from mill tailings, 163,940 were screened hydraulic sand, 109,778 were dry pit sand and gravel, and 132,986 cubic yards were rock from mine development. Approximately the same rate of backfilling will be maintained through 1955.

Ore Development

Between the 2,650- and 2,800-foot levels there are 720,303 tons of ore having a grade of 0.4063 ounces per ton; between the 2,800- and 2,950-foot levels there are 589,481 tons of ore having a grade of 0.4485 ounces per ton; between the 2,950- and 3,100-foot levels there are 444,385 tons of ore having a grade of 0.4236 ounces per ton; and between the 3,100 and the 3,250-foot levels there are 574,314 tons of ore having a grade of 0.3452 ounces per ton. In all cases the foregoing figures allow for dilution. The tonnages are included in *Ore Reserves*.

At the 3,400-foot level, orebodies Nos. 21 and 21S. have been drilled to a point where there is now indicated an ore length of 1,640 feet, an average width of 36.2 feet, and an indicated undiluted grade of 0.4387 ounces per ton.

On the 3,550-foot level, ore development has been started.

At the 3,700-foot level the ore picture, showing 7,774 tons per vertical foot with an undiluted grade of 0.6768 ounces per ton, remains unchanged.

From the average of 7,300 tons per vertical foot between the 2,500- and 2,650-foot levels, the known orebodies have progressively narrowed down to an apparent minimum of about 2,750 tons at the 3,100-foot level and then progressively expanded again to the 3,700-foot level where they show about 8,500 tons per vertical foot after allowing for dilution. Fortunately, the improvement in ore grade is such that there are about as many ounces of gold per vertical foot in these lower levels as there were in those upper horizons above the 2,500-foot level. At the 3,700-foot level the concentration of gold is greater than at any horizon so far developed.

Ore Reserves

Proven ore reserves at the end of 1954 were as follows:

Between surface and the 1,600-foot level there are 3,539,353 tons of ore having an average grade of 0.2280 ounces per ton; between the 1,600- and 2,500-foot levels there are 8,068,616 tons of ore having an average grade of 0.2955 ounces per ton; and between the 2,500- and 3,250-foot levels there are 3,382,942 tons of ore having an average grade of 0.3800 ounces per ton; or a total of 14,990,911 tons having an average grade of 0.2986 ounces per ton, after allowing for dilution. Included in this reserve are 518,638 tons of broken ore having a grade of 0.1850 ounces per ton.

General

Alongside the timber-treatment plant erected last year a timber-framing plant has been built to make possible the preparation of the constantly increasing volume of timber now being used as stoping is carried to greater depths. At the year's end only part of the equipment had been installed, and the waste-burning system was still incomplete.

In April a decision was made to erect flotation and roasting plants within and adjacent to the cyanide mill in order that a higher percentage of the gold might be recovered from the greater tonnages of refractory ore now being mined. At the year's end construction work on these plants was well along, with their operation expected by April 1, 1955. To supply the power for these plants a three-phase, 2,500-kilovolt-ampere transformer was added to the substation. A waste-heat steam generator is included in the roasting plant. It will have a rated capacity of 10,900 pounds of steam per hour at a pressure of 400 pounds per square inch. The steam will be used for heating the entire surface plant.

Twenty houses were constructed during the year for employees' accommodation.

An average of 1,045 men was employed, of whom 654 were underground and 391 on the surface. W. S. Row is manager.

Kirkland Lake Gold Mining Company, Limited

Kirkland Lake Gold Mining Company, Limited, was incorporated in November, 1915, with an authorized capitalization of 5,500,000 shares of $1 par value, of which 5,326,699 have been issued. The officers and directors are: V. H. Emery, president; W. S. Walton, vice-president; H. F. Cassidy, secretary-treasurer; N. S. Beaton, managing director; J. B. Tyrrell and J. A. Dalton, directors. The head office and mine office are at Chaput-Hughes. The executive office is at 44 King Street West, Toronto.

The company's main property consists of 11 claims in Teck township, Kirkland Lake area, district of Timiskaming.

Mining and milling operations continued throughout 1954.

The depths of the shafts and winzes in the mine are given in the following table:

Shaft or winze	Number of compartments	Total depth from surface
		feet
No. 1 shaft[1]	2	894
No. 2 or main shaft	3	2,666
No. 1 winze (below 2,475-foot level)	4 to 2,975 feet 3 below 2,975 feet	4,952
No. 2 winze (below 4,900-foot level)	3	5,897
No. 3 winze (below 3,600-foot level)	3	4,487
"1,000" winze (below 1,000-foot level)	2	1,134
No. 4 winze (below 4,750-foot level)	3	5,886

There was no shaft sinking in 1954.

[1]Not being used.

The following table shows the development work done during 1954, and the totals at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
No. 2 (MAIN) SHAFT:						
100-foot						171
200-foot						96
300-foot						179
400-foot		213		172		109
500-foot		445		345		58
600-foot		987		206		
700-foot		251		107		
800-foot		1,918		470		287
900-foot		754		391		185
1,000-foot		1,990		387		365
1,100 foot (sublevel from 1,000-foot)		552		236		173
1,200 foot		1,698		379		196
1,300-foot		1,484		648		321
1,400-foot				17		
1,500-foot				19		284
1,600-foot		2,614		1,893		
1,725-foot				27		168
1,850-foot		787		256		389
1,975-foot		1,186		499		231
2,100-foot		1,019		238		171
2,225-foot		774		464		174
2,350-foot		1,575		426		572
2,475-foot	205	1,388	90	766	136	474
No. 1 WINZE:						
2,600-foot		961		453		349
2,725-foot		1,693		259		506
2,850-foot		2,196		310		91
2,975-foot		1,550		282		365
3,100-foot		1,396		195		153
3,225-foot	834	1,379	58	333	119	269
3,375-foot		1,007		84		166
3,475-foot		1,587		677		265
3,600-foot		2,461		3,401		239
3,750-foot		3,337		796		412
3,875-foot		3,466		1,729		611
4,000-foot		1,369		821		
4,150-foot		2,333		950		228
4,300-foot		4,503		1,462		475
4,450-foot		7,690		2,294		954
4,600-foot	160	4,998		1,930		642
4,750-foot	68	3,891	129	2,431		1,571
4,900-foot	224	5,260		1,599	67	1,141
No. 2 WINZE:						
5,050-foot		1,108		816		245
5,200-foot		197		320		96
5,325-foot		723		210		383
5,450-foot	294	7,786	70	2,021	90	1,524
5,600-foot		1,027		80		310
5,725-foot		51		7		
5,850-foot	212	1,647		2,089	74	258
No. 3 WINZE:						
3,725-foot		297		321		165
3,850-foot		360		192		165
3,975-foot		669		214		165
4,100-foot		904		152		207
4,225-foot		834		181		142
4,350-foot		1,136		254		220
No. 4 WINZE:						
5,010-foot	15	2,000		396	35	659
5,120-foot	5	1,641	27	418	117	453
5,230-foot	250	3,284	15	910	37	416
5,340-foot	449	4,109	68	793	58	1,150
5,600-foot	173	4,276		652	24	753
5,725-foot	8	2,724	432	1,183	212	563

Diamond-drilling in 1954 consisted of 45 holes, totalling 6,654 feet, from underground.

The following is taken from the report of the managing director for the year ending December 31, 1954:

Operating Costs

	Total	Cost per ton milled
Development and exploration	$ 222,926.53	$ 1.90
Stoping	325,789.92	2.78
Timbering	252,195.72	2.15
Transporting ore, hoisting, etc.	285,297.10	2.44
Milling	192,156.79	1.64
Marketing bullion	12,120.43	0.10
General and undistributed charges (maintenance mine buildings, administration and management, insurance, workmen's compensation, and miscellaneous)	209,716.71	1.79
Total	$1,500,203.20	$12.80

Gold produced	ounces	39,572.473
Cost per ounce		$37.91

For purposes of comparison with previous years the government cost-aid has not been taken into account in the foregoing calculations.

Work Done in Mine

Ore broken	tons	116,941
Drifting	feet	2,905
Crosscutting	feet	799
Sinking		nil
Raising	feet	969
Excavation	cubic feet	14,207
Diamond-drilling	feet	6,654

The distribution of work done for the year, excluding excavation, was as follows:

	Hoisting lift		
	First (2,400-foot level to surface)	Second (4,900- to 2,400-foot level)	Third (5,850- to 4,900-foot level)
	percent	percent	percent
Ore hoisted	0.1	6.4	93.5
Development	9.2	35.7	55.1

New Ore Developed During the Year

Level	Length	Average width	Average cut grade at $35 per ounce
	feet	feet	
32nd	275	3	$10.30
49th	23	3	10.80
50th	15	3	42.00
52nd	150	3	14.80
54th	216	3	13.00
56th	85	3	9.20
Total	764	3	$12.50

Ore from development accounted for 17 percent of the ore milled during the year, and 26 percent of drifting was in ore.

Production

Milled	tons	117,137
Value per ton		$12.12
Gross value		$1,420,197.35
Recovery per ton		$11.53
Bullion produced		$1,351,081.48

Milling

Ore milled	tons	117,137
Average value per ton		$12.12
Gross value		$1,420,197.35
Loss in tailings		$69,115.87
Net value recovered		$1,351,081.48
Average milled per day	tons	320.9
Value in tailings per ton		$0.59
Extraction	percent	95.1

Production

Quarter	Milled	Bullion value	Recovery per ton
	tons		
1st	29,975	$321,635.33	$10.73
2nd	30,740	354,097.10	11.52
3rd	25,670	303,825.50	11.83
4th	30,752	371,523.55	12.08

The following table covering the last five years shows the adverse effect on bullion returns, resulting from the differences in exchange between the Canadian and American dollars, also the cost per ounce:

Year	Produced	Average price received per ounce for gold	Value of bullion recovered	Cost per ounce
	ounces			
1950	39,114	$38.11	$1,490,850	$32.85
1951	42,035	36.86	1,549,738	33.99
1952	44,827	34.35	1,540,202	33.09
1953	43,173	34.42	1,489,066	35.00
1954	39,572	34.07	1,351,081	37.91

General

During 1954, as compared with 1953, tonnage milled was increased and costs per ton lowered, but since the grade of ore treated was down, costs per ounce of gold produced were up.

Because of the increase in the cost per ounce it was necessary to remove 46,710 tons, at least temporarily, from the reserve of ore in place. This is a serious loss; also possible new ore, which might have been discovered in the course of mining the tonnage referred to, will remain undiscovered. In addition, six old workings with 7,995 tons of broken ore were excluded from broken ore reserves since it is not now economic to treat this material. The proven ore reserves in the mine at the end of 1954 amounted to 224,953 tons, having a gross cut value of $3,396,513 (gold at $35 per ounce).

The mine payroll at Kirkland Lake for 1954 was $1,018,246.23, an increase of $12,714.97 over 1953.

The company spent $393,090.42 for supplies and materials in 1954, practically all in Canada.

Mine Exploration

Exploratory work was concentrated this year on the upper levels of the mine in an attempt to find ore that would be less expensive to mine than the principal current sources, which are over a mile down. On the 24th level a low-grade vein was drifted on for 205 feet. At the year's end a raise on this vein was in ore for 98 feet, which averages $24.25 for a width of three feet.

On the 32nd level two shoots of ore, totalling 275 feet, averaged $10.30 for a three-foot width and a raise from one shoot showed $36.70 for a three-foot width along a slope length of 145 feet. On the 46th level submarginal grade was found along 160 feet of drifting, and this vein will be investigated above this horizon. Ore grades mentioned in this paragraph are cut grades and are based on gold at $35 per ounce.

Last year's report described the finding of an interesting zone of mineralization some 1,200 feet south of the producing veins on the 57th level. Additional work was done this year but owing to the depth and the distance of this zone from the principal workings the cost of bringing such a zone into production under present conditions rendered further exploratory work unjustified at this time.

Outside Exploration

Field activities during 1954 were shared at different times with other mining companies and consisted mainly of prospecting and testing base metal and iron prospects in northwestern Ontario.

No further work was done during the year at the Labbe Asbestos prospect near Thetford Mines, Quebec, the Selley Uranium prospect in southeastern Manitoba, or the claims staked in 1953 in New Brunswick. Interests held and work done at these properties have been detailed in previous reports.

The iron-bearing serpentine staked in 1953 at Puddy Lake, which is west of Lake Obongo in northwestern Ontario, was surveyed magnetically last winter. Geological mapping and surface sampling carried out during the summer showed this structure to be too low in iron to make an orebody. Last summer additional iron-bearing serpentine belts were found in this vicinity but these also were of too low a grade to be of economic interest. Our company had a 50 percent interest in these undertakings.

Last spring a small interest was acquired in Baseline Mines, Limited, which owns 63 claims near Killala Lake, some 30 miles west of Manitouwadge Lake. Geophysical surveys indicated a conductor, which outcropped as a large rusty zone. Seven diamond-drill holes through this zone all showed sulphides, but no assays of economic interest were had, and work has now been suspended.

The company participated in financing Chip Mines, Limited, which owns 46 claims at Manitouwadge Lake adjoining Geco and Willroy property. An electromagnetic survey indicated several conductors, and these are being tested by diamond-drilling. Drilling has been confined to the northern portion of the western claims group where eight holes have been drilled to test a strong conductor along a strike length of about a half a mile. These holes cut pyrrhotite mineralization with traces of copper in places. One hole cut a parallel anomaly caused by an unmineralized shearing. Drilling is to be resumed to test other geophysical anomalies, some of which are under Manitouwadge Lake. The company's interest in this financing is 10 percent.

In the Tashota area, where Teck-Hughes prospectors made base metal finds last fall, a group of 25 claims has been staked jointly by Kirkland Lake Gold Mining Company, Limited, and Northern Canada Mines, Limited, at Cecil Lake some four miles east of the main Teck-Hughes claims group. The men doing the staking were shown an old copper find on the company's ground, but no details of this occurrence are available. Plans are being considered to have the claims surveyed geophysically this winter. Prospecting and geological mapping will be done next summer, and the reported copper find will be investigated.

The company has a 5½-percent interest in 55 claims that were staked recently in the Little River area, New Brunswick, where American Metals is investigating important base metal discoveries.

An average of 306 men was employed, of whom 218 were underground and 88 on the surface. L. C. Dixon is general superintendent.

Lake Shore Mines, Limited

Lake Shore Mines, Limited, was incorporated in February, 1914, with an authorized capitalization of 2,000,000 shares of $1 par value, all of which have been issued. The officers and directors are: A. L. Blomfield, chairman of the board; J. C. Adamson, president; Albert Wende, vice-president and treasurer; G. F. Doggett, secretary; W. W. Foskett and C. M. Hilton, directors. The head office and mine office are at Kirkland Lake.

The company's main property, containing about 287 acres, is in Teck township, Kirkland Lake area, district of Timiskaming.

Mining and milling operations continued throughout 1954.

The depths of the shafts in the mine are shown in the following table:

Shaft	Number of compartments	Total depth from surface
		feet
No. 1 (surface to 2,200-foot level)	3	2,250
No. 1 shaft extension (2,000-foot to 4,450-foot level)[1]	3	4,500
No. 2 (inclined)[2]	1	[3] 200
No. 3[1]	5	3,995
No. 4 (below 4,325-foot level)[4]	3	8,176
No. 5	5	3,995
No. 6 (below 3,575-foot level)[5]	5	6,098

There was no shaft sinking in 1954.

The following table shows the development work done in 1954, and the totals at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
100-foot		582		14		
200-foot		5,346		2,001		823
300-foot		851		181		91
400-foot		7,814		2,727		9,104
600-foot		9,732		3,146		8,540
800-foot		10,307		3,304		12,339
1,000-foot		10,197		4,013		16,575
1,200-foot		8,415		1,677		8,655
1,400-foot		5,546		2,616		10,091
1,600-foot		6,948		2,360		6,419
1,800-foot		5,872		2,057		5,796
2,000-foot		6,776		3,554		4,763
2,200-foot		7,217		2,073		6,542
2,325-foot		6,814		1,845		3,843
2,450-foot		6,647		1,557		3,049
2,575-foot		7,035		2,331		3,698
2,700-foot		7,118		2,576		3,628
2,825-foot		7,678		1,597		2,142
2,950-foot		7,418		1,689		2,316
3,075-foot		9,116		3,071		2,287
3,200-foot		7,801		1,240		2,334
3,325-foot		5,575		1,524		1,692
3,450-foot		5,888		1,273	115	1,389
3,575-foot		5,172		2,131		1,315
3,700-foot		6,521		3,158		1,986
3,825-foot		4,217		2,368		1,260
3,950-foot		4,673		2,359		1,399
4,075-foot		4,466		1,505	122	1,130
4,200-foot	77	4,762		1,833	115	1,779
4,325-foot		4,952		962		1,445
4,450-foot		5,411		2,343		1,787
4,575-foot	31	4,485		1,997		1,355
4,700-foot		3,983		881		958
4,825-foot		4,727		846		1,099
4,950-foot		4,278		992		838
5,075-foot		4,647		2,159		1,107
5,200-foot		4,902		1,844		1,110
5,325-foot		4,605		2,244		1,172
5,450-foot		5,856		3,687	11	1,513
5,575-foot		4,456		1,489		906

[1]Not being used.
[2]Used for supplies and timber only.
[3]Incline distance, 632 feet.
[4]Hoist at 5,575-foot level.
[5]Hoist at 3,825-foot level.

(UNDERGROUND DEVELOPMENT WORK—*Continued*)

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
5,700-foot	110	4,069	.....	1,518	27	688
5,825-foot	.....	3,089	.....	1,551	146	1,155
5,950-foot	.....	4,479	.....	1,613	.....	965
6,075-foot	.....	2,487	.....	855	126	844
6,200-foot	.....	1,205	.....	601	.....	369
6,325-foot	.....	2,048	.....	417	.....	479
6,450-foot	.....	138	.....	567	.....	247
6,575-foot	.....	1,563	.....	1,461	.....	163
6,700-foot	.....	.....	.....	297	.....	155
6,825-foot	.....	1,230	.....	849	40	56
7,075-foot	.....	.....	123	531	217	217
7,325-foot	.....	2,242	119	1,783	.....	230
7,575-foot	.....	400	.....	863	274	341
7,700-foot	413	1,339	137	823	82	402
7,825-foot	503	2,490	153	1,410	174	336
7,950-foot	1,160	1,160	881	1,005	.....	.....
8,075-foot	1,572	1,572	759	879	.....	.....

Diamond-drilling in 1954 consisted of 83 holes, totalling 9,438 feet, from underground.

Sand for mine backfill was obtained from the company's own pit in Gauthier township.

The following is taken from the mine superintendent's report for the year ending December 31, 1954:

During the year, 252,455 dry tons of ore milled produced bullion yielding 85,303 ounces of gold and 30,565 ounces of silver. The gross value, including the estimated amount recoverable under the Emergency Gold Mining Assistance Act, was $3,343,002.89.

Production

From March, 1918, to December 31, 1954:		
Milled	tons	14,829,736
Gross value of bullion[1]		$242,963,548.46
Dividends paid		$103,160,000.00

Costs

Costs per ton milled for the last five years are given below:

	1950	1951	1952	1953	1954
Development	$ 1.234	$ 1.144	$ 1.432	$ 1.273	$ 1.102
Mining	6.658	7.358	8.600	8.826	8.169
Milling and refining	1.586	1.744	[2] 2.498	[2] 2.449	[2] 2.283
Marketing bullion	0.104	0.159	0.093	0.114	0.093
General and administrative	0.299	0.334	0.428	0.406	0.382
Operating cost	$ 9.881	$10.739	$13.051	$13.068	$12.029
Depreciation	0.425	0.355	0.364	0.294	0.215
	$10.306	$11.094	$13.415	$13.362	$12.244
Provision for Dominion and Provincial taxes	1.125	1.079	.....	0.017	.....
Total	$11.431	$12.173	$13.415	$13.379	$12.244
Retreatment of other tailings	0.195	0.198	.....	.....	.....

[1]Includes exchange premium and amount recoverable under the Emergency Gold Mining Assistance Act (estimated 1954). The mint price per ounce of gold continued to decline during the year and particularly so in the last half of the period. At the year's end the price received from the mint for an ounce of gold was $33.85.

[2]Retreatment of other tailings included in *Milling and refining* (1952, $0.328; 1953, $0.376; 1954, 0.318).

Better efficiency, partly attributable to a more stable working force, lowered the operating costs per ton milled by $1.039 per ton. At the end of the year changes in the clarifying section of the mill were completed, which it is anticipated will further reduce the cost of milling in 1955.

Ore Trammed for the Year

Level	Development	Stoping	Total
	tons	tons	tons
600-foot		484	484
1,400-foot		1,607	1,607
2,575-foot		58	58
3,325-foot	68	5,011	5,079
3,450-foot	1,028	3,110	4,138
3,575-foot	111	2,488	2,599
3,700-foot		4,179	4,179
3,825-foot		5,234	5,234
3,950-foot	70	3,022	3,092
4,075-foot	668	5,110	5,778
4,200-foot	806	6,006	6,812
4,325-foot	188	4,047	4,235
4,450-foot		8,330	8,330
4,575-foot	303	16,647	16,950
4,700-foot		2,943	2,943
4,825-foot		4,490	4,490
4,950-foot		2,515	2,515
5,075-foot		7,034	7,034
5,200-foot		7,931	7,931
5,325-foot	139	17,503	17,642
5,450-foot	210	37,226	37,436
5,575-foot	374	26,458	26,832
5,700-foot	445	13,952	14,397
5,825-foot	1,039	14,942	15,981
5,950-foot		19,839	19,839
6,075-foot	655	7,212	7,867
6,200-foot		181	181
6,325-foot		357	357
6,450-foot	288	849	1,137
6,825-foot	456		456
7,325-foot	222	6,544	6,766
7,575-foot		211	211
7,700-foot	2,249		2,249
7,825-foot	3,711	1,323	5,034
7,950-foot	4,785		4,785
8,075-foot	5,876		5,876
Total	23,691	236,843	260,534

Development

On the completion of sinking operations in No. 4 shaft, near the end of 1953, development of the two new deep levels at the 7,950- and 8,075-foot horizons was started. Crosscuts from the shaft to the vein zone on the two new levels were completed and drifting started in March, 1954. Of the total drifting, done in the mine during the year, nearly 73 percent was carried out on these two new deep levels, in the Nos. 2 and 4 vein zones.

In the year, 3,866 feet of development drifting, done on seven levels in the mine, exposed a total of 798 feet of ore having an average cut grade of 0.369 ounces per ton across a width in the drifts of 62.7 inches. In the preceding year, 1,096 feet of drifting exposed a length of 561 feet of 0.413-ounce ore over a width of 63.2 inches.

Of the year's drifting, 38.3 percent was done in the No. 2 or north vein zone, 58.9 percent in the No. 4 vein zone, and 2.8 percent on the No. 40 series of veins. No drifting was done in the No. 1 vein zone.

During the year considerable work was done in preparation for stoping the orebodies in the No. 4 vein zone from the 7,575-foot level down to the 8,075-foot horizon and in the No. 2 vein zone at the 8,075-foot level.

An ore-pass was completed from a loading pocket at No. 4 shaft, 50 feet below the 8,075-foot level, through to the 7,700-foot horizon, to facilitate the handling of ore produced from the stopes in this part of the mine.

Additional stope development raises were driven on the veins from the 7,825- and 7,700-foot levels. One of these, which was started on a particularly fine shoot of ore on the 7,825-foot level, proved the continuity of good grade ore through to the 7,700-foot horizon.

A start was made in September, 1954, to drive a series of inclined raises from 7,575-foot level through to the 6,700-foot horizon to provide a separate escapeway from the lower-level workings. It is anticipated that this job will be completed in May, 1955.

Near the end of the year backstopes were started on the 7,825- and 7,700-foot levels. The backstopes will be completed and the necessary timber installed in the drifts under the stopes by the time the separate escapeway is completed. Full-scale stoping operations on the No. 4 vein zone can then be started.

At the year's end the total footage of ore exposed in the drifts in the mine and available for stoping was 13,166 feet, grading 0.514 ounces per ton over a width in the drifts, before slashing, of 57.2 inches. This is a decrease from last year of 902 feet in length and a slight drop in grade of 0.002 ounces per ton. In the year development drifting exposed a length of 798 feet of new ore as follows:

Level	Ore length	Width before slashing	Grade per ton
	feet	inches	ounces
4,200-foot	35	66.8	0.553
4,575-foot	31	67.0	0.650
5,700-foot	50	60.0	0.254
7,700-foot	85	60.4	0.461
7,825-foot	49	75.8	0.538
7,950-foot	320	60.5	0.288
8,075-foot	228	63.0	0.354
Total	798	62.7	0.369

Mining

In the year an average of 692 tons per day was milled as compared with an average of 648 tons per day for 1953.

The sources of the ore milled by levels are given in the summary of ore trammed. The total, which is up 15,786 tons from last year, was made up of 26.0 percent from the No. 1 or south vein zone, 66.9 percent from the No. 2 or north vein zone, and 7.1 percent from the new No. 4 vein zone. Production from the No. 4 vein zone, at 7.1 percent of the total tonnage milled, is up from 4 percent for last year. Part of this rise is owing to initial stoping in the zone from a stope on the 7,325-foot level from which 5,400 tons of 0.4-ounce ore was obtained.

Ground conditions at Lake Shore impose the necessity of maintaining an orderly progression of stope faces along the orebody regardless of periodic variations in grade. For this reason it is extremely difficult to maintain an even grade for the material mined and sent to the mill for treatment, and as a result, the average grade of the ore milled in 1954 was 0.0429 ounces per ton less than the average grade treated in the preceding year. With gold valued at $35 per ounce this is equal to $1.50 per ton, which, if applied to the tonnage treated in 1954, would have increased a total income by more than $375,000. A small improvement in average grade is anticipated for 1955.

Reflecting a reduction in the necessary amount of rock-burst recovery work, the cost of drift and crosscut maintenance and repair work was down $71,762 from the figure for last year. Despite the reduction, the cost of this work is still high, being $0.619 per ton milled in 1954 as compared with $0.963 per ton in 1953.

Shaft Work and Lower Development

In the year the following work was done on lower development:

The installation of a loading pocket at No. 4 shaft, 50 feet below the 8,075-foot level, was completed early in the year.

An ore-pass was driven from the loading pocket through to the 7,700-foot level. Crosscuts were driven from the main crosscuts to the ore-pass on the 7,700-foot, 7,825-foot, 7,950-foot, and 8,075-foot levels, and the necessary dumps and control chutes were installed. In this work, as is the case in other parts of the mine, especially on lower development, rock bolts were used extensively to prevent sloughing of the ground.

A start was made on work necessary to provide a separate escapeway from stoping sections located on the lower levels of the mine. This job will require the driving of a series of inclined raises, equipped with adequate ladderways, from the 7,575-foot level through to the 6,700-foot horizon. The total length of raising required is 1,120 feet, of which, at the end of the year, 490 feet had been completed.

The permanent pumping installation was completed at the 8,075-foot level. The job required the excavation of a 50,000-gallon-capacity-pump sump, the erection of a reinforced concrete dam to retain the water in the sump, the cutting of a pump station, and the installation of the pump and connecting water lines to the sump on the 7,325-foot level.

Refuge stations were built at the north end of the main crosscuts on the 7,700- and 7,950-foot levels, as required by the Mining Act of Ontario.

The construction of an air receiver was completed at the north end of the main crosscut on the 7,825-foot level to provide a more even flow of compressed air to the workings on the lower levels. The work required the construction of a reinforced concrete bulkhead, six feet long, to seal off a space at the end of the crosscut.

With the completion of more openings between levels at lower horizons in the mine, and by the use of small fan installations, ventilation of the lower levels has been considerably improved.

An average of 551 men was employed, of whom 340 were underground and 211 on the surface. W. T. Robson is mine superintendent.

Leitch Gold Mines, Limited

Leitch Gold Mines, Limited, was incorporated in July, 1935, with an authorized capitalization of 3,000,000 shares of $1 par value, of which 2,912,505 have been issued. The officers and directors are: K. J. Springer, president; J. H. C. McClelland, vice-president; W. W. McBrien, secretary-treasurer; F. E. Hall, assistant secretary; S. H. Robinson, J. D. Barrington, and J. R. Cryderman, directors. The head office is at 67 Yonge Street, Toronto. The mine address is Beardmore.

The main property is in Eva and Summers townships, district of Thunder Bay, about 5 miles from Beardmore by motor road.

Mining and milling continued throughout 1954. Operations are conducted through a vertical shaft and winze, the depths of which are shown in the following table:

Shaft	Number of compartments	Total depth from surface
		feet
No. 1	3	3,006
Winze (below 2,875-foot level)	3	3,375

The following table shows the development work done during 1954, and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
1st	.....	2,240	.....	756	.....	485
2nd	.....	2,500	.....	625	.....	593
3rd	.....	2,433	.....	390	.....	1,336
4th	.....	2,672	.....	116	.....	1,134
5th	.....	4,879	.....	239	.....	1,237
6th	.....	2,514	.....	350	.....	993
7th	.....	2,772	.....	387	.....	1,093
8th	.....	4,791	.....	7,161	.....	1,351
9th	.....	2,703	.....	628	.....	1,584
10th	.....	2,281	.....	601	.....	1,689
11th	.....	2,632	.....	623	.....	1,405
12th	.....	1,931	.....	623	.....	965
13th	.....	2,005	.....	593	.....	1,036
14th	.....	2,071	.....	1,063	.....	1,116
15th	.....	1,670	.....	982	.....	1,153
16th	.....	.....	.....	66	.....	463
17th	.....	1,480	.....	1,034	.....	473
18th	.....	1,649	.....	585	.....	1,155
19th	19	1,836	.....	1,288	182	1,451
19th sublevel	.....	.....	.....	.....	.....	165
20th	1,365	1,396	429	491	183	183
21st	1,189	1,189	308	308	186	186
22nd	1,827	1,827	587	586	184	184

Diamond-drilling in 1954 consisted of 3 holes totalling 2,436 feet, from surface, and 41 holes totalling 7,154 feet, from underground.

The following is taken from the manager's report for the year ending December 31, 1954:

Exploration and Development

A heavy lateral development program on the three new levels established by the winze in 1953 was undertaken during the year under review. As a result, the opening up of the main producing ore shoots on the 20th, 21st, and 22nd levels was virtually completed.

On the 20th level, a total advance of 1,793.5 feet of crosscutting and drifting with 162.0 feet equivalent of slashing was completed. No. 20-02W drift was advanced 781.5 feet, 347.5 feet in ore, and 134.0 feet in low-grade material. No. 20-03 drift was advanced 373.0 feet, 215.5 feet in ore. No. 20-04 drift was advanced 210.0 feet, 80.0 feet in ore. On the 21st level, the total lateral advance was 1,497.0 feet with 103.0 feet equivalent of slashing. No. 21-02 drift was advanced 687.0 feet, 188.5 feet in ore with the face still in ore. No. 21-03 drift was advanced 197.5 feet, 149.5 feet in ore, with the face still in ore. No. 21-04 drift was advanced 304.5 feet, 259.5 feet in ore. On the 22nd level, the total lateral advance was 2,413.5 feet with 257.5 feet equivalent of slashing. No. 22-02 drift was advanced 1,001.5 feet, 369.5 feet in high-grade ore, and 143.0 feet in medium-grade ore. No. 22-03 drift was advanced 326.0 feet, 130.5 feet in ore. No. 22-04 drift was advanced 499.5 feet, 109.5 feet in ore.

Numerous flat diamond-drill holes were drilled on the new levels to guide lateral development and for general exploration. No occurrences of note were encountered apart from the main ore structure.

Surface diamond-drilling consisted of the drilling of several more holes to test a zone to the northwest where two isolated intersections had been obtained in previous drilling. Nothing of interest was revealed in this latest surface drilling.

Ore shoots developed to date on the winze levels are as follows:

Shoot	Length	Width	Grade	
	feet	inches	ounces per ton	
No. 20-02E	145	8.9	0.562	(not ore grade)
No. 20-02A	345	19.0	2.394	
No. 20-03	425	28.0	0.704	
No. 20-04	95	10.0	2.632	(not completed)
No. 21-02A	190	23.1	1.750	(not completed)
No. 21-03	210	20.3	0.626	(not completed)
No. 21-04	295	18.2	1.732	
No. 22-02A	370	19.2	2.646	
No. 22-02C	135	9.5	1.105	
No. 22-03	180	34.2	0.445	
No. 22-04	135	15.2	2.171	

Ore Reserves

Ore reserves are estimated at 83,488 tons of average grade, 0.753 ounces per ton, making a total of 63,156.45 ounces.

Hoisting

Some 51,632 tons of ore were hoisted: 8,526 tons, or 16.6 percent, from drifts; 968 tons, or 1.9 percent, from raises; and 42,138 tons, or 81.5 percent, from stopes; and 23,894 tons of waste were hoisted.

Milling

A total of 39,205.5 tons of ore was milled after sorting 10,700 tons of waste. Average tonnage milled was 108.3 tons per day and average sorted was 29.6 tons per day—based on 362 days operation during the year. Production for the year was 33,607.614 ounces of fine gold and 1,082.18 ounces of fine silver, valued at $1,145,319.21. Average recovery was 0.857 ounces of gold per ton milled.

Tailings losses averaged 0.046 ounces per ton milled, and extraction was 94.9 percent.

Plant Equipment and Construction

Only small additions were made to plant and equipment during the year. A power transformer was installed on the 19th level to supply pumping power to the winze.

Six dwellings, occupied by Leitch employees, were purchased from the Undersill Gold Mining Company, Limited. Three of the smaller units were sold to the occupants, and the other three will be moved to sites on Leitch ground to augment the housing accommodation on the property.

Costs

Operating costs per ton milled for the year were as follows:

EXPLORATION AND DEVELOPMENT:	
Surface exploration	$ 0.01
Surface diamond-drilling	0.17
Station-cutting	0.01
Sump-cutting	0.01
Crosscutting	1.04
Drifting	3.60
Raising	0.33
Underground diamond-drilling	0.23
Total	$ 5.40
MINING	11.60
MILLING	4.57
Total operating cost at mine	$21.57

Over-all operating costs were only slightly higher than in 1953, the increase being only $0.23 per ton milled. Development costs were still higher with the heavy expenditures on lateral development this year exceeding the cost of sinking last year. Mining costs were lower, $11.60 per ton milled as against $13.00 last year owing chiefly to the larger proportion of ore coming from development. Milling costs were only slightly higher, being $4.57 per ton milled, compared with $4.33 in 1953.

Unit costs were generally favorable in comparison with previous years.

A tabulation for the past few years shows a fairly steady level of costs with no definite trend.

	1951	1952	1953	1954
Crosscutting and drifting, cost per foot advance	$25.56	$29.27		$29.12
Raising, cost per foot advance	17.00	17.62	$16.89	17.19
Mining, cost per ton broken	9.22	10.70	9.83	9.17
Milling, cost per ton milled	3.75	4.41	4.33	4.57

In the above tabulation, the figures used for crosscutting and drifting in previous years are for the work on the 8th level, which is comparable to current work, and no figure is given for 1953 since an insufficient amount of lateral development was done to obtain a true cost. Mining costs were the lowest for the past four years, but milling costs were slightly higher owing to heavy charges for replacement and repair of mill equipment.

General

The purchase of the Undersill property enabled the company to continue the development of the ore shoots on the Nos. 2 and 3 veins to their extremities beyond the old boundary and greatly extended the limits of the ore structure.

An average of 136 men was employed, of whom 73 were underground and 63 on the surface. G. A. McKay is manager.

Macassa Mines, Limited

Macassa Mines, Limited, was incorporated in April, 1926, with an authorized capitalization of 3,000,000 shares of $1 par value, of which 2,678,068 have been issued. The officers and directors are: R. A. Bryce, president; L. Soliague, vice-president; H. W. Salthouse, secretary-treasurer; C. R. Leonard, J. D. Perrin, A. G. Slaght, and H. M. Porteous, directors; G. A. Howes, director and mine manager. The head office is at 85 Richmond Street West, Toronto. The mine address is Kirkland Lake.

The company's property consists of 11 claims in Teck township, Kirkland Lake area, district of Timiskaming.

Mining and milling operations continued throughout 1954.

The following table shows the depths of the shafts and winzes on the property:

Shaft	Number of compartments	Depth from surface
		feet
Elliott[1]	2	523
Main No. 1	3	3,043
No. 1 winze (below 3,000-foot level)	3	4,824
No. 2	3	4,070
No. 2 winze (below 4,625-foot level)	3	5,756

The following table shows the development work done in the workings from Nos. 1 and 2 shafts and the winzes in 1954, and the totals at December 31, 1954:

Level[2]	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
1,300-foot	.....	581	.....	47	.....	933
1,400-foot	.....	1,101	.....	138	.....	169
1,500-foot	.....	2,940	.....	837	.....	360
1,525-foot	.....	113	.....	.....	.....	50
1,550-foot	.....	63	.....	.....	.....	.....
1,625-foot	.....	1,110	.....	363	.....	395
1,725-foot	.....	245	.....	39	.....	88
1,850-foot	.....	1,377	.....	258	.....	371
2,000-foot	.....	1,958	.....	573	.....	356
2,175-foot	.....	1,682	.....	289	.....	800
2,325-foot	.....	2,392	.....	402	.....	529
2,475-foot	62	2,529	.....	1,613	.....	769
2,525-foot	.....	457	.....	.....	.....	.....
2,575-foot	.....	2,179	.....	543	.....	260
2,675-foot	.....	4,105	.....	1,535	.....	262
2,800-foot	.....	6,215	.....	1,790	.....	731
3,000-foot	.....	[3]8,266	.....	[4]7,448	.....	1,469
3,100-foot	20	6,967	.....	1,454	.....	690
3,225-foot	90	6,294	131	1,245	.....	667
3,350-foot	.....	5,386	.....	1,392	.....	766
3,475-foot	.....	4,066	.....	593	.....	797
3,600-foot	.....	4,341	.....	923	.....	1,023
3,725-foot	.....	3,831	.....	2,112	40	1,471
3,875-foot	.....	2,751	.....	744	.....	557
4,000-foot	.....	2,281	.....	437	.....	588
4,125-foot	78	3,658	.....	2,064	369	1,287
4,250-foot	.....	4,488	14	899	.....	622
4,375-foot	72	3,308	187	591	140	623
4,500-foot	283	5,445	119	1,780	186	311
4,625-foot	461	5,853	44	2,292	479	1,254
4,750-foot	1,098	2,461	468	910	647	647
4,900-foot	1,804	3,026	438	800	158	514
5,025-foot	471	690	226	447	.....	345
5,125-foot (station only)	.....	.....	.....	.....	.....	.....
5,150-foot	.....	.....	.....	142	.....	358
5,150-foot loading pocket (below the level)	.....	.....	.....	.....	.....	180
5,300-foot	.....	.....	.....	60	.....	.....
5,450-foot	.....	.....	.....	73	.....	.....
5,600-foot	.....	.....	.....	157	.....	.....
5,725-foot (station only)	.....	.....	.....	.....	.....	.....

[1]Not being used.

[2]At the levels above 1,300 feet stations only have been cut.

[3]Includes 273 feet of drifting in Casakirk property.

[4]Includes 721 feet of crosscutting in Casakirk property.

Diamond-drilling in 1954 consisted of 112 holes, totalling 12,218 feet, from underground.

The following is taken from the mine manager's report for the year ending December 31, 1954:

Production

The following are the production figures for 1954 with comparative figures for the previous two years, which do not include amounts received under The Emergency Gold Mining Assistance Act:

Year	Gross recovery	Milled	Recovery per ton
		tons	
1954	$1,721,034.36	145,286	$11.84
1953	1,603,630.54	144,175	11.12
1952	1,534,630.74	139,660	10.99

During the year the price of gold in terms of Canadian dollars fluctuated between a high of $34.52 per ounce and a low of $33.84 per ounce. The average price received for our gold for the year was $34.048 per ounce as compared with $34.43 for 1953. Under the provisions of The Emergency Gold Mining Assistance Act it is estimated that the company is entitled to receive the sum of $199,978.39, which is $1.37 per ton milled or $3.971 per ounce of gold recovered. Combining the mint price with the estimated cost-aid gives a total of $38.02 per ounce compared with $38.50 for 1953 and $37.42 for 1952. The average price received for silver was $0.828 per ounce.

Milling

The average tons milled per day for 1954 was 398, compared with 395 for 1953 and 381.6 for 1952. The mill operated at full capacity with the exception of the July holiday period of two weeks, when necessary mechanical repairs were made. Bullion recovery comprised 50,358.06 ounces of gold and 6,948.13 ounces of silver. Over-all extraction was 95.1 percent. Since the commencement of milling (October, 1933) 2,344,262 tons of ore have been treated from which 948,006.26 ounces of gold and 161,240.73 ounces of silver have been recovered, having a gross value of $34,634,473.02, the equivalent of $14.77 per ton, exclusive of cost-aid.

Development and Exploration

During the year, a total of 1,261 feet of new ore was exposed in regular level drifting, which averaged 0.49 ounces over an average width of 5.8 feet. Of this total, 100 feet is on the 3,350-foot level and 170 feet on the 4,500-foot level. On the eight new levels below the 4,625-foot, work was confined mainly to the first two, namely, the 4,750- and 4,900-foot. On the 4,750-foot level, 345 feet of new ore was opened by drifting, which averages 0.6 ounces over 6.7 feet, and on the 4,900-foot, 646 feet was exposed by drifting, which averages 0.45 ounces over 5.8 feet. The ore probabilities of these two levels have been only partially explored.

Comparative figures for the past three years covering development footages with totals for the mine to date are as follows:

Year	Sinking	Drifting	Cross-cutting	Raising	Station-cutting	Diamond-drilling
	feet	feet	feet	feet	feet	feet
1952	.....	2,705.0	3,322.0	1,332.5	.....	9,900
1953	.....	5,148.0	1,232.0	1,044.0	.....	9,951
1954	.....	5,301.5	1,723.0	2,028.5	.....	12,218
Total for mine to date	10,129	120,499.0	36,370.5	21,600.0	1,132	289,662

Active exploration of both the older part of the mine above the 4,625-foot level and the new levels below that horizon will be continued as quickly and as extensively as conditions permit.

Ore Reserves

New ore exposed by drifting and extensions of known ore blocked out by sublevel drifting and stoping operations resulted in a positive ore reserve as of December 31, as follows, which is somewhat higher than at the end of 1953:

	Tons	Ounces per ton	Value at $35 per ounce
Unbroken	328,900	0.388	$13.58
Broken	43,580	0.361	12.63
Total	372,480	0.384	$13.44

Operating Costs

To keep in line with the basic wage rates of other gold mines, an increase of 3 cents per hour was made in all hourly and salary rates as of March 1, 1954.

The operating supply cost held reasonably steady during the year, but the wage increase is reflected in a higher operating cost. The operating and other costs per ton milled and per ounce of gold recovered, and a comparison with those of 1953 are as follows:

	1954		1953	
	50,358.058 ounces recovered from 145,286 tons milled		46,387.547 ounces recovered from 144,175 tons milled	
	Per ton	Per ounce	Per ton	Per ounce
Development and exploration	$ 1.472	$ 4.248	$ 1.435	$ 4.460
Mining	6.322	18.239	6.276	19.507
Milling	1.527	4.406	1.390	4.321
Undistributed mine operating charges	0.419	1.209	0.430	1.337
Administration and head office	0.452	1.304	0.444	1.380
Operating costs	$10.192	$29.406	$ 9.975	$31.005
Depreciation	0.238	0.685	0.225	0.698
Provision for municipal, provincial, and federal taxes	0.717	2.068	0.448	1.394
Total costs	$11.147	$32.159	$10.648	$33.097

A comparison of the main items of operating expenditure during 1954 with those of 1953 follows:

	1954	1953
Wages and salaries	$891,008	$868,606
Supplies and services	445,571	443,827
Power (hydro-electric)	78,564	76,434
Provision for taxes	104,137	64,660

Capital Expenditures

An expenditure of $2,713.59, mainly on office and machine-shop equipment, and one of $23,971.26 on underground equipment such as scraper hoists, diamond-drills, mucking machines, cages and other smaller items, were necessary during the year.

An average of 269 men was employed, of whom 182 were underground and 87 on the surface.

McIntyre Porcupine Mines, Limited

McIntyre Porcupine Mines, Limited, was incorporated in March, 1911, with an authorized capitalization of 800,000 shares of $5 par value, of which 798,000 have been issued. The officers and directors are: Balmer Neilly, president; B. E. Smith, vice-president; E. D. Fox, secretary; W. B. Dix, treasurer; J. C. Fraser, D. H. McDougall, and R. S. McLaughlin, directors. The address of the head office and the mine is Schumacher. The executive office is at 25 King Street West, Toronto.

The company has numerous holdings in Ontario, the chief of which is the McIntyre mine in Tisdale township, Porcupine area, district of Cochrane.

Mining operations, which had been suspended since September 21, 1953, because of a labour strike, were resumed on January 22, 1954, and continued for the rest of the year. The mill operated from January 21 to the end of 1954.

There are twelve shafts on the property, four of which are used at the present time. The depths of the four shafts are shown in the following table:

Shaft	Number of compartments	Total depth from surface
No. 5	2 to 1,375 feet 3 to bottom	2,389
No. 6	3 to 1,000 feet 4 to bottom	3,045
No. 11 (or main)	5	4,130
No. 12 (below 3,875-foot level)	4	7,007

The following table shows the development work done in 1954, and the total at December 31, 1954:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
50-foot		420		167		
100-foot		956		975		
200-foot	62	9,901		4,859	128	1,875
300-foot		13,075		3,329		1,064
400-foot		5,762		3,297		704
500-foot	285	12,839		5,607	121	2,156
600-foot		10,746		3,510		1,100
700-foot	214	9,781		3,076		1,280
800-foot	30	11,784		4,951		882
900-foot		4,414		1,404		635
1,000-foot		13,541		6,894		1,810
1,125-foot	82	11,221		3,290		1,134
1,250-foot	295	17,331	91	6,935		2,694
1,375-foot	30	16,475		5,210		1,021
1,500-foot	583	16,757		4,199		1,403
1,625-foot	887	13,858	47	4,602		941
1,750-foot	1,364	15,665	243	6,251		821
1,875-foot	411	16,050	101	9,659		1,636
2,000-foot	382	15,474		5,073		971
2,125-foot		11,367		5,317		715
2,250-foot	96	13,688	63	4,973		415
2,375-foot	211	18,930	37	10,032		1,397
2,500-foot	36	15,095		4,945	134	952
2,625-foot	150	19,136	70	5,321	116	780
2,750-foot	480	17,423	156	4,836	78	764
2,875-foot	617	19,159	218	7,409		1,004
3,000-foot	103	11,071	93	2,164	249	720

(UNDERGROUND DEVELOPMENT WORK—*Continued*)

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
3,125-foot	.....	12,156	.....	2,393	.....	590
3,250-foot	121	10,905	.....	2,392	243	695
3,375-foot	.....	12,549	.....	8,243	.....	1,107
3,500-foot	.....	9,811	416	4,154	186	808
3,625-foot	182	11,051	.....	5,808	.....	579
3,750-foot	24	13,077	291	7,061	252	1,505
3,875-foot	571	11,124	95	13,828	89	975
4,025-foot	425	6,194	.....	1,148	.....	485
4,175-foot	1,267	12,042	.....	5,439	127	1,910
4,325-foot	1,077	9,073	48	4,449	62	568
4,475-foot	560	10,122	191	5,701	780	1,655
4,625-foot	98	5,866	84	3,654	292	1,041
4,775-foot	486	7,147	393	3,642	305	911
4,925-foot	76	11,894	.....	5,476	309	860
5,075-foot	.....	806	180	1,913	166	641
5,225-foot	719	6,012	952	3,165	232	705
5,375-foot	758	13,088	70	13,670	.....	860
5,525-foot[1]	.....	.....	290	290	.....	.....
5,675-foot	910	3,931	23	3,556	135	135
5,825-foot[1]	.....	.....	325	325	269	269
5,975-foot	143	3,629	.....	3,000	268	268
6,125-foot	.....	.....	800	852	286	286
6,275-foot	45	45	279	329	249	249
6,425-foot	1,050	3,871	167	2,913	268	268
6,575-foot	6	74	649	985	234	234
6,825-foot	.....	1,515	104	3,090	103	415
6,995-foot	.....	.....	.....	.....	.....	179

Diamond-drilling in 1954 consisted of 999 holes, totalling 170,243 feet, all from underground.

A total of 750,570 tons of ore was hoisted and milled in 1954.

The following is taken from the manager's report for the nine months ending December 31, 1954:

Production

Ore treated		tons 608,000
Value per ton (0.2835 ounces per ton)		$9.6633
Gross value		$5,875,292.36
Gold and silver produced:		
Gold (163,508.669 ounces at $34.0865)	$5,573,434.48	
Silver (33,090.730 ounces at $0.8303)	27,475.17	
Total value		$5,600,909.65
Recovery per ton (0.2703 ounces per ton)		$9.21

PRODUCTION SINCE THE BEGINNING OF MILLING IN 1912 TO MARCH, 1954

Milled	tons 23,123,583
Average value per ton	$10.10
Gross value	$233,633,597.82
Average recovery per ton	$9.62
Total value	$222,564,347.38

Mining

	Tons
Ore broken in stopes	560,090
Ore from development	52,359
Total	612,449
Ore delivered to passes	610,254

[1]The station for this level was cut several years ago, but no development work was done on it until 1954.

Development

Development work amounted to 21,880 feet. This includes 11,806 feet of drifting of which 1,969 feet was on line, and 3,728 feet in ore averaging 0.339 ounces per ton over a width of 6.8 feet.

No. 3 Vein.—Stopes produced 41,493 tons of an average of 0.328 ounces per ton; 1,096 feet of drifting on the 1,250-, 1,500-, 1,625-, 1,750-, and 1,875-foot levels developed 520 feet of ore averaging 0.300 ounces per ton over a width of 5.5 feet.

No. 5 Vein.—Stopes produced 24,492 tons of an average of 0.432 ounces per ton; 539 feet of drifting on the 700-, 1,625-, and 1,750-foot levels developed 430 feet of ore averaging 0.343 ounces per ton over a width of 6.5 feet.

No. 6 Vein.—Stopes produced 2,112 tons of an average of 0.196 ounces per ton; 225 feet of drifting on the 2,750-foot level developed 106 feet or ore averaging 0.276 ounces per ton over a width of 8.0 feet.

No. 7 Vein.—Stopes produced 22,539 tons of an average of 0.281 ounces per ton; 611 feet of drifting on the 1,250-, 1,500-, 1,625-, and 2,375-foot levels developed 91 feet of ore averaging 0.247 ounces per ton over a width of 7.6 feet.

No. 8 Vein.—Stopes produced 2,211 tons of an average of 0.216 ounces per ton; 25 feet of drifting on the 1,750-foot level developed 25 feet of ore averaging 0.271 ounces per ton over a width of 8.3 feet.

No. 9 Vein.—Stopes produced 77,815 tons of an average of 0.274 ounces per ton; 1,131 feet of drifting on the 1,500-, 1,625-, 1,875-, 2,625-, 2,875-, and 3,000-foot levels developed 177 feet of ore averaging 0.363 ounces per ton over a width of 9.0 feet.

No. 10 Vein.—Stopes produced 121,618 tons of an average of 0.226 ounces per ton; 1,961 feet of drifting on the 1,875-, 2,000-, 2,375-, 2,750-, 3,625-, 3,750-, 3,875-, 4,025-, 4,325-, 4,475-, 4,625-, 4,775-, 4,925-, and 5,225-foot levels developed 623 feet of ore averaging 0.314 ounces per ton over a width of 5.5 feet.

No. 12 Vein.—Stopes produced 34,009 tons of an average of 0.277 ounces per ton; 492 feet of drifting on the 200-, 500-, 700-, 800-, 1,625-, and 1,750-foot levels developed 131 feet of ore averaging 0.276 ounces per ton over a width of 10.6 feet.

No. 13 Vein.—Stopes produced 26,355 tons of an average of 0.192 ounces per ton.

No. 14 Vein.—Stopes produced 14,303 tons of an average of 0.320 ounces per ton; 302 feet of drifting on the 1,875-, and 3,250-foot levels developed 95 feet of ore averaging 0.271 ounces per ton over a width of 10.6 feet.

No. 15 Vein.—Stopes produced 32,895 tons of an average of 0.258 ounces per ton; 66 feet of drifting on the 3,000- and 5,375-foot levels developed no ore.

No. 16 Vein.—Stopes produced 5,633 tons of an average of 0.389 ounces per ton; 532 feet of drifting on the 3,875-, 4,775-, 4,925-, 6,275-, and 6,575-foot levels developed 186 feet of ore averaging 0.479 ounces per ton over a width of 6.6 feet.

No. 20 Vein.—Stopes produced 412 tons of an average of 0.135 ounces per ton; 198 feet of drifting on the 500-foot level developed 26 feet of ore averaging 0.329 ounces per ton over a width of 7.3 feet.

Nos. 21 and 22 Veins.—Stopes produced 98,866 tons of an average of 0.241 ounces per ton; 4,455 feet of drifting on the 3,875-, 4,025-, 4,175-, 4,325-, 4,475-, 4,625-, 5,225-, 5,375-, 5,675-, 5,975-, and 6,425-foot levels developed 1,258 feet of ore averaging 0.348 ounces per ton over a width of 6.4 feet.

No. 25 Vein.—Stopes produced 53,142 tons of an average of 0.497 ounces per ton; 170 feet of drifting on the 4,025-foot level developed 60 feet of ore averaging 0.493 ounces per ton over a width of 15.6 feet.

Ore Reserves

	Tons	Ounces of fine gold	Value (gold at $35 per ounce)
Estimated in place	2,506,105	821,117.4	$28,739,110
Broken ore	51,188	12,423.9	434,835
Total	2,557,293	833,541.3	$29,173,945
Average per ton		0.326	$11.40

Costs
(For 9 months ending December 31, 1954)

		Per ton ore milled
Mining:		
Exploration	$ 24,835.15	$0.0408
Development	837,294.23	1.3771
Breaking and stoping	3,732,613.08	6.1392
Total	$4,594,742.46	$7.5571
Milling	670,138.54	1.1022
Administration and General Expense	101,108.94	0.1663
Total	$5,365,989.94	$8.8256

ADDITIONS TO PLANT BUILDINGS AND EQUIPMENT
(For 9 months ending December 31, 1954)

Surface buildings and equipment	$20,891.39
Underground equipment	28,417.50
Total	$49,308.89

General

Mine operations were normal throughout the period under review. The labour force was relatively stable and, unlike former years, efficiency just prior to and following the annual vacation shutdown was not affected.

Fresh air is being delivered directly to the lower-level workings through the main ventilation raise, which is now in service from surface to the 4,175-foot level. This raise is being continued downward. No. 12 shaft ore pass is completed except for the portion between the 5,525- and 5,375-foot levels and the waste pass to the 5,225-foot level. Development work below the 5,375-foot level was tied in to the mining program above that horizon with drifting on No. 22 vein confined to the 5,675-, 5,795-, and 6,425-foot levels and crosscutting to the intermediate levels.

An average of 1,269 men was employed, of whom 847 were underground and 422 on the surface. M. L. Urquhart is manager.

McKenzie Red Lake Gold Mines, Limited

McKenzie Red Lake Gold Mines, Limited, was incorporated in February, 1933, with an authorized capitalization of 3,000,000 shares of $1 par value, of which 2,940,000 have been issued. The officers and directors are: H. G. Young, president and managing director; A. C. Snively, vice-president and secretary-treasurer; Stanley Langley, G. P. Campbell, and J. A. McDougald, directors. The address of the head office and mine office is McKenzie Island.

The property consists of 12 claims at the north end of McKenzie Island in Red Lake, Dome township, Patricia portion of Kenora district.

Mining and milling operations continued throughout 1954.

The work of preparing the new No. 5 inclined shaft for use was continued, a steel headframe was constructed, and a 60- by 66-inch, double-drum Bertram-Nordberg hoist was installed. Further details regarding the new shaft appear below in the mine manager's report.

The following table shows the depths of the shafts on the property:

Shaft	Inclination	Number of compartments	Total depth from surface
			feet
No. 1	Vertical	3	456
No. 2 (below 450-foot level)	36 degrees	3	1,275
No. 4 (below 1,250-foot level)	Vertical	3	1,635
No. 5	47½ degrees	3	1,600

The following table shows the development work done during 1954, and the total at December 31, 1954:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
150-foot	.....	1,828	.....	384	.....	475
250-foot	.....	3,689	.....	1,184	20	1,322
350-foot	13	3,460	.....	616	107	2,173
450-foot	104	7,138	.....	1,166	116	3,057
550-foot	.....	5,596	91	1,033	61	2,094
650-foot	330	7,992	470	1,810	233	3,984
750-foot	.....	4,194	.....	747	.....	921
850-foot	878	13,060	.....	2,623	643	5,573
950-foot	.....	3,869	.....	1,009	.....	1,262
1,050-foot	420	12,722	212	3,466	349	8,331
1,150-foot	.....	312	.....	186	.....	137
1,250-foot	751	13,060	337	3,216	574	5,973
1,350-foot (station only)	.....	.....	.....	16	.....	.....
1,450-foot	.....	511	.....	134	.....	.....
1,550-foot (station only)	.....	.....	.....	5	.....	.....
1,650-foot	.....	24	.....	353	.....	.....
No. 5 shaft preparation	.....	121	.....	867	.....	2,158

Diamond-drilling in 1954 consisted of 3 holes totalling 2,874 feet, from surface, and 304 holes totalling 47,199 feet, from underground.

The following is taken from the mine manager's report for the year ending December 31, 1954:

Production and Costs

	1954	1953
Milled tons	73,856	75,070
Average recovery per ton milled ounces	0.237	0.289
Value of bullion recovered	$596,758,81	$748,099.45
Operating cost	$764,300.41	$745,119.66

The total value of bullion produced during the year, $596,758.81, was realized from 17,321 ounces of fine gold at an average price of $34.05 per ounce, and 8.296 ounces of silver at an average price of 0.82 cents per ounce. The average price for gold per ounce was 64 cents less than in 1953. Tonnage milled was somewhat lower than in 1953 owing chiefly to a three-weeks loss of production caused by a breakdown in the mill.

Development

Total development for the year was 5,971 feet, of which 2,496 feet was drifting and sub-drifting, 1,100 feet was crosscutting, and 2,365 feet was raising. A heavy program of diamond-drilling resulted in 50,073 feet drilled, a considerable increase over the previous year.

Construction

The headframe of No. 5 shaft was completed, and the construction within the shaft was completed at the year's end, after several unforeseen delays. Although the shaft is complete and in service it will not be possible to handle ore through this and the new crushing plant until a connecting ore-pass system is completed. This shaft and associated buildings and machinery are a credit to a small mine, and will be a great benefit in years to come.

Ore Position and Future Development

A new structure or series of structures is developing in the south part of the mine. Diamond-drilling into the hanging wall on the 650-foot level intersected a vein about 500 feet out. Sub-

sequent drilling to trace its extent indicated good grade, and a crosscut was driven to examine it; 250 feet of drifting was done to the south limit of the vein. It is still open to the north. Diamon-drilling on the 550-, 750-, 850-, and 1,050-foot levels in the same area has shown the structure to persist.

There is considerable development to be done on the levels above the 1,250-foot level, as well as opening up the new levels made possible by the new shaft. The company will shortly be in a position to increase the development rate.

Mining and Milling Operations

	1954	1953	Total to date
	tons	tons	tons
Ore broken in stopes and stope development (slashes included)	74,189	71,069	1,490,948
Ore broken in development	11,019	13,283	196,152
Ore milled	73,856	75,070	1,433,481
Ore discarded by sorting	11,352	9,282	253,619
Total ore hoisted (milled and sorted, dry)	85,208	84,352	1,687,100
	ounces	ounces	ounces
Average value per ton milled	0.2427	0.2956	0.3163
Average recovery per ton milled	0.2373	0.2894	0.3080
	feet	feet	feet
Diamond-drilling	50,073	36,428	472,086
	percentage	percentage	percentage
Extraction	97.77	97.90	97.37
Total value of bullion produced and marketed	$596,758.81	$748,099.45	$16,104,343.21
Total operating cost	$764,300.41	$745,119.66	$11,626,620.19

Operations Costs

	Total cost		Per ton milled and sorted (85,208 tons)		Per ton milled (73,856 tons)	
MINE OPERATIONS:						
Development and exploration:						
Diamond-drilling	$ 57,129.50		$0.670		$0.774	
Current development	134,691.30		1.581		1.823	
Total		$191,820.80		$2.251		$ 2.597
Stoping		304,505.85		3.574		4.123
MILL OPERATIONS:						
Crushing and conveying	$ 20,790.26		$0.244		$0.281	
Sorting	14,458.42		0.170		0.196	
Milling	106,882.46		1.254		1.447	
Total		$142,131.14		$1.668		$ 1.924
GENERAL EXPENSE		$113,804.32		$1.336		$ 1.541
HEAD OFFICE EXPENSE		$ 12,038.30		$0.141		$ 0.163
TOTALS		$764,300.41		$8.970		$10.348

An average of 141 men was employed, of whom 84 were underground and 57 on the surface. R. W. Warren is mine manager.

MacLeod-Cockshutt Gold Mines, Limited

MacLeod-Cockshutt Gold Mines, Limited, was incorporated in September, 1933, with an authorized capitalization of 3,000,000 shares of $1 par value, of which 2,862,490 have been issued. The officers and directors are: F. G. MacLeod, president; Arthur Cockshutt, vice-president; J. M. Macintosh, secretary-treasurer; A. L. Cochrane, J. W. Baker, and William Smith, directors. The head office is at 357 Bay Street, Toronto. The mine address is Geraldton.

The company owns and operates a property consisting of 23 claims in Ashmore and Errington townships, district of Thunder Bay.

Mining and milling operations continued throughout 1954.

The depths of the shafts serving the mine are given in the following table:

Shaft	Inclination	Number of compartments	Total depth from surface
			feet
No. 1	vertical	3	2,053
No. 2	vertical	4	1,921
No. 3 winze (below the 11th level)[1]	45 degrees	4	2,015

The following table shows the development work done during 1954, and the totals at December 31, 1954:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
1st–4th	.....	28,007	.....	9,187	.....	8,518
5th	.....	6,831	.....	2,820	.....	2,727
6th	274	4,797	431	2,485	.....	1,774
7th	374	5,623	.....	1,404	.....	2,267
8th	226	5,797	104	1,786	334	1,920
9th	222	11,363	7	2,085	397	2,504
10th	513	9,452	61	1,870	192	2,975
11th	46	11,180	341	1,719	62	4,628
12th	293	1,464	.....	381	415	415
13th	....	5,988	161	671	88	730

Diamond-drilling in 1954 consisted of 240 holes, totalling 41,996 feet, from underground.

A total of 556,525 tons of ore was hoisted in 1954. The mill treated 553,400 tons at an average daily rate of 1,516 tons.

The company's fiscal year has been changed to coincide with the calendar year. The following is taken from the general manager's report for the 15-month period ending December 31, 1954:

General

During this period, all the ore milled was mined in the *F* zone, with the exception of 2,466 tons from No. 1360 stope in the north diorite zone.

[1]Not being used.

Mining

The tonnage of ore supplied to the mill for the 15-month period, October 1, 1953, to December 31, 1954, was 679,500 tons—an increase of 305 tons per day over the previous year's average.

The broken ore reserves increased to 129,401 from 125,917 tons, and the tonnage drilled off ready for blasting increased from 201,999 to 271,278 tons.

Production per man shift based on the payroll increased 12.8 percent (as did production per man shift from underground), and underground production per man shift increased proportionately.

ORE DELIVERED TO THE ORE-PASS SYSTEM
(October, 1953–December, 1954)

Level	Total ore	Percentage of total tonnage	Grade	Total production	Percentage of production
	tons		ounces per ton	ounces	
F zone:					
6th	50	.....	0.113	5.65	.....
8th	4,393	0.6	0.102	447.48	0.6
9th	334,868	49.3	0.113	37,824.51	46.5
10th	222,063	32.7	0.120	26,746.61	32.9
11th	112,594	16.6	0.136	15,272.70	18.8
12th	2,739	0.4	0.153	420.19	0.5
Total *F* zone	676,707	99.6	0.119	80,717.14	99.3
North diorite zone:					
13th	2,466	0.4	0.254	625.88	0.7
Total	679,173	100.0	0.120	81,343.02	100.0

Milling

The mill operated for 443.8 days during the 15-month period at an average rate of 1,531 tons per day, and treated 679,500 tons of ore, from which was recovered 76,022.26 ounces of fine gold and 8,178.68 ounces of fine silver The value of this production, plus cost-aid assistance amounted to $2,919,240 or $4.29 per ton. No major installations or changes were made in the mill during this period.

Ore Reserves

Ore reserves at the year's end were 1,760,000 tons with a grade of 0.150 ounces per ton, of which 38,000 tons were in the sulphide zones. The remainder of the ore reserves previously reported in the sulphide zones are considered to be below economic grade under present conditions and have not been included in this total.

Costs

(October, 1953–December, 1954)

	Amount	Per ton milled
Mining exploration and development	$ 209,038	0.3076
Mining	1,085,197	1.5970
Milling	552,223	0.8127
Mine office and supervision	125,925	0.1853
General operating expenses	189,772	0.2793
Marketing bullion	23,457	0.0345
Total expense at property	$2,185,612	3.2164

An average force of 247 men was employed, of whom 101 were underground and 146 on the surface. H. E. Rudd is general manager.

Madsen Red Lake Gold Mines, Limited

Madsen Red Lake Gold Mines, Limited, was incorporated in March, 1935, with an authorized capitalization of 5,000,000 shares of $1 par value. On June 6, 1940, the capitalization was reduced to 3,500,000 shares by the cancellation of 1,500,000 unissued shares. The number of shares issued at the end of 1954 was 3,499,528. The officers and directors are: Joseph McDonough, president; F. R. Marshall, vice-president; Margaret Masterson, secretary-treasurer; Marius Madsen, Hugh Mackay, H. G. Young, A. H. Seguin, and S. J. Bird, directors. The head office is at 67 Yonge Street, Toronto. The mine address is Madsen.

The company's main property is in Baird and Heyson townships, Red Lake area, Patricia portion of Kenora district. It is about seven and a half miles southwest of the Howey mine and may be reached by road from Red Lake.

Mining and milling operations continued throughout 1954. The depths of the two shafts on the property are shown in the following table:

Shaft	Number of compartments	Depth from surface
		feet
No. 1, vertical[1]	2	573
No. 2, vertical	3	2,949

The following table shows the development work done in 1954, and the total at December 31, 1954:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
1st		1,908		271		848
2nd	587	6,046		756	54	3,079
3rd		2,068		226		1,439
4th	504	5,174		603	75	2,475
5th	402	4,348		407		1,835
6th	321	4,784		430		1,631
7th	724	4,140	90	776	407	1,880
8th	665	5,214		748	820	1,595
9th	106	4,062	68	1,220	520	2,320
10th	434	5,062		958	370	1,848
11th		4,869		1,028	111	1,468
12th	200	4,601		873	411	1,268
13th		3,716		746	292	1,192
14th		3,469		881		943
15th		3,730		929		616
16th	2,332	3,475		1,092		455
17th			255	643		417
18th				53		418

Diamond-drilling in 1954 consisted of 62 holes, totalling 33,378 feet, from surface; and 1,066 holes, totalling 196,672 feet, from underground.

A new change-house, 104 by 100 feet, and a frame garage, 68 by 27 feet, were built during the year.

The following is taken from the general manager's report for the year ending December 31, 1954:

[1]Not being used.

Summary

The grade of the ore reserve was increased for the third consecutive year.

The tonnage of new ore developed replaced the 286,246 tons milled and added 730 tons to the ore reserve.

The tonnage of broken ore reserve was increased by 25,460 tons to a total of 82,720 tons. The grade was increased from 0.187 to 0.300 ounces per ton.

An estimated 46,000 tons of 0.302-ounce ore was disclosed in the McVeigh zone.

December's production of $326,523.64 established a new monthly record.

The conversion of mining from shrinkage and open stope to cut-and-fill methods was successfully completed to the degree required.

Production

Bullion totalling 82,333.188 ounces of fine gold and 16,892.800 ounces of fine silver was produced during the year from the treatment of 286,246 tons of ore. The value of this bullion was $2,818,462.90. The average recovery was $9.846 per ton treated.

During the year gold was sold to the Royal Canadian Mint at an average price of $34.062 per fine ounce. This price was $0.352 per fine ounce less than the price received last year and the lowest in the history of the mine.

Production was partially interrupted on July 25 for a period of nine days when lightning damaged one of the two motors on the surface hoist. During this period only small ore loads could be lifted, and the total tonnage raised was sufficient to operate the mill at only half its capacity. It is estimated that the production from 3,760 tons of ore was lost at this time. This loss will be recovered when our claim under business-interruption insurance is settled.

Total production since milling started on August 11, 1938, to December 31, 1954, amounted to $27,381,240.50 from the treatment of 3,103,273 tons of ore. Average recovery per ton milled was $9.03.

Analysis of Operating Costs

The total operating costs increased by $0.646 per ton of ore milled to $7.621. However, the increase in estimated credits under the Emergency Gold Mining Assistance Act absorbed $0.320 per ton of this amount, leaving the net operating costs at $6.133, up $0.326 per ton milled over last year's figure. The factors causing this continued rise in costs were as follows:

1) Changing from shrinkage and open stope to cut-and-fill mining methods.
2) Further increase in rate and amount of stope preparation work.
3) Increase in general expense.
4) Increase in milling costs.
5) Continued heavy development program

The estimated payment to be received under the Emergency Gold Mining Assistance Act for the year was calculated at $426,000, an increase of $93,000 above the amount received last year.

The details of the operating costs are outlined in the following table:

	Total cost	Cost per ton milled	Cost per ounce produced
Development and exploration	$ 566,112.99	$1.977	$ 6.875
Stope preparation	240,458.67	0.840	2.921
Stoping	458,250.86	1.601	5.566
Mucking, tramming, and hoisting	263,849.60	0.922	3.205
Crushing and conveying	73,581.10	0.257	0.894
Milling	287,775.20	1.005	3.495
Mine general expense	221,868.44	0.776	2.695
Head office expense	45,656.88	0.159	0.553
Marketing charges	24,014.04	0.084	0.292
Total operating costs	$2,181,567.78	$7.621	$26.496
Deduct estimate of emergency assistance	426,000.00	1.488	5.174
Net operating costs	$1,755,567.78	$6.133	$21.322

Property Exploration

A surface diamond-drill was operated throughout the year, but negligible results were obtained from the 33,378 feet of drilling completed.

Mine Development

The amount of lateral development work completed underground during the year was only 70 percent of the footage done in the previous year. However, the footage of raising was increased by 30 percent, and the footage of underground diamond-drilling was increased by 50 percent to a total of 198,177 feet.

The section of the mine west of the shaft continued to receive attention, with good results being produced by the work undertaken. In this section of the mine on the upper levels, the No. 2-W drift was advanced 599 feet to explore ore values obtained in earlier surface drilling. The west drifts on the 4th, 5th, 6th, 7th, 8th, 10th, and 12th levels were all extended. On the latter group of levels a total of 2,987 feet of drifting was completed.

East of the shaft on the upper levels, the 8th, 9th, and 10th levels were advanced 372, 106, and 212 feet, respectively.

Drifting east and west on the 16th level was continued. The east heading was advanced 1,317 feet, and the west heading 1,081 feet.

The driving of the No. 17-O-S crosscut was resumed, and the heading was advanced 255 feet by the end of the year.

The No. 4-O-N drift was driven 520 feet northeast from the 4th level shaft station so that the McVeigh zone in this region could be explored by diamond-drilling.

In the year a total of 3,680 feet of drifting and 3,249 feet of raising was done to prepare ore bodies for mining.

The crusher station at the 2,740-foot horizon was equipped by July and put into service during that month.

Mining

While some 40 percent of the ore drawn during the year came from shrinkage stopes, this was reduced to 30 percent during the last quarter of the year, and to 17 percent during December. At the end of the year it could be considered that the conversion to cut-and-fill mining methods had been completed to the degree required. The mine was also in a good position in regard to stope preparation for cut-and-fill mining.

Classified mill tailings continued to be used as the sole means of backfilling current cut-and-fill stopes. An additional 79,462 dry tons of these sands were placed in the mine to make a total of 202,345 dry tons since this method of backfilling was started. At the year's end there was only one area below the 7th level, in which mining had been completed, that was not backfilled.

Details of the mining conducted during the year are as follows:

In the Austin Zone.—The drawing of the broken ore from No. 4-14 stope was completed; some broken ore still remains to be drawn from Nos. 5-14, 6-14, and 7-16 stopes.

The mining of the crown pillar over No. 8-8 stope was resumed.

No. 9-10 stope was backfilled to the crown pillar at the 7th level, and mining of a small ore body to the east of this stope was started.

The mining of Nos. 9-8, 9-10A, and 10-24 orebodies was continued, and the mining of Nos. 9-20, 9-22, 10-10, and 10-10A orebodies was started.

The mining of Nos. 11-6, 11-8, and 11-24 orebodies was completed, although some broken ore remains to be drawn from No. 11-8 stope.

The preparation for mining of Nos. 12-10, 12-24, 12-26, 13-10, 13-20, and 14-20 orebodies was completed.

In the South Austin Zone.—Above the 4th level No. 2-17 orebody was prepared for mining, and No. 3-15 orebody was mined up to a crown pillar below the 2nd level.

Between the 4th and 10th levels the preparation of Nos. 8-11, 8-13, 9-9, and 9-11 orebodies was completed. Mining started in the last two of these orebodies.

Below the 10th level the preparation of No. 12-0 orebody was undertaken, and mining was started in Nos. 13-2, 13-4, 14-4, and 15-4 orebodies.

Ore Developed

In the year, 286,976 tons of ore were developed in sufficient detail to be taken into the ore reserve. This tonnage of new ore replaced the 286,246 tons milled and added 730 tons to the ore reserve.

The grade of the new ore developed was above the average of the ore reserve. This, together with the mining and milling of a substantial tonnage of lower-grade ore, had the effect of increasing the over-all grade of the ore reserve from 0.281 to 0.299 ounces per ton.

The new ore was developed in the following sections of the mine:

1) In the Austin zone considerable tonnage of ore was added by the extensions to orebodies now being mined; new orebodies were also disclosed in the east section of this zone between the 14th and 15th levels.

2) In the south Austin zone, between the 8th and 10th levels to the west of the shaft and between the 15th and 16th levels to the east of the shaft.

3) In the McVeigh zone, to the east of the shaft from 50 feet below the 2nd level to the 4th level. The disclosure of this ore indicates that with further exploration the McVeigh zone could become the source of a substantial tonnage of ore.

Ore Reserve

The calculated ore reserve is as follows:

Block	December 31, 1953			December 31, 1954		
	Tonnage	Ounces	Grade	Tonnage	Ounces	Grade
7th level to surface	15,530	3,205	0.206	55,530	15,989	0.288
11th to 7th level	311,430	74,051	0.238	210,930	53,327	0.253
16th to 11th level	465,610	150,686	0.323	501,380	160,304	0.320
Broken reserve	57,260	10,708	0.187	82,720	24,816	0.300
Total reserve	849,830	238,650	0.281	850,560	254,436	0.299
Increase				730	15,786	0.018

All high assays were reduced to 1 ounce, and a dilution factor of 10 percent was allowed on the calculation of the tonnage of the reserve.

Milling

The details of the mill operation are shown in the following summary. For comparative purposes the details of the two previous years' operation and for the total operating life of the mine are also shown:

	1952	1953	1954	August 11, 1938, to date
Dry tons treated	304,251	285,018	286,246	3,103,273
Percentage operating time	98.54	98.46	97.58	94.79
Tons treated per calendar day	831.3	780.9	784.2	518.3
Average gold assay of heads, ounces	0.2358	0.3141	0.3079	0.2574
Average gold assay of tails, ounces	0.0145	0.0243	0.0203	0.0158
Recovery, percent	93.87	92.25	93.40	93.85

The percentage recovery obtained during the year was slightly above the average for the previous year.

An average of 332 men was employed, of whom 193 were underground and 139 on the surface. E. G. Crayston is general manager.

Midcamp Mines, Limited

Midcamp Mines, Limited, was incorporated in November, 1946, with an authorized capitalization of 4,500,000 shares of $1 par value, of which 2,881,355 have been issued. The officers and directors are: J. Y. Murdoch, president; J. R. Timmins, vice-president; C. H. Windeler, secretary; R. G. Rudolf, treasurer; W. H. Bouck, E. H. Walker, and James Ingram, directors. R. V. Porritt

is manager. The head office and manager's address is Bank of Nova Scotia Building, Toronto. The mine address is Timmins.

The company owns 355 acres in Deloro and Tisdale townships, Porcupine area, district of Cochrane.

There are no shafts on the property. All underground development has been done from the levels of the adjoining Paymaster Consolidated and Preston East Dome mines.

Operations in 1954 were carried on from May to October. The following table shows the development work done in 1954 and the total when operations were suspended:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
From Preston East Dome mine:						
9th		112		2,819		6
12th		2,310		5,017		15
23rd			1,093	1,985		
From Paymaster mine:						
10th		547				
20th		419		321		
25th		1,125				

Diamond-drilling in 1954 consisted of 12 holes, totalling 6,800 feet, from underground.

The labour was all supplied by Preston East Dome Mines, Limited, and is included in the employment figures for that company. R. E. Findlay was resident manager.

New Dickenson Mines, Limited

Dickenson Red Lake Mines, Limited, was incorporated in November, 1944, with an authorized capitalization of 3,500,000 shares of $1 par value. In June, 1947, the capitalization was increased to 4,000,000 shares. In June, 1949, the company was reorganized, and the name was changed to New Dickenson Mines, Limited. The capitalization was reduced to 3,750,000 shares. The number of shares issued at the end of 1954 was 2,750,200. The officers and directors are: A. W. White, president and treasurer; C. R. Diebold, vice-president; R. B. Law, secretary; L. W. McIlmurray, assistant secretary; H. R. Heard, assistant treasurer; R. A. Jodrey, T. M. Fyshe, E. B. Magee, and W. G. Weston, directors. The head office is at 145 Yonge Street, Toronto. The mine address is Balmertown.

The company owns 32 claims in Balmer township, Red Lake area, Patricia portion of Kenora district.

Mining and milling continued throughout 1954. The vertical No. 1 shaft was sunk a further 708 feet to a total depth of 2,023 feet, and stations for five new levels were cut at 1,415, 1,565, 1,715, 1,865, and 2,015 feet from surface. The shaft has three compartments from the surface to the eighth level, and four compartments from there to the bottom.

The following table shows the development work done during 1954 and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
1st	121	3,476	.....	2,135	127	1,019
2nd	162	4,622	48	2,818	355	2,210
3rd	631	3,444	37	1,206	461	1,508
4th	136	3,799	93	3,567	127	2,500
5th	216	2,824	.....	1,069	407	1,175
6th	1,179	3,544	956	2,040	944	1,498
7th	807	2,530	152	1,324	194	570
8th	2,763	4,879	84	2,264	475	979
9th	.....	.....	390	390	.....	196

Diamond-drilling in 1954 consisted of 281 holes, totalling 39,262 feet, from underground.

There were 131,422 tons of ore hoisted. The mill treated 131,544 tons at an average daily rate of 344 tons.

The following steel-frame buildings were erected during the year: a 20- by 36-foot oil-storage warehouse; a 64- by 78-foot combination shop building; a 40- by 78-foot hoistroom; a 32- by 40-foot extension to the mill building to hold tailings backfill; and a 32- by 80-foot cold-storage warehouse. A two-storey frame building, to be used as a medical centre, was built. New plant equipment included: a 45- by 35-inch Canadian Ingersoll-Rand electric sinking-hoist; a Canadian Ingersoll-Rand XVHE-2 compressor, capacity 2,000 cubic feet per minute, driven by a synchronous motor; and a dust-collecting unit for the crushing plant. A used, 96- by 60-inch Canadian Ingersoll-Rand electric hoist and a 110-foot steel headframe were bought in 1954, but were not installed.

An average of 233 men was employed, of whom 117 were underground and 116 on the surface. F. A. Fell is general manager.

Pamour Porcupine Mines, Limited

Pamour Porcupine Mines, Limited, was incorporated in March, 1934, with an authorized capitalization of 5,000,000 shares of no par value, all of which have been issued. The officers and directors are: J. Y. Murdoch, president; H. L. Roscoe, vice-president; C. H. Windeler, secretary; R. G. Rudolf, treasurer; J. R. Timmins, Messmore Kendall, L. H. Timmins, G. H. Rainville, and J. R. Bradfield, directors. The executive office is at 1709 Bank of Nova Scotia Building, Toronto. The head office and mine office are at Pamour.

The main property, in Whitney township, Porcupine area, district of Cochrane, includes the former La Palme Porcupine, Three Nations, and Porcupine Grande properties.

Mining and milling continued throughout 1954. Operations are conducted through a vertical shaft and winze, the depths of which are shown in the following table:

Shaft	Number of compartments	Total depth from surface
		feet
No. 3	5	3,144
No. 4 internal (below 600-foot level)	2	2,437

The following table shows the development work done in 1954, and the total amount at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
100-foot	.....	1,018	.....	713	.....	140
200-foot	.....	9,342	.....	4,806	.....	3,359
300-foot	.....	33	.....	116	.....	.....
400-foot	.....	22,545	82	4,331	69	14,766
500-foot	.....	264	.....	88	.....	263
600-foot	1,010	18,817	.....	1,757	.....	14,594
700-foot	.....	35	.....	.....	.....	79
800-foot	793	14,499	476	3,454	313	9,516
900-foot	.....	27	.....	.....	.....	.....
1,000-foot	132	10,108	.....	1,684	.....	8,360
1,100-foot	.....	72	.....	.....	.....	56
1,200-foot	868	12,402	.....	2,429	.....	11,038
1,300-foot	.....	29	.....	.....	.....	.....
1,400-foot	645	16,119	.....	1,717	220	5,203
1,600-foot	98	5,459	.....	1,722	57	1,464
1,700-foot	.....	213	.....	.....	.....	276
1,800-foot	.....	3,356	33	275	269	540
1,900-foot	.....	41	.....	.....	.....	737
2,000-foot	382	776	54	250	281	625
2,100-foot	.....	114	.....	26	.....	65
2,200-foot	.....	4,157	47	354	542	804
2,400-foot	.....	5,736	20	352	561	1,160
2,600-foot	33	779	19	29	358	615
2,800-foot	.....	613	18	40	260	516
2,900-foot	.....	113	.....	7	91	197
3,000-foot	.....	14	...	24	113	405
3,100-foot	.....	66	.....	.....	.....	57

Diamond-drilling in 1954 consisted of 370 holes, totalling 52,306 feet, from underground.

The following is taken from the manager's report for the year ending December 31, 1954:

Mine Development

The west ore and waste-pass systems for the new block of levels below the 1,400-foot level were completed from the 2,400 to the 1,600-foot level. The east waste-pass raise was driven from the 3,000-foot loading pocket to the 2,200-foot level, and the east ore-pass raise was extended from the 2,400 to the 2,000-foot level.

Drifting and crosscutting below the 1,400-foot level accounted for only 15 percent of the total lateral advance and was mainly to provide access to the ore and waste-pass systems. Of the 4,006 feet of drifts and crosscuts driven above the 1,400-foot level, 81 percent was in the west end greywacke and lava formations, 4 percent in conglomerate, and 15 percent in north lava in the east end of the mine.

A total of 1,569 feet of lateral advance was in ore with an average assay of 0.127 ounces of gold per ton over an average exposed width of 6.5 feet.

Development in the preparation of new stopes was carried on in 13 west-end and 14 east-end ore areas.

Diamond-Drilling

About 14 percent of the drilling was in conglomerate areas. It proved the ore grade of a small surface pillar and outlined several new stoping areas above and below the 800-foot level. Exploration of lavas accounted for 19 percent of the drilling and indicated upward extensions of ore zones above the 1,200-foot level in the east end of the mine. East greywacke received considerable attention with 27 percent of the drilling, and results were encouraging on the 400 and 800-foot levels. The remaining 40 percent of the drilling was in west greywacke where several new stoping areas and faulted extensions of known veins were indicated.

Stoping

Ore breaking was carried on in 11 east-end and 20 west-end stopes. One stope in the west and 5 stopes in the east end were in lava ore. The east end produced 69 percent of the tons broken and 62 percent of the tons milled.

Cut-and-fill stopes produced 11 percent of the ore broken and 6 percent of the ore pulled. The remainder of the ore was produced from shrinkage stopes.

Ore Reserves

	Tonnage	Grade
		ounces per ton
Broken ore:		
East end	473,533	0.081
West end	207,887	0.122
Total broken ore	681,420	0.094
Ore in place:		
East end	480,920	0.097
West end	301,925	0.130
Total ore in place	782,845	0.110
Total east end	954,453	0.089
Total west end	509,812	0.127
Total	1,464,265	0.102

No allowance was made for dilution in calculating the grade and tonnage of ore in reserve. As pointed out in previous years, considerable dilution does occur, particularly in shrinkage stoping.

After milling 637,012 tons of ore, total ore reserves were increased by about 18,000 tons with no significant change in the grade. The broken ore reserves decreased by 103,000 tons mainly because of the increased substitution of cut-and-fill stoping in place of shrinkage stoping in the west end of the mine.

Mill

Average daily tonnage was 1,745 tons, making a total of 637,012 tons milled during the year. The average grade of ore milled was 0.095 ounces per ton. Production for 1953 and 1954 is tabulated below:

Year	Milled	Mill-head assay	Recovery	Recovery		Gross value of bullion shipped
				Gold	Silver	
	tons	ounces per ton	percent	ounces	ounces	
1953	627,398	0.1010	92.26	58,475	4,959	$2,016,615
1954	637,012	0.0954	91.89	55,865	5,055	1,906,418

General

The tonnage of ore milled during 1954 exceeded the recorded tonnage for any previous year.

An average of 373 men was employed, of whom 222 were underground and 151 on the surface. D. E. G. Schmitt is manager.

Paymaster Consolidated Mines, Limited

Paymaster Consolidated Mines, Limited, was incorporated in February, 1930, with an authorized capitalization of 9,000,000 shares of $1 par value, of which 8,629,090 have been issued. The officers and directors are: E. H

Walker, president and managing director; A. S. Fuller, vice-president; E. L. O'Reilly, secretary-treasurer; W. W. Lindsay, assistant secretary-treasurer; C. E. Cook, H. M. Pryale, H. D. Rothwell, and A. J. Feuer, directors. The head office and mine office are at South Porcupine. The executive office is at 19 Melinda Street, Toronto,

The main property, in Deloro and Tisdale townships, Porcupine area, district of Cochrane, contains about 748 acres and consists of amalgamated holdings of former operating companies.

Mining operations, which had been suspended on December 16, 1953, were resumed on September 20, 1954, and continued for the rest of the year. The mill operated from October 13, 1954, to the end of the year.

The only underground development work done in 1954 was 277 feet of crosscutting on the 3,900-foot level and 100 feet of raising in No. 5 winze.

The depths of the various shafts and winzes on the property are included in the table below, which shows the total amount of development work in the mine at December 31, 1954, and the section of the mine in which it was done:

Shaft and level	Drifts	Cross-cuts	Raises	Total depth of shafts and winzes
	feet	feet	feet	feet
No. 1 SHAFT (abandoned)[1]				80
No. 2 SHAFT (dormant)[1]				814
No. 3 SHAFT (dormant)[1]				400
"Tunnel"	144	130		
38-foot	76	27		
100-foot	921	1,156		
200-foot	769	395	70	
300-foot	4,543	2,336	602	
400-foot	2,423	3,500	578	
600-foot	1,521	902	991	
800-foot	892	839		
475-foot[2]		1,537		
1,400-foot[2]	505	218	141	
1,550-foot[2]	627		184	
1,700-foot[2]	314	29	386	
2,000-foot[2]	140		68	
3,100-foot[2]	640	50		
3,250-foot[2]	172	49		
3,450-foot[2]	175		210	
No. 4 SHAFT (top cemented)[3]				253
100-foot	450	312		
200-foot	467	240		
No. 5 SHAFT (operating)[4]				4,287
No. 7 SHAFT (filled)[4]				75
No. 8 SHAFT (filled)[4]				185
No. 9 SHAFT (ventilation)[4]				185
No. 1050-1 WINZE (abandoned)[4]				162
No. 1050-2 WINZE (abandoned)[4]				582
60- and 75-foot	988	393		
120-foot	1,171	303		
180-foot	2,769	713	5	
300-foot	2,543	887		
400-foot	3,430	1,493	186	
500-foot	1,406	927	67	
600-foot	2,224	338	53	
750-foot	1,806	251		

[1]On former Premier Paymaster property.
[2]Work done from the No. 5 shaft of the Buffalo Ankerite mine.
[3]On former United Mineral Lands property.
[4]On former Dome Lake property.

(UNDERGROUND DEVELOPMENT WORK—*Continued*)

Shaft and level	Drifts	Cross-cuts	Raises	Total depth of shafts and winzes
	feet	feet	feet	feet
900-foot	2,736	367	263	
1,050-foot	8,463	4,660	1,852	
1,200-foot	3,210	545	600	
1,325-foot	3,202	662	805	
1,450-foot	3,135	711	400	
1,575-foot	6,975	2,164	985	
2,075-foot	6,281	4,167	3,444	
2,575-foot	6,592	12,601	1,504	
3,900-foot		907	200	
4,075-foot	4,431	6,094	2,047	
No. 4075-6 WINZE (operating)[1]				27
No. 1050-3 WINZE (operating)[1]				1,070
1,225-foot	2,763	1,176	501	
1,400-foot	2,345	1,585	434	
1,740-foot	5,568	1,284	1,469	
1,910-foot	6,158	1,184	3,090	
No. 5 WINZE (formerly 2075-1; operating)[1]				2,156
2,200-foot	4,939	710	1,814	
2,325-foot	5,585	1,260	2,056	
2,450-foot	2,976	286	1,429	
2,700-foot	4,090	730	2,609	
2,825-foot	4,902	1,471	2,603	
2,950-foot	4,494	520	2,267	
3,075-foot	4,739	646	1,935	
3,200-foot	3,031	530	584	
3,325-foot	1,742	273	347	
3,450-foot	1,785	403	370	
3,575-foot	1,555	536	479	
3,700-foot	230	315	409	
3,825-foot	257	302	353	
3,950-foot	302	309	370	
No. 6 SHAFT (inclined; dormant)[2]				482
100-foot	266	908		
200-foot	2,804	317	138	
300-foot	5,824	1,864	427	
400-foot	3,960	820	488	
No. 400-4 WINZE (dormant)[2]				615
525-foot	3,662	834	849	
675-foot	4,259	782	1,211	
800-foot	1,547	512	774	
1,000-foot	1,173	255	392	

Diamond-drilling in 1954 consisted of 8 holes, totalling 192 feet, from underground.

There were 29,042 tons of ore hoisted during the period of operation in 1954; the mill treated 28,236 tons, operating at an average daily rate of 371.3 tons.

During the period in which production was suspended the headframe of No. 5 shaft was raised to improve hoisting conditions. Two new 16- by 14-inch Denver mineral jigs and a new 24- by 36-inch Rogers jaw-crusher were added to the mill equipment. The following used equipment was purchased and installed in the mill: a 4-foot Symons cone crusher; a 5- by 16-foot Allis-Chalmers tube mill and 150-horsepower Canadian General Electric motor; an 11-foot

[1]On former Dome Lake property.
[2]On former West Dome property.

6-inch by 16-foot, Northern Foundry drum filter; two 20- by 24-foot, two 20- by 15-foot, and three 16- by 16-foot Dorr agitators.

The following is taken from the general manager's report for the fiscal year ending June 30, 1955:

Mining

During the period of active operations in the fiscal year, lateral development consisted of drifting along No. 18 vein on the 3,450- and 3,575-foot levels of No. 5 winze and crosscutting and drifting on the 3,750- and 3,900-foot levels of No. 5 shaft. On the 3,450-foot level of No. 5 winze, 398 feet of drifting on the westward extension of No. 18 vein had, at June 30, developed an additional 274 feet of ore having an average cut grade of 0.27 ounces over an average width of 127 inches; work is being continued here. On the 3,575-foot level, drifting was resumed along No. 18 vein to the west and, at June 30, 22 feet had been advanced in ore. On the 3,900-foot level, the crosscut south from No. 5 shaft was advanced 406 feet to intersect No. 36 orebody and 1,021 feet of drifting done east and west of this crosscut. Of this drifting, 577 feet are in ore, which represents the *B*, *C*, and *D* sections of No. 36 orebody. Drifting is being extended east to complete development of the *D* section and west towards the *A* section. The grade and widths, as far as has been established to date, compare favourably with those obtained in No. 36 orebody on the 4,075-foot level. On the 3,750-foot level a crosscut south from No. 5 shaft towards the No. 36 orebody was started and had advanced 235 feet by June 30.

The main ore and waste-pass systems for the lower levels of No. 5 shaft are being driven as level development progresses.

Hoisting facilities from the 4,075-foot loading pocket were completed, and the installation of the underground crusher is proceeding. The crusher foundations have been poured, and the roof and walls of the crusher station have been re-inforced with interwoven scrap-hoisting cable anchored in place by rock bolts and coated with cement by guniting. A temporary chute was erected in the crusher station to by-pass ore to the loading pocket while the installation work is underway. The transformer-station room has been concreted and the walls and roof gunited.

Since operations have been resumed, no further development was done on No. 6 winze below the 4,075-foot level. Until the development of No. 36 and associated orebodies above the 4,075-foot level has progressed considerably farther, the No. 6 winze sinking program has been held in abeyance.

Stoping operations were resumed from the No. 5 winze levels between the 2,575- and 3,075-foot levels on the Nos. 8, 18, 23, 24, 27, and 31 orebodies and from No. 5 shaft levels between the 1,575- and 2,575-foot levels on the Nos. 3, 14, 19, and 27 orebodies. From the No. 5 shaft levels between the 2,575- and 4,075-foot levels, stoping was commenced on Nos. 25 and 36 orebodies on the 4,075-foot level, and No. 30 orebody on the 2,575-foot level.

A clean-up of stope remnants on the levels above the 2,075-foot, which are serviced by No. 3 winze was completed in April, 1955, and this winze is no longer in regular operation. The hoisting installation will remain intact here until salvageable equipment has been removed from the levels serviced by the winze.

With the increasing depth of mining and, in some cases, wider orebodies, less favourable ground conditions tend to prevail and in the interests of safer operations and prevention of ore dilution, cut-and-fill mining methods are being used almost exclusively as new stopes are developed. Heretofore, waste rock from current development and stored waste in old stopes has taken care of backfill requirements. However, increasing demands for fill require that new sources be provided. Plans have been completed and, work scheduled to commence immediately, whereby waste rock or gravel fill can be introduced into the mine from surface by way of old mine workings involving a minimum of rock work and construction.

The sources of ore milled during the past fiscal year were as follows: development, 6.7 percent; No. 5 winze, 2,575- to 3,075-foot levels, 59.8 percent; No. 5 shaft, 1,575- to 2,575-foot levels, 30.8 percent; and No. 5 shaft, 2,575- and 4,075-foot levels, 2.7 percent.

Ore Reserves

Ore	Tonnage	Grade
		ounces per ton
Probable	105,280	0.235
Positive	353,260	0.250
Broken	38,593	0.270
Total	497,133	0.249

Ore reserves showed an increase of 37,945 tons. The over-all grade increased from 0.244 ounces at June 30, 1954, to 0.249 ounces at June 30, 1955.

Milling

Milling operations were resumed on October 15, 1954. During the period of October 15, 1954, to June 30, 1955, 111,247 tons of ore were milled. The daily average milling rate for this period was 430 tons as compared with 431 tons in the previous fiscal year during which time the mill operated 5½ months.

Costs

The mining cost per ton of ore broken was $6.78.

Following is an analysis of the operating costs:

	Total cost	Cost per ton milled
Diamond-drilling	$ 5,654.79	$0.05
Drifting	38,233.23	0 34
Crosscutting	11,583.02	0.11
Raising	25,967.47	0.23
Mining	605,548.59	5.44
Ore transportation	11,622.93	0.11
Crushing	18,048.95	0.16
Milling	180,193.33	1.62
General expense	91,294.40	0.82
Total	$988,146.71	$8.88

General

As in the past, no bullion was sold on the open market.

The average prices received from the Royal Canadian Mint per ounce of gold sold during each of the last five fiscal years were as follows:

Fiscal Year Ending	Per Ounce
June 30, 1951	$37.54
June 30, 1952	35.87
June 30, 1953	34.34
June 30, 1954	34.40
June 30, 1955	34.26

The average number of men employed for the year was 87, of whom 48 were underground and 39 on the surface. C. E. Cook is general manager.

Pickle Crow Gold Mines, Limited

Pickle Crow Gold Mines, Limited, was incorporated in January, 1934, with an authorized capitalization of 3,500,000 shares of $1 par value, of which 3,136,850 have been issued. The officers and directors are: J. E. Hammell, president and managing director; C. S. Hamilton, vice-president; G. M. Huycke, secretary-treasurer; John Bland, assistant secretary-treasurer; A. G. Hattie, director of mining. The head office and mine office are at Pickle Crow. The executive office is at 25 King Street West, Toronto.

The property consists of 96 claims in Connell and McCullagh townships, Pickle Lake area, Patricia portion of Kenora district.

Mining and milling continued throughout 1954. The No. 3 shaft was sunk a further 551 feet, to a total depth of 2,587 feet, and new levels were cut at depths of 2,050, 2,200, 2,350, and 2,460 feet.

The following table shows the total depths of the shafts on the property and the number of compartments in each:

Shaft	Inclination	Number of compartments	Total depth from surface
			feet
No. 1, main[1]	vertical	3 to 1,200 feet 4 from 1,200 to 2,450 feet 3 from 2,450 feet to bottom	3,042
No. 2 (winze below 750-foot level)[2]	vertical	3	1,547
No 3[3]	vertical	3 to 1,554 feet 4 from 1,554 feet to bottom	2,587

The following table shows the development work done in 1954, and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
No. 1 VEIN:						
125-foot		1,869		140		510
250-foot		1,216		222		254
375-foot		1,643		379		300
500-foot		1,561		291		468
625-foot		1,311		232		405
750-foot		2,426		7,055		370
900-foot		1,417		229		657
1,050-foot		1,415		384		530
1,200-foot		1,750		354		571
1,350-foot		1,922		2,732		799
1,500-foot		1,315		668		638
1,650-foot		1,030		623		594
1,800-foot		1,074		940		531
1,950-foot		936		724		1,089
2,075-foot		793				367
2,200-foot		775		806		1,046
2,450-foot	640	1,924		1,380		971
IRON-FORMATION ZONE:						
2,600-foot		235		310	53	345
2,750-foot				340		
2,900-foot				8		
No. 2 VEIN:						
250-foot				1,450		308
450-foot		909		999		348
550-foot		1,279		857		1,089
600-foot						75
750-foot		2,454		1,727	89	1,471
850-foot		1,432		771		1,141
975-foot	45	2,326	30	1,586	66	1,490
1,100-foot		1,265		1,887		1,381
1,225-foot		1,085		1,060	80	821
1,350-foot				144		182
1,475-foot		923		1,549	438	1,426
1,600-foot		866		2,164	61	296
No. 5 VEIN:						
1,350-foot						23
No. 6 VEIN:						
1,475-foot		519		213	202	413
1,600-foot	42	841		23		373
1,750-foot	802	802	739	739	508	508
1,900-foot	674	674	692	741	412	468
2,460-foot					20	20

[1]On Howell vein system, claim Pa.747.

[2]In Cohen-McArthur section, about a mile northeast of No. 1 shaft; not being used.

[3]On claim Pa.2062, about 5,000 feet northeast of No. 1 shaft and 1,400 feet south of No. 2 shaft (winze).

Diamond-drilling during 1954, which was all from underground, consisted of the deepening of 6 holes and the drilling of 83 new holes. The total length was 10,035 feet.

The following is taken from the general manager's report for the year ending December 31, 1954:

Development[1]

No. 1 Shaft (Iron-formation Zone)

2,450-foot Level.—During the year, the iron-formation band in which the 2403W. and 2603W. stopes are located was explored to the west by the 2404W. drift in an attempt to locate other ore-bearing sections.

To achieve a speedier advance, the heading was advanced into the greenstone directly south of the iron, and the iron band diamond-drilled at intervals. Some 640 feet of drifting was done here, and although drilling of the band returned some interesting values, no ore of commercial value was outlined.

2,600-foot Level.—Some 53 feet of raising completed the 2603W. No. 2 raise during the year. Systematic sampling of the raise returned an average grade of $7.10 for the last 81 feet. This compares with a grade of $13.30 for the first 65 feet of diamond-drill hole No. 2485 drilled downward from the 2,450-foot level in the 2603W. No. 2 raise area.

No. 2 Vein

975-foot Level.—Some 30 feet of crosscutting was done at the east end of the 975-foot level to open up No. 2 vein in this area. Previous flat diamond-drill holes had shown good widths of vein material but only low values. During the year, exploration subdrifting some 50 feet above the drift opened up a short section containing large quantities of coarse gold. Due to this and the results obtained from further diamond-drilling, this area is being opened up from the drift level. Forty-five feet of drifting was done on the vein during the year with erratic assays ranging up to $9.10 being obtained.

The 2-921E. raise was driven on the vein from the back of the drift for a length of 66 feet. Channel samples averaged $5.95 across 32 inches for the entire length, and the last 16 feet averaged $15.40 across 31 inches. Further exploration work will be done in this area.

1,225-foot Level.—The 2-129W. raise was driven from the 2-121W. stope to the 1,100-foot level, with an advance of 80 feet. This heading was driven at the extreme east end of the stope for mining purposes.

1,475-foot Level.—Two raises, totalling 371 feet, were driven from the back of the 3-141 No. 1 stope to the 1,225-foot level during the year. These raises and a finger raise 67 feet in length will be used in mining operations.

Channel samples averaged $17.15 across 18 inches for one raise, and $19.95 across 24 inches for the other.

1,600-foot Level.—Two raises totalling 61 feet were driven from the 3-161W. No. 1 stope to the 1,475-foot level for mining operations.

No. 6 Vein

1,475-foot Level.—The 3-142W. No. 2 raise was driven from the south end of the 3-142W. No. 2 stope for exploration purposes for a length of 202 feet, or to a vertical height of 215 feet above the 1,475-foot level drift. Narrow stringers were followed for the greater part of this advance, but for a length of 47 feet the vein widened out and averaged $8.40 across 27 inches.

1,600-foot Level.—A drift, 42 feet in length, was driven in the south wall of the 3-162W. drift to investigate values obtained by diamond-drilling. Only a narrow stringer was encountered, and values were low.

1,750-foot Level.—Some 739 feet of crosscutting was done on the 1,750-foot level during the year to reach No. 6 vein from No. 3 shaft, and 802 feet of drifting and considerable slashing was done to open up the vein.

Channel sampling has disclosed the following information:

Vein length	Width	Grade	
		Cut	Actual
feet	inches		
85	20	.....	$ 5.60
50	37	.....	3.50
142	29	$14.00	21.35
165	41	8.05	12.60

Although channel sampling obtained low values in a good part of the drifting, pockets of visible gold have been found near by, and it is felt that, because of this and results experienced on

[1] All values given in this report are based on gold at $35 per ounce.

other levels opened up, the stoping length will be considerably greater than that shown by drift samples.

An ore pass 289 feet long was driven in waste to the 1,600-foot level. This heading is located in the main crosscut near No. 3 shaft and is part of a system of passes to transfer ore to the loading pocket below the 1,900-foot level.

Two raises were started from the 1,750-foot level on No. 6 vein, one of which was completed during the year and averaged $16.80 cut grade over 18 inches for its entire length of 189 feet.

The second raise was started in December and was advanced 30 feet.

1,900-foot Level.—During the year, 670 feet of crosscutting was done on the 1,900-foot level to reach No. 6 vein, and 674 feet of drifting was done on the vein. Of this 674 feet, 497 feet of vein length averaged $17.15 cut grade over 28 inches, or $31.50 uncut grade.

An ore pass in the crosscut near No. 3 shaft was driven to the 1,750-foot level. This heading was 215 feet in length.

One raise was driven on the vein to the 1,750-foot level and averaged $17.50 over 19 inches.

As on the 1,750-foot level, visible gold has been found where nearby channel samples have not indicated commercial ore. Because of this, stoping lengths are becoming longer than drift channel assays outline.

No. 3 Shaft.—No. 3 shaft was deepened 551 feet during the year, from 2,036 to 2,587 feet below the collar, and during January, 1955, the present sinking program was completed with the shaft 2,600 feet below the collar.

The 2,050-, 2,200-, and 2,350-foot stations were cut at 150-foot intervals velow the 1,900-foot level, and the 2,460-foot station was cut at 110 feet below the 2,350-foot level.

A dump pocket and deck were cut, 80 feet above the 2,350-foot level, and will be used when further sinking is undertaken.

A loading pocket was cut 65 feet below the 2,460-foot level, and ore and waste passes were driven to the 2,460-foot level.

To obtain a more efficient method of handling waste from the lower levels, a raise 89 feet in length was driven from the 750-foot level to the dump pocket above the level. An air-controlled door will be installed at the top of this raise and will allow ore and waste to be handled by the skips.

During sinking operations two gold-bearing quartz veins were intersected. The first vein was encountered at the 2,275-foot horizon striking N.20°W. and dipping approximately 70 degrees northeast, leaving the shaft 97 feet below the 2,200-foot station. A great deal of coarse gold was found where the vein was first intersected, although channel samples taken nearby were low.

The second vein appeared 112 feet below the 2,460-foot level striking northeast and dipping north. This vein remained in the shaft after the sinking program had been completed.

Visible gold was also found in this vein but was finer and more evenly distributed. Channel sampling on the vein opened up averaged $12.95 over 19 inches.

No. 3 shaft is located in the greenstone, and this material has remained in the shaft to date. Porphyry bands were encountered in the shaft from the 2,200-foot level to the present bottom and it is felt that this geological structure makes this area very promising.

Diamond-Drilling

	Feet
No. 1 SHAFT:	
Exploration No. 1 vein	319
Exploration iron-formation zone	988
Total	1,307
No. 3 SHAFT:	
Exploration No. 2 vein	2,333
Exploration No. 6 vein	6,342
Exploration No. 7 vein	53
Total	8,728

No. 1 Shaft.—Seven short holes were drilled on No. 1 vein to aid mining operations.

Six holes totalling 988 feet of exploratory drilling was done in the iron formation on the 2,450-foot level. This drilling has been referred to under development.

No. 3 Shaft.—Some 8,728 feet were drilled in this area during the year for exploratory purposes and to guide mining operations.

Stoping

During the year 112,282 tons were hoisted of which 101,862 tons were obtained from the stopes.

No. 1 shaft stoping operations supplied 21,445 tons of which 20,589 tons were extracted from No. 1 vein and 856 tons from the stopes in the iron formation.

No. 3 shaft stoping operations supplied 80,417 tons of which 53,677 tons were extracted from No. 2 vein and 26,740 tons from No. 6 vein.

The balance of 10,420 tons was obtained from development.

Ore Reserves

Ore reserves amounted to 475,304 tons of an average grade of $12.85 per ton.

Milling

A summary of the mill operations follows:

Milled	tons	111,677
Gold recovered per ton milled	ounces	0.4182
Gold value per ton milled	ounces	0.4243
Total recovered	ounces	46,705

Costs

	Cost	Per ton	Per ounce
Development, including shaft-sinking	$ 329,287.62	$ 2.948	$ 7.050
Mining	642,076.53	5.749	13.747
Milling	212,709.55	1.904	4.554
General mining expenditures	139,181.42	1.246	2.980
Total	$1,323,255.12	$ 11.847	$ 28.331
Depreciation	37,200.71	0.333	0.797
	$1,360,455.83	$ 12.180	$ 29.128

An average of 229 men was employed, of whom 132 were underground and 97 on the surface. A. G. Hattie is general manager.

Plator Gralouise Gold Mines, Limited

Plator Gralouise Gold Mines, Limited, was incorporated in 1948 to succeed Plator Porcupine Gold Mines, Limited. The authorized capitalization is 3,500,000 shares of $1 par value, of which 2,114,623 have been issued. The officers and directors are: E. W. Shaw, president; R. H. Killebrew, vice-president; M. G. Lee, secretary-treasurer; I. W. Shaw and G. V. Munroe, directors. The head office is at 300 Roncesvalles Avenue, Toronto. The mine address is Atikokan.

The company holds nine claims, six of which are patented, on an island in Marmion Lake, north of Schwenger township, Rainy River district, about ten miles north of Atikokan.

There is a two-compartment, vertical shaft, 275 feet deep, with stations at 125 and 250 feet, on claim F.F.3704. It was dewatered and sampled in 1954. Fifteen diamond-drill holes, totalling 3,647 feet, were drilled from underground.

An average of five men was employed.

Preston East Dome Mines, Limited

Preston East Dome Mines, Limited, was incorporated in January, 1911, and reorganized by supplementary letters patent in February, 1936. The authorized capitalization is 3,000,000 shares of $1 par value, all of which have been issued. The officers and directors are: W. M. Bouck, president; G. B. Langford, vice-president; L. I. Hall, secretary-treasurer; W. A. Hutchison, managing director; S. A. Hayden, J. H. Hirshhorn, F. R. Joubin, C. F. W. Burns,

and R. A. Jodrey, directors. The executive office is at 111 Richmond Street West, Toronto. The head office and mine office are at South Porcupine.

The company owns seven claims immediately south and east of the Dome mine, in Tisdale township, Porcupine area, district of Timiskaming. During 1954 a number of claims were acquired in the Sudbury, Sault Ste. Marie, Kenora, and Kowkash mining divisions.

Mining operations at the Preston East Dome mine in Tisdale township, which had been suspended because of a labour strike in July, 1953, were resumed on February 19, 1954, and continued for the rest of the year. The mill operated from March 3, 1954, to the end of the year.

The following shows the depths of the shafts in the mine:

Shaft	Inclination	Number of compartments	Total depth from surface
			feet
No. 1	63 degrees	2	95
No. 2	vertical	5	2,388
No. 3 internal (below 18th level)	vertical	3 from 18th level to 69 feet above 28th level 4 to bottom	3,658

The following table shows the development work done in 1954, and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
1st		1,422		805		146
2nd	344	5,589	171	2,150	61	1,552
3rd	292	7,066	291	2,361	56	1,539
4th		5,321		1,091		1,947
5th	84	6,473	306	4,240		2,305
6th	120	5,034	574	3,686	153	1,784
7th	17	6,288	116	3,720	230	2,060
8th	264	4,530		2,364	118	1,693
9th	152	5,129	396	7,798	182	2,114
10th		2,576		1,985		1,092
11th		1,708		1,379		1,233
12th		3,814		7,363		2,170
13th	105	2,081	57	4,258	48	1,414
14th	257	3,268		5,067		1,217
15th		3,599		7,126		1,365
16th		1,501	107	6,935		1,360
17th		1,380		3,024		1,996
18th	16	3,345	566	9,685		3,324
19th	478	2,593	430	5,154	304	1,916
20th	772	2,812	304	4,136	528	1,892
21st	10	1,578	1,240	4,525	67	1,428
22nd	48	1,939	130	2,343	180	1,272
23rd	783	3,220	407	5,763	343	1,505
24th	226	1,468		2,162	51	927
25th		178	980	2,917		574
26th	59	839	33	328	21	472
27th		72	995	2,514		369
28th			144	902	77	409
29th			60	236	66	378

The following diamond-drilling was done from underground in 1954:

Property	Holes	Feet
Preston East Dome	271	51,636
Midcamp	12	6,800
Cincinnati	4	2,697
Dome	4	2,504

The new additions to the office and mill buildings were completed, and two new Hardinge agitators were added to the mill equipment.

The following is taken from the managing director's report for the year ending December 31, 1954:

Production

Ore hoisted	tons	211,112
Total milled	dry tons	209,510
Average milled per day	dry tons	698
Average mill heads gold per ton	ounces	0.283
Average net recovery per ton milled	ounces	0.278
Average gold in tailings per ton	ounces	0.0056
Average recovery	percent	98.0
Gold produced	fine ounces	58,186.75
Silver produced	fine ounces	6,753.96

Tonnage treated was increased by 5 percent, and grade decreased by 3 percent compared with the operating period of 1953. However, due to the increase in milling rate, production was at a somewhat higher level than in 1952, the last full year of production.

Costs

The total mine operating costs for the period, exclusive of administration, write-offs, depreciation, and taxes, are shown in the following table:

Development and diamond-drilling	$2.224
Mining	5.413
Milling	1.121
Total	$8.758

Compared with the previous year, operating costs showed an increase of $0.225 due, in part, to an increase in expenditures on maintenance and, in part, to a general wage increase and other employee benefits.

Development

Lateral development for the year, exclusive of work performed on Midcamp property, totalled 11,181.5 feet. This work was productive of 1,992 feet of ore grading 0.45 ounces per ton uncut and 0.23 ounces per ton cut over an average width of 17.3 feet.

The table below shows the distribution of lateral development by zones completed in 1954:

Zone	Lateral development	Percentage of total
	feet	
West porphyry	5,264.0	47.0
Preston porphyry	854.5	8.0
North greenstone	1,362.5	12.0
Porphyry greenstone	3,700.5	33.0
Total	11,181.5	100.0

West Porphyry.—During the year development in the West Porphyry produced 604 feet of ore grading 0.38 ounces per ton uncut and 0.21 ounces per ton cut.

Most of this ore was disclosed in levels above the 10th, where detailed development was concentrated during the year. In addition, a long-range exploration program was continued in drives to the west on the 18th and 27th levels towards the projected position of the known favourable areas on adjacent levels.

Preston Porphyry.—Detailed development in the Preston Porphyry was mainly confined to the 13th, 15th, and 19th levels. This work disclosed a total of 172 feet of ore grading 0.22 ounces per ton uncut and 0.17 ounces per ton cut.

North Greenstone.—In the North Greenstone a total of 65 feet of ore, grading 0.20 ounces per ton, was disclosed in lateral development on the 21st level.

Towards the year's end a drive on the 25th level was approaching the area from which detailed investigation of the favourable zone will be carried out during the current year.

Porphyry Greenstone.—The Porphyry Greenstone area has been under development in the block between the 19th and 23rd levels where a total of 1,151 feet of ore, grading 0.49 ounces per ton uncut and 0.24 ounces per ton cut, was disclosed.

At the year's end, development was proceeding in ore on the 21st and 22nd levels, and drives are being extended on the 25th and 27th levels for exploration of the favourable area at depth.

It is of interest to note that the total footage of ore disclosed to date in the block between the 19th and 23rd levels is 2,009 feet with a grade of 0.50 ounces per ton uncut and 0.21 ounces per ton cut.

Diamond-Drilling

The total footage drilled during the period was 51,636 feet of which 57 percent was drilled in the West Porphyry; 8 percent in the Preston Porphyry; 10 percent in the North Greenstone; and 25 percent in the Porphyry Greenstone.

Mining

During the period under review the mine produced 213,429 tons of ore of which 90 percent came from stopes, and the remaining 10 percent was derived from development.

Broken ore remaining in the stopes at the year's end totalled 39,151 tons, as compared with 36,200 tons at the previous year's end.

The table below gives a record of ore trammed for the year 1954:

Mining method	Trammed	Percentage of total
	tons	
Open stopes	1,328	0.6
Square-set pillar recovery	14,427	6.8
Shrinkage	14,492	6.8
Cut-and-fill	91,269	42.7
Open stoping over stull timber	52,688	24.8
Miscellaneous	15,038	7.0
Development	24,187	11.3
Total	213,429	100.0

The following gives a record of production by zones:

Source	Ore trammed	Percentage of total	Grade	
			Uncut	Cut
	tons		ounces per ton	ounces per ton
Preston Porphyry	32,428	15.2	0.24	0.16
West Porphyry	95,538	44.8	0.39	0.24
Porphyry Greenstone	11,415	5.3	0.27	0.18
North Greenstone	49,861	23.4	0.27	0.15
Development	24,187	11.3	0.30	0.14
Total	213,429	100.0	0.321	0.191

Ore Position

Ore reserves as of December 31, 1954, totalled 507,083 tons with a grade of 0.261 ounces per ton after allowances for dilution. Compared with the previous year, this shows a moderate tonnage increase of 6,833 tons and a slight grade decrease of 0.014 ounces per ton.

Of the total reserve, 48.7 percent is contained in the West Porphyry; 13.2 percent in the Preston Porphyry; 24.2 percent in the Porphyry Greenstone; and 13.9 percent in the North Greenstone.

Milling

The installation of two additional agitators in the mill circuit has brought to this operation a degree of efficiency that is unusual. Mill recovery now runs between 98 and 99 percent, and with an almost negligible increase in operating cost, the new equipment will recover the capital outlay in less than two years.

Capital Expenditures

Capital expenditures for the year totalled $96,705. Equipment and preparations for deepening No. 3 shaft and the mill addition accounted for approximately two-thirds of this figure.

Outside Exploration

A total of 33 properties were submitted to the company during the year, and of these 13 were examined, and 3 were taken under option; 4 other properties were investigated and optioned, and 5 properties were staked by the company's field staff.

The company's main holdings at the year's end included two groups adjoining Pronto property on the east and west; three groups in the Tashota base metal area where line cutting is in progress in preparation for an electromagnetic survey; a large group in the Bathurst-Newcastle base-metal district, which is currently being explored; a group in the Kenora uranium belt where further work is planned this year; and a lead-zinc property north of Sudbury on which an electromagnetic survey was completed in 1954.

As of December 31, 1954, the company controlled a total of 338 claims, all of which were acquired by staking, and 145 claims were held under option agreements.

Cincinnati Property

During the year four parallel diamond-drill holes, totalling 2,697 feet, were drilled on this property. These holes, spaced across the east-west width of the claim, were drilled horizontally from the 23rd level and located a porphyry body, but failed to disclose mineralization of interest.

Further exploration of this property is planned for the current year by surface diamond-drilling and in raising from the 9th level where two low-grade ore shoots were disclosed by previous development work.

Midcamp Property

During the year the 23rd level drive was extended 1,093 feet. Diamond-drilling, totalling 6,800 feet in 12 holes, was completed. No development has been done on this property from the company's workings since September when work was suspended by the Midcamp management.

An average of 353 men was employed, of whom 242 were underground and 111 on the surface. H. W. Hutchison, who was formerly manager at the mine, became managing director of the company. R. D. Lord succeeded him as manager.

Renabie Mines, Limited

Renabie Mines, Limited, was incorporated in January, 1941, with an authorized capitalization of 1,500,000 shares of $1 par value, of which 1,050,005 have been issued. The company is a subsidiary of Macassa Mines, Limited. The officers and directors are: R. A. Bryce, president; Larmour Soliague, vice-president; H. W. Salthouse, secretary-treasurer; J. D. Bryce, G. A. Howes, and H. M. Porteous, directors. The head office is at 85 Richmond Street West, Toronto. The mine address is Renabie.

The company owns 33 claims in Leeson and Rennie townships, district of Sudbury.

Mining and milling continued throughout 1954. Operations are conducted through two vertical, three-compartment shafts; No. 1 shaft is 281 feet deep, and No. 2 shaft is 1,430 feet deep.

The following table shows the development work done in 1954 and the total at the end of 1954:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
125-foot		3,965		104		1,025
250-foot		3,508		729		1,057
375-foot	294	1,723		698		957
525-foot	400	1,297		528		883
675-foot	970	1,787		2,203	771	1,679
800-foot		1,755		1,425	20	1,155
925-foot		879		154		549
1,100-foot	694	802		561	199	981
1,250-foot				327		176
1,400-foot				13		87

Diamond-drilling in 1954 consisted of 42 holes, totalling 13,037 feet, from underground.

There were 167,257 tons of ore hoisted. The mill treated 166,982 tons, operating at an average daily rate of 457.48 tons.

A new frame hoistroom and concrete-block substation were built at the No. 2 shaft, and the headframe was reinforced with timber. A new 96- by 60-inch, double-drum Bertram-Nordberg electric hoist and a 200-horsepower Canadian General Electric motor were installed.

The following is taken from the mine manager's annual report for the year ending December 31, 1954:

Production

The following figures show the production for 1954 with comparable figures for 1953 and for 1952:

	1954	1953	1952
Gross recovery	$1,466,352.35	$1,429,648.79	$1,406,342.51
Tons milled	166,982	168,243	169,674
Recovery per ton	$8.78	$8.50	$8.29

The average Mint settlement value per ounce of gold was $34.07 compared with $34.39 in 1953. Under provisions of The Emergency Gold Mining Assistance Act, it is estimated the company is entitled to receive the sum of $173,841.73 for the year, which is $1.041 per ton milled, or $4.068 per ounce of gold recovered.

Milling

The average tons milled per day for 1954 was 457.5 as compared with 460.9 in 1953. The extraction for the year was 92.7 percent. Bullion recovery comprised 42,727.873 ounces of gold and 13,019.24 ounces of silver. From the commencement of milling operations in July, 1947, 1,032,447 tons of ore have been milled from which have been recovered 246,772.150 ounces of gold and 78,916.92 ounces of silver having a gross value of $8,790,354.67, equivalent to $8.51 per ton milled, exclusive of cost-aid.

Development

Work was continued on known orebodies lying between the 250- and 1,100-foot level, and two new orebodies, designated "K" and "L," having a combined tonnage of 450 tons per vertical foot and a grade of 0.25 ounces per ton, were developed on the 1,100-foot level. Diamond-drilling extended the *J* orebody from the 800- to the 1,100-foot level; the *J* orebody is continuous from the 525- to the 1,100-foot level and is above mine average grade.

Comparative figures for development footages for the years 1954 and 1953, and the total to date, are shown in linear feet as follows:

	1954	1953	Total to date
	feet	feet	feet
Drifting	3,190.0	1,539.0	15,099.3
Crosscutting	.....	1,311.0	11,105.9
Raising	1,062.0	2,246.5	8,203.0
Shaft-sinking	.....	.....	1,733.3
Station-cutting (shaft equivalent)	.....	0.4	716.5
Diamond-drilling	13,037.0	16,687.0	79,263.0

Ore Reserves

The technical position of ore reserves at the year's end after allowing for dilution was as follows:

	Tons	Ounces per ton	Value (gold at $35 per ounce)
Unbroken ore	395,400	0.249	$8.72
Broken ore	106,600	0.255	8.93
Total	502,000	0.250	$8.75

Operating Costs

The operating and other costs per ton and per ounce of gold recovered were as follows:

	1954		1953	
	Per ton milled (166,982 tons)	Per ounce recovered (42,727.873 ounces)	Per ton milled (168,243 tons)	Per ounce recovered (41,248.379 ounces)
Development and exploration	$0.837	$ 3.269	$0.865	$ 3.527
Mining	2.816	11.006	2.678	10.922
Milling	1.495	5.843	1.458	5.946
Undistributed operating charges including administration and head office	0.530	2.071	0.571	2.331
Total operating costs	$5.678	$22.189	$5.572	$22.726
Depreciation	$1.748	$ 6.833	$1.554	$ 6.340
Preliminary exploration and development write-off	0.659	2.575	0.654	2.668
Provision for municipal, federal, and provincial taxes	0.165	0.643	0.166	0.677
Total costs	$8.250	$32.240	$7.946	$32.411

Capital Expenditure

The total capital expenditure amounted to $203,089.28 and, briefly summarized, was as follows:

New hoist building and hoist	$154,600.94
Headframe	12,036.85
Underground equipment	24,435.06
Shops and miscellaneous	12,016.43
Total	$203,089.28

Construction

The No. 2 shaft hoistroom was enlarged to house the new 8-foot hoist, installed in August (ultimate capacity, 3.5-ton pay load from a depth of 3,500 feet). The headframe was reinforced to handle the increased pay load.

General

The community of Renabie comprised 71 families, 76 houses, and a total population of 348. The present enrolment at the public school is 60 pupils.

An average of 168 men was employed, of whom 74 were underground and 94 on the surface. A. A. McCloskey is mine manager.

Starratt Olsen Gold Mines, Limited

Starratt Olsen Gold Mines, Limited, was incorporated in June, 1945, with an authorized capitalization of 3,000,000 shares of $1 par value, all of which have been issued. The officers and directors are: J. E. Hammell, president and managing director; C. S. Hamilton, vice-president; A. G. Hattie, director of mining; G. M. Huycke, secretary-treasurer; John Bland, assistant secretary-treasurer. The head office is at 25 King Street West, Toronto. The mine address is Madsen.

The property consists of 18 claims in Baird township, Red Lake area, Patricia portion of Kenora district, and is just west of the Madsen Red Lake mine. It is reached by an eight-mile road from Red Lake.

Mining and milling continued throughout 1954. Operations are conducted through the vertical, three-compartment main shaft, which is 2,129 feet deep.

The following table shows the development work done in 1954, and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
175-foot		1,845		243		520
300-foot		2,387		609		394
550-foot		2,557		272		1,193
675-foot		357				135
800-foot		4,794		86		1,291
1,000-foot		2,758		18	72	1,832
1,150-foot	663	5,149			562	979
1,325-foot		3,715				1,320
1,475-foot	1,191	5,855				1,070
1,660-foot		28				561
1,810-foot						
1,960-foot		1,588				120

Diamond-drilling consisted of 201 holes, totalling 25,570 feet, from underground.

There were 99,898 tons of ore hoisted. The mill treated 99,375 tons.

The following is taken from the manager's report for the year ending December 31, 1954:

Mine Development[1]

Total mine development work amounted to 2,487.5 feet of advance and 6,175 cubic feet of slashing in drifting and raising.

Lateral exploration at the 1,475-foot level had reached a point 3,625 feet west of the shaft at the year's end. This work outlined the following two lengths of ore in a new geological structure:

	Length	Width	Grade
	feet	feet	
No. 1	110.0	6.5	$15.37
No. 2	80.0	5.0	13.60

Subsequent work above these lengths revealed the vertical continuity to be very irregular.

Drifting west at the 1,150-foot level towards the upward extension of the new ore zones was started late in the year. This drift, completed early in 1955, outlined a length of 135.0 feet, averaging $13.87 across an average width of 6.5 feet.

Stope Preparation

Total stope preparation consisted of 2,320 feet of advance and 12,212 cubic feet of slashing in drifting, subdrifting, and raising.

Ore Reserves

As of January 1, 1955, total mine ore reserves were 30,000 tons, averaging $6 per ton.

Milling and Production

	Tons
Ore milled	99,375
Average milled per day	273

	Value per ton		Total value	
	ounces		ounces	
Head assays	0.148	$5.18	14,700.87	$514,530.45
Heads calculated	0.160	5.60	15,905.26	556,684.28
Tailings	0.013	0.447	1,268.90	44,411.50

Mint Settlement Values

Gold (14,636.365 ounces)		$498,913.26
Silver (2,378.67 ounces)		$1,975.12
Recovery	percent	92.0

Operating Costs

	Cost	Per ton	Per ounce
Development, including diamond-drilling	$ 93,159.67	$0.937	$ 6.365
Mining	311,422.63	3.134	21.277
Milling	145,172.61	1.461	9.919
Marketing charges	4,619.49	0.047	0.316
Surface and general administration at mine	73,600.77	0.741	5.028
Total	$627,975.17	$6.319	$42.905

Exploration

Exploration work was further extended west into a new area west of all previous workings.

An average of 96 men was employed, of whom 51 were underground and 45 on the surface. Alexander Watt is manager.

[1]All values given in this report are based on gold at $35 per ounce.

Sylvanite Gold Mines, Limited

Sylvanite Gold Mines, Limited, was incorporated in June, 1913, with an authorized capitalization of 3,300,000 shares of $1 par value, of which 3,299,500 have been issued. The officers and directors are: W. V. Moot, president and managing director; K. C. Gray, vice-president and general manager; W. S. Walton, secretary-treasurer; A. H. Sharpe, Harry Yates, L. R. Gulick, and A. F. Osborn, directors. The executive office is at Erie County Bank Building, Buffalo, N.Y. The secretary's office is at 44 King Street West, Toronto. The head office and mine office address is Box 670, Kirkland Lake.

The main property is in Teck township, Kirkland Lake area, district of Timiskaming.

Mining and milling continued throughout 1954. The table below shows the depths of the shafts on the property and the number of compartments in each. The shafts are all vertical.

Shaft	Number of compartments	Total depth from surface
		feet
No. 1[1]	2	125
No. 2	3	3,642
No. 3[1]	2	118
No. 4	2	1,762
No. 5 (winze below 3,150-foot level)	4	5,400

The following table shows the development work done in 1954, and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
125-foot	.....	2,030	.....	356	.....	232
250-foot	153	8,744	24	2,546	250	1,379
375-foot	163	11,222	43	3,002	76	2,694
500-foot	138	13,367	.....	4,168	262	2,556
625-foot	56	11,722	37	3,004	.....	2,595
750-foot	.....	14,285	.....	3,722	427	3,333
875-foot	97	15,919	21	4,730	327	4,071
1,000-foot	23	15,694	16	5,471	98	5,865
1,125-foot	.....	10,026	.....	2,935	154	3,305
1,250-foot	.....	8,983	33	3,760	248	3,037
1,375-foot	.....	5,921	.....	2,403	.....	1,705
1,500-foot	.....	5,864	.....	2,538	.....	1,911
1,625-foot	149	6,156	.....	2,045	113	1,410
1,750-foot	760	9,669	43	3,013	508	2,386
1,875-foot	222	6,742	.....	1,942	199	1,727
2,000-foot	156	5,873	462	2,532	27	1,534
2,125-foot	.....	1,305	.....	430	160	681
2,250-foot	218	5,054	.....	1,831	189	1,840
2,375-foot	.....	4,481	.....	2,187	132	909
2,500-foot	....	5,881	.....	2,008	.....	2,220
2,625-foot	.....	4,646	.....	1,535	.....	1,191
2,750-foot	454	3,741	176	2,025	.....	1,174
2,875-foot	.....	3,238	190	1,594	.....	520
3,000-foot	....	4,265	.....	1,646	.....	1,170
3,150-foot	.....	2,977	.....	1,219	162	1,385
3,300-foot	...	.....	.....	23	.....	355
3,450-foot	. .	2,146	. .	552	68	141

[1]Not used for hoisting.

(UNDERGROUND DEVELOPMENT WORK—*Continued*)

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
3,600-foot	.....	2,551	.....	1,051	.....	363
3,750-foot	.....	3,025	.....	341	.....	356
3,900-foot	115	870	.....	283	.....	151
4,050-foot	.....	.....	.....	.....	.....	.....
4,200-foot	885	2,476	312	745	267	645
4,350-foot	.....	3,271	.....	636	50	548
4,500-foot	.....	2,983	.....	660	.....	582
4,650-foot	.....	2,448	.....	176	.....	346
4,800-foot	.....	2,865	.....	384	.....	320
4,950-foot	.....	1,655	.....	213	.....	283
5,100-foot	.....	1,149	.....	149	.....	.....
5,250-foot	.....	411	.....	.....	.....	.....
5,400-foot	.....	1,948	.....	28	.....	.....
5,550-foot	.....	1,040	.....	98	.....	12

Diamond-drilling in 1954 consisted of 129 holes, totalling 8,116 feet, from underground.

There were 171,572 tons of ore hoisted. The mill treated 171,854 tons, at an average daily rate of 470.8 tons.

The following is taken from the report of the vice-president and general manager for the year ending December 31, 1954:

Production

During the year, 171,854 tons were milled producing 53,716.903 ounces of gold and 10,648.75 ounces of silver with a value of $1,838,532. The mill averaged 470.8 tons per day, which is 5.0 tons more per day than in the previous year.

SUMMARY OF PRODUCTION

Year	Milled	Gold produced	Average price per ounce	Total production gold and silver	Average gold recovery
	tons	fine ounces			ounces per ton
1950	170,552	48,034.186	$38.00	$1,833,687	0.28
1951	171,017	46,573.063	36.80	1,722,843	0.27
1952	170,868	54,249.834	34.20	1,866,401	0.32
1953	170,032	53,865.208	34.41	1,864,940	0.32
1954	171,854	53,716.903	34.06	1,838,532	0.31

Mining

Year	Ore broken in stopes	Ore from development	Total ore broken	Waste broken and used for backfill	Total ore and waste broken
	tons	tons	tons	tons	tons
1952	176,233	19,732	195,965	15,384	210,349
1953	154,022	15,391	169,413	23,655	193,068
1954	150,158	17,978	168,136	19,162	187,298

Broken Ore Reserves

Broken ore reserves were 93,452 tons at the end of the year, a decrease of 3,436 tons from the previous year.

Development

Total development was 12,664.5 feet as compared with 10,972.5 for the previous year.

Class of work	1952	1953	1954	Total from begining of operations to December 31, 1954
	feet	feet	feet	feet
Drifting	2,027.0	3,128.5	3,587.0	216,634.0
Crosscutting	887.5	1,202.5	1,354.5	67,970.0
Raising	2,700.5	2,808.0	3,713.0	54,924.0
Sublevel drifting	4,368.5	2,539.5	2,799.0	46,239.5
Box-hole raising	1,414.5	1,294.0	1,211.0	21,267.5
Shaft-sinking				8,090.0
Total	11,398.0	10,972.5	12,664.5	415,125.0
	percent	percent	percent	percent
Proportion of crosscutting to total of crosscutting and drifting	30.5	27.8	27.4	23.8
	cubic feet	cubic feet	cubic feet	cubic feet
Shaft stations, stations, and sump excavations, etc.				395,964.0
	feet	feet	feet	feet
Diamond-drilling	12,492	13,296	8,116.0	407,929.0

Development Summary

During the year, 2,374.0 feet of ore was developed in drifting and development subdrifting.

Total development footage, including lateral work and raising, was 15 percent greater than in the previous year. However, owing to the greater difficulty of finding what is now ore in an old mine, it is estimated that the year's development results did not put as much ore in sight as was milled.

In drifting, 903.5 feet of ore was developed in a total advance of 3,587.0 feet. Two-thirds of the ore footage was developed in short ore sections in the upper levels of the mine from the 250- to 2,750-foot levels. The remaining 300 feet of ore was opened up on the 4,200-foot level on the north *B* vein in an area east of previously developed ore on this vein at the lower levels of the mine.

In development subdrifts, 1,470.5 feet of ore was developed in a total footage of 2,799 feet of advance. Most of this work was done in the section of the mine above the 2,000-foot level. Here the vein structure is particularly complex both on strike and dip, but continued exploration by diamond-drilling the ground between levels and subsequent development by raises and subdrifts has produced good tonnages of ore. The over-all cost per ton of mining this ore is higher than that of the ore normally mined from this level.

In the No. 5 shaft section of the mine stoping was increased with 13.2 percent of the tonnage milled coming from the workings served by this shaft.

The source of ore milled was as follows:

Level	Tons	Percent
125- to 1,125-foot	76,461	44.4
1,250- to 1,875-foot	44,983	26.2
2,000- to 2,875-foot	21,729	12.7
3,000- to 3,600-foot	6,041	3.5
No. 5 shaft:		
3,750- to 5,500-foot	22,640	13.2
Total	171,854	100 0

Operating Costs

Operating costs per ton milled were 28.6 cents per ton higher than last year.

	Total 1954	Cost per ton ore milled	Cost per ounce fine gold produced
Development and exploration	$ 266,477	$1.551	$ 4.961
Mining	911,071	5.301	16.961
Milling (including tailings disposal expense)	252,468	1.469	4.700
General charges after deducting sundry revenue	77,907	0.453	1.450
Administration expense	51,143	0.298	0.952
Bullion-selling expense:			
Insurance, shipping, and mint-refining charges	3,318	0.019	0.062
Mint-handling charges	10,743	0.063	0.200
Total	$1,573,127	$9.154	$29.286

The main charges to operations in the fiscal year were:

Wages and mine salaries	$1,001,264
Supplies, including power and water	416,715
Provision for taxes on mining income	92,450

Capital Expenditures for Buildings, Improvements, and Equipment and Replacement.—A total of $11,011 was spent on capital account during the year, of which $458 was expended on the completion of 1953 building improvement and $10,553 on plant and mine equipment.

General Summary.—The average price received for an ounce of gold in 1954 was $34.06 compared with the average received in 1953 of $34.41.

In 1954 the net profit was down 11.7 percent from the year 1953. This was due in part to increased labour and other costs and in part to the mining of an increasing proportion of smaller and less accessible stopes. Wages and mine salaries exceeded $1,000,000 for the first time.

The average gold recovered in ounces per ton milled was again held close to the high figure of the two previous years, well above what has been considered the advisable grade for the mine. To obtain this increase in grade, it has been necessary to abandon the mining of marginal-grade veins, which in the past has been an important source of mill tonnage.

Although favourable areas remain to be developed, the ore developed by drifts and subdrifts did not equal the ore mined.

An average of 300 men was employed, of whom 202 were underground and 98 on the surface. W. S. Maguire is general superintendent.

Teck-Hughes Gold Mines, Limited

Teck-Hughes Gold Mines, Limited, was incorporated in March, 1923, with an authorized capitalization of 5,000,000 shares of $1 par value, of which 4,807,144 have been issued. The officers and directors are: J. C. Perry, president; P. N. Tapley, vice-president and treasurer; J. W. Stephenson, secretary; R. A. Jodrey, W. H. Keith, G. A. La Bine, P. H. McCloskey, and S. G. Sharpe, directors. The head office address is Woodstock. The executive office is at 25 King Street West, Toronto. The mine address is Kirkland Lake.

The main property is in Teck township, Kirkland Lake area, district of Timiskaming.

Mining and milling continued throughout 1954. There was no shaft-sinking during the year. A new 11th level was cut from the south shaft.

The following table shows the depth, inclination, and number of compartments of the active shafts and winzes on the property:

Shaft	Inclination	Number of compartments	Total depth from surface
			feet
Central shaft	vertical	4	3,014
South shaft	vertical	4	3,690
South-shaft extension (below 30th level)	vertical	4	5,546
No. 3 winze (below 40th level)	60 degrees	3	6,182
No. 4 winze (below 30th level)	vertical	3	4,457

The following table shows the development work done in 1954, and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
1st		1,477		827		252
2nd		2,227		872		453
3rd		1,081		462		335
4th		2,682		2,170		1,760
5th		4,456		2,254		1,296
6th		5,437		1,305		2,240
7th		3,465		1,120		1,936
8th		3,421		1,915		2,291
9th		3,191		887		2,030
10th		4,462		3,598		2,127
11th	161	2,924	284	765	48	606
12th		3,021		480		901
13th		2,655		1,033		958
14th		2,292		590		1,129
15th		2,318		378		930
16th		2,156		423		948
17th		2,614		837		691
18th		1,117		182	33	744
19th		1,932		1,112		705
20th		1,816		489	174	1,304
21st		2,213	84	775		977
22nd		2,114		384		2,055
23rd	85	2,647	15	658	6	2,423
24th		3,006	123	1,785	300	2,400
25th		3,958	12	1,333	21	2,983
26th		4,007		1,330		3,427
27th		3,579		731		3,307
28th		2,352		1,312		1,371
29th		2,246		890		1,603
30th		5,250		3,540	24	2,570
31st		2,955		648		2,743
32nd	310	2,669	65	550	24	2,359
33rd	782	2,887		599	270	1,622
34th		3,422		921		1,211
35th	104	2,961	30	925		1,994
36th	48	2,624	155	1,332	134	1,339
37th		2,673	11	638	158	1,773
38th	51	3,536	31	973	554	2,653
39th		2,188		671		1,513
40th	163	3,316	95	1,939	71	1,548
41st		2,013	29	357	185	1,165
42nd		1,558		189		869
43rd		1,914		517		400
44th		2,526		762		1,757
45th		3,496		1,495		2,590
46th		2,731		1,054		2,117
47th		1,815		423		1,781
48th		1,314		270		475
49th		1,499		333		298
50th		1,477		947		567

Diamond-drilling in 1954 consisted of 8 holes, totalling 405 feet, from underground. There were 237,174 tons of ore hoisted. The mill treated 237,050 tons, at an average daily rate of 649 tons.

The following is taken from the manager's report for the year ending December 31, 1954:

During the year 237,050 tons of ore from the mine were milled. Recovery of bullion amounted to 37,529.244 ounces of fine gold and 6,778.64 ounces of fine silver. The value of bullion production was $1,462,612.89 or $6.17 per ton, which includes estimated cost-aid of $178,575.08. Income from general investments and profit from investments sold amounted to $83,948.37, making a total revenue of $1,546,561.26. Operating costs amounted to $1,240,215.49 or $5.23 per ton, leaving an operating profit of $306,345.77 or $1.29 per ton.

Income from dividends on shares of Lamaque Gold Mines, Limited, amounted to $581,568 Net profit for the fiscal year was $887,913.77

Operating Costs

An analysis of operating costs follows:

	Total cost	Cost per ton or ore treated	Cost per ounce of gold produced
Development	$ 179,480.97	$0.76	$ 4.782
Mining	701,838.06	2.96	18.701
Milling	272,045.25	1.14	7.249
General expense	84,615.13	0.36	2.255
Depreciation	2,236.08	0.01	0.060
Total	$1,240,215.49	$5.23	$33.047

Development '

Development for the year was as follows:

	Feet
Drifting	1,742.5
Crosscutting	1,148.0
Subdrifts and sub-crosscuts	1,466.0
Raising	1,999.0
Total	6,355.5

Ore production from drifting and crosscutting amounted to 6,445.0 tons.
New ore found totalled 438 feet or 25.1 percent of all drifting, as follows:

Level	Length	Width	Grade
	feet	feet	pennyweights per ton
32nd (T vein)	24	6.5	10.45
33rd (T vein)	320	6.7	10.33
35th (main break)	44	6.0	4.54
40th (branch vein)	50	6.0	12.08

Ore Reserves

Ore reserves at December 31, 1954 were as follows:

	Tons	Gold content in ounces	Average grade in pennyweights per ton
Positive ore:			
Blocked	35,060	14,926.6	8.51
Broken	35,205	7,560.0	4.29
Total	70,265	22,486.6	6.40
Potential ore:			
Blocked	209,381	46,124.0	4.41
Broken	22,917	6,356.8	5.55
Total	232,298	52,480.8	4.52

As before, potential ore includes proven ore that *may* not be recovered because of the unusual hazard, expense, or disturbing effect involved in its removal.

General Observations

The following table shows the sources of ore milled during 1954 and 1953:

Section	Tons		Gold content in ounces		Average grade in pennyweights per ton	
	1954	1953	1954	1953	1954	1953
Surface stock pile	nil	987	nil	187.6	nil	3.80
Surface to 20th level	49	nil	5.9	nil	2.43	nil
20th to 30th level	184,215	136,647	24,870.9	17,504.8	2.70	2.56
30th to 40th level	44,221	54,854	14,052.8	16,870.1	6.36	6.15
40th to 46th level	8,565	35,937	1,583.3	7,157.9	3.70	3.98
Total	237,050	228,425	40,512.9	41,720.4	3.42	3.65

Mine operating results compared favourably with those of the previous years though the grade was lower. They are shown in the following table for the past three years.

Year	Tons milled per day	Average grade in pennyweights per ton	Bullion production per ton	Investment income per ton	Operating cost per ton	Profit per ton
1952	598	3.97	$6.64	$0.29	$5.68	$1.25
1953	626	3.65	6 54	0.28	5.48	1.34
1954	649	3.42	6 17	0.36	5.23	1.29

Production from branch veins in the hanging wall of the main break amounted to only 9.4 percent of the total tonnage milled. However, owing to the higher grade of this ore the gold content was 24.3 percent of the total recovered.

Most of the tonnage, from the 20th to 30th levels, came from the 21st, 23rd, and 24th levels, where large quantities of caved ore from the mineralized hanging wall were extracted. Caving in many cases was initiated by blasting long holes drilled with jointed rods. Some higher-grade ore was also mined from a small branch vein above the 23rd level and from main break pillars above the 30th level.

In the lower part of the mine, below the 30th level, extraction of pillars and remaining small ore shoots in the main break continued, augmented by production from branch veins.

The T vein on the 32nd level in the hanging wall of the main break was mined out, but its extension on the 33rd level was discovered in August and is still being developed. A total of 12,618 tons, grading 9.05 pennyweights per ton, was extracted from this vein during the year. The length of T-vein ore developed on the 33rd level at the year's end totalled 320 feet. The downward extension of this structure was explored quite extensively on the 34th level several years ago. Results were encouraging, but no ore was developed. However, as the slope distance to the 33rd level varies from 160 to 200 feet there is room to find ore shoots of worthwhile size extending below the 33rd level.

The new No. 4 vertical winze between the 30th and 36th levels and some 300 feet south of the main break was put into part-time operation in connection with the T-vein development.

Starting in August a new 11th level was established off the south shaft, and a crosscut driven about 400 feet southwest to get under the downward extension of the F vein, which was developed and mined out between the 6th and 10th levels several years ago. A raise, started in December, picked up the F-vein ore about 75 feet below the 10th level. It is hoped that a few thousand tons of good-grade ore in this area can be developed.

Starting in September the footwall ore-pass system from the 20th level to the 17th level, was extended, utilizing an existing manway raise for the portion between the 19th and the 17th levels. After reopening parts of the 17th level a 700-foot crosscut was started southeastward to connect with the south shaft to provide access to the 17th level independent of the central shaft. The latter passes through the main ore zone just above this level and is likely to become impassable through this section when adjacent broken and unbroken ore is extracted.

All the 1954 bullion production was sold to the Mint at Ottawa. The average price received from the Mint for silver was 82.93 cents per ounce and for gold $34.06 per ounce.

Including estimated Emergency Assistance the average amount realized for the gold was $38.82 per ounce.

A number of rockbursts occurred in the lower levels of the mine. Some damage was done, which has since been repaired. Fortunately there were no injuries.

An average of 223 men was employed, 149 of whom were underground and 74 on the surface. G. G. Gilchrist is manager.

Upper Canada Mines, Limited

Upper Canada Mines, Limited, was incorporated in April, 1929, with an authorized capitalization of 3,500,000 shares of $1 par value, of which 3,274,827 have been issued. The officers and directors are: R. R. Brown, president; J. A. W. Brown, vice-president; G. F. Summers, secretary-treasurer; T. J. Day, Dr. J. A. Dickson, J. W. McBean, and R. V. Porritt, directors. The head office is at 85 Richmond Street West, Toronto. The mine address is Dobie.

The company's property consists of 35 claims in Gauthier township, Kirkland Lake area, district of Timiskaming.

Mining and milling continued throughout 1954. The mine has been developed through two vertical shafts. No. 1 shaft was deepened from 2,889 to 3,291 feet in 1954, and three new levels were established at depths of 2,900, 3,050, and 3,200 feet. The depths of the shafts and the number of compartments are shown in the following table:

Shaft	Number of compartments	Depth from surface
		feet
No. 1	3 to 1,750-foot level 4 to bottom	3,291
No. 2	3	1,877

The shafts are connected on the 375- and 1,000-foot levels.

The following table shows the development work done in 1954, and the total at December 31, 1954:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
125-foot		3,336		1,068		491
250-foot		4,285		839		1,049
375-foot		6,597		2,771		998
500-foot		7,930		1,850		1,117
625-foot	39	6,917	74	895		1,974
750-foot		5,567		1,045		1,384
875-foot	361	5,354	65	1,954		1,937
1,000-foot	583	12,921	78	1,937	117	1,991
1,125-foot	13	4,213		1,322		1,815
1,250-foot	5	5,602	65	1,345		1,713
1,375-foot	111	3,783		665	164	1,674
1,500-foot	7	3,573		699		1,653
1,625-foot		3,502		967	76	802
1,750-foot	46	9,548	726	2,968		1,790
1,875-foot	98	98		7	188	188
2,000-foot	165	1,949	90	273	59	145
2,125-foot	745	745	50	70	137	300
2,250-foot	233	3,274		162	41	717
2,375-foot	426	2,031	93	215	202	539
2,500-foot	460	1,818		280	145	426
2,625-foot	281	1,806		304	169	618
2,750-foot	453	5,593	148	1,261	180	867
2,900-foot	20	20				
3,050-foot	23	23				
3,200-foot	14	14				

Diamond-drilling consisted of 447 holes, totalling 39,694 feet, from underground.

The following is taken from the report of the general manager for the year ending December 31, 1954:

Exploration

What may develop into a new productive zone is currently being explored on the 1,750-foot level. Here, at a point 2,500 feet west of No. 2 shaft and 700 feet south of the *L* zone, an exploration crosscut has intersected an entirely new ore structure. Drifting and diamond-drilling have explored this zone for a distance of 300 feet, of which 50 percent or more appears to be ore of close to mine-average grade over drift width. Mineralization is widespread, and there is evidence of parallel structure.

Work to the far west of No. 2 shaft on she 1,000-foot level has proven a number of marginal orebodies distributed over a length of 2,000 feet. In view of the strong structural conditions, and surface drill intersections, it seemed advisable to test the zone further by drilling above and below the level. This drilling is now under way.

Exploration of the new zone east of No. 1 shaft on the 2,750-foot level is suspended during shaft sinking operations.

Development

Drifting footages are lower than in the preceding year, owing to the commencement of sinking in No. 1 shaft. This shaft is being sunk from the 2,750-foot level to the 3,650-foot horizon to provide six new levels. The *L* zone between the 1,750- and 2,750-foot levels has now been opened by drifting with the exception of the 1,875- and 2,125-foot sublevels. The ore developed this year has shown some improvement in value over that developed in the previous year. Wide sections of lower-grade ore indicated by drilling remain to be opened by stope preparation. Their effect will be to lower both over-all grade and mining costs.

At No. 2 shaft, both the *L* and *B* zones continue to respond favourably to close exploration on parallels and from stopes, resulting in only a very small decrease in ore reserves for this section of the mine.

Mine Production[1]

Zone	Tons	Grade	Value
No. 1 shaft:			
L zone	38,450	$ 8.80	$ 338,359
H zone	1,449	7.30	10,574
M zone	564	8.11	4,575
Total	40,463	$ 8.74	$ 353,508
No. 2 shaft:			
L zone	100,715	$10.86	$1,093,796
B zone	50,798	6.15	312,368
K zone	5,002	6.45	32,286
Total	156,515	$ 9.19	$1,438,450
Total mine	196,978	$ 9.10	$1,791,958

The average daily mill tonnage was 539.7.

Tons hoisted were 14,095 higher, but the grade was lower, and bullion production was the same as in the preceding year. Most of the increase in tonnage came from No. 1 shaft where there was also a small improvement in value. The increase in mill tonnage and lower mining costs permitted the mining of lower-grade sections of the No. 2 *L* and *B* zones.

Milling

Comparative mill figures for the past three years are tabulated below.

	1954	1953	1952
Total milled.....tons	196,978	182,883	177,468
Average per day.....tons	539.7	501.0	484 9
Heads at $35 per ounce gold	$9.10	$9.764	$10.522
Total tails	$0.66	$0.677	$0.753
Recovered	$8.44	$9.087	$9.769
Recovery.....percent	92.77	93.07	92.84
Possible running time.....percent	98.14	96.55	97.55
Cost per ton	$1.06	$1.15	$1.22

[1]Gold at $35 an ounce.

Mill tonnage was again increased to a rate of 539.7 tons per day. Owing to the higher tonnage and lower heads, there was a small drop in recovery, but the decrease in mill costs alone resulting from the greater tonnage more than offset this loss.

Operating Costs

Cost per ounce of fine gold produced before depreciation, taxes, etc., was $31.57, compared with $32.27 in 1953. Operating costs per ton milled over the last four years are tabulated below.

	1954	1953	1952	1951
Diamond-drilling and exploration	$1.38	$2.42	$2.13	$1.22
Mining	4.28	3.86	3.92	3.89
Milling	1.06	1.15	1.22	1.24
General expense and head office	0.81	0.86	0.91	0.99
Total	$7.53	$8.29	$8.18	$7.34

The drop in costs of 76 cents per ton is the result of a decrease in the amount of development and exploration, as well as the increase in mill tonnage.

General

Drilling below the 2,750-foot level indicates that the excellent ore conditions on this level will continue into the ground to be opened by the new levels from No. 1 shaft. With the ore remaining at No. 2 shaft, and with the substantial tonnages being developed from No. 1 shaft workings above the 2,750-foot level, the addition of these new levels should easily maintain the physical condition of the mine.

An average of 238 men was employed, of whom 163 were underground and 75 on the surface. J. H. Botsford is general manager.

Wright-Hargreaves Mines, Limited

Wright-Hargreaves Mines, Limited, was incorporated in June, 1916, with an authorized capitalization of $5,500,000 shares of no par value, all of which have been issued.The officers and directors are: E. L. Miller, president; J. Y. Murdoch, vice-president; G. F. Miller, treasurer; P. H. Gerhard, secretary; W. E. Kreiner, W. J. Craig, R. L. Healy, and F. V. C. Hewett, directors. The head office is at Fort Erie. The mine address is Kirkland Lake.

The company's main property is in Teck township, Kirkland Lake area, district of Timiskaming.

Mining and milling continued throughout 1954. The following table shows the depths of the shafts and the winze that serve the mine:

	Number of compartments	Depth from surface
		feet
No. 1 shaft[1]	2 to 2,000 feet 3 to bottom	2,285
No. 2 shaft[2]	2	319
No. 3 shaft	3 to 1,200 feet 4 to bottom	4,089
No. 4 shaft	3	4,000
No. 5 winze (below 3,600-foot level)	4 to 6,450 feet 3 to bottom	7,272

[1]Now used for ventilation.
[2]Now used as a sand pass.

The following table shows the development work done during 1954, by levels, the total since January 1, 1930, by levels, and the total footage at December 31, 1954:

Level	Drifts		Crosscuts		Raises	
	1954	Jan. 1, 1930, to Dec. 31, 1953	1954	Jan. 1, 1930, to Dec. 31, 1954	1954	Jan. 1, 1930, to Dec. 31, 1954
	feet	feet	feet	feet	feet	feet
100-foot	.....	542	.....	263	.....	58
200-foot	.....	3,498	.....	868	.....	16
300-foot	.....	2,534	.....	824	.....	525
400-foot	179	4,430	58	1,611	64	968
550-foot	.....	6,017	.....	1,592	.....	2,059
700-foot	.....	4,217	.....	1,072	.....	936
850-foot	120	5,963	.....	2,055	.....	1,306
1,000-foot	.....	4,753	.....	1,826	.....	1,310
1,125-foot	.....	6,702	.....	2,211	.....	657
1,250-foot	.....	3,820	.....	1,519	.....	369
1,375-foot	.....	7,667	.....	2,617	.....	1,122
1,500-foot	.....	7,028	.....	1,648	.....	1,087
1,625-foot	233	9,069	.....	3,563	39	2,360
1,750-foot	.....	6,236	.....	1,397	265	1,612
1,875-foot	42	9,694	46	2,692	330	1,609
2,000-foot	.....	7,511	.....	2,736	165	1,411
2,125-foot	28	10,362	32	2,781	82	1,902
2,250-foot	.....	11,809	.....	3,413	.....	1,577
2,400-foot	.....	9,793	.....	3,119	.....	1,817
2,550-foot	33	6,745	106	2,895	275	2,305
2,700-foot	46	8,772	.....	2,599	277	1,760
2,850-foot	.....	2,872	.....	2,627	391	2,407
3,000-foot	.....	3,793	.....	2,767	.....	2,020
3,150-foot	.....	6,673	.....	1,879	78	1,680
3,300-foot	105	6,799	24	1,642	.....	2,659
3,450-foot	21	5,770	.....	1,641	.....	1,422
3,600-foot	.....	2,956	.....	1,949	114	1,625
3,750-foot	.....	4,263	.....	1,483	.....	1,337
3,900-foot	.....	4,697	.....	1,435	67	895
4,050-foot	.....	5,627	.....	2,343	150	2,462
4,200-foot	.....	5,238	.....	1,871	185	1,974
4,350-foot	230	6,122	65	1,783	308	3,196
4,500-foot	148	5,875	14	2,328	170	2,617
4,650-foot	.....	6,097	.....	1,463	25	1,602
4,800-foot	.....	4,718	.....	1,648	149	1,659
4,950-foot	.....	3,102	.....	2,071	.....	1,920
5,100-foot	.....	5,297	.....	1,390	.....	2,018
5,250-foot	40	2,167	.....	1,101	122	1,008
5,400-foot	.....	1,721	.....	795	193	717
5,550-foot	.....	2,554	.....	734	195	857
5,700-foot	358	1,095	274	691	348	495
5,850-foot	61	2,340	45	587	.....	142
6,000-foot	273	991	62	472	.....	233
6,150-foot	.....	3,258	.....	846	301	528
6,300-foot	.....	711	.....	812	.....	184
6,450-foot	.....	.....	.....	154	.....	.....
6,600-foot	.....	926	.....	711	.....	36
6,750-foot	.....	1,547	.....	650	.....	147
6,900-foot	.....	929	.....	565	.....	446
7,050-foot	128	2,022	.....	799	.....	732
7,200-foot	363	2,544	.....	1,486	246	622
Total	2,408	239,862	726	84,019	4,539	64,406
Total footage prior to Jan. 1, 1930	.....	61,459	.....	12,301	.....	942
Total footage to Dec. 31, 1954	.....	301,321	.....	96,320	.....	65,348

Diamond-drilling in 1954 consisted of 15 holes totalling 3,073 feet, from surface, and 123 holes totalling 20,273 feet, from underground.

There were 193,900 tons of ore hoisted and milled during the calendar year.

The following is taken from the general manager's report for the fiscal year ending August 31, 1954:

There were 191,890 dry tons of ore, averaging 0.426 ounces of gold, milled, from which were recovered 78,785.703 ounces of gold and 13,412.38 ounces of silver; $2,707,615.06 was received from marketing this bullion. In addition to the bullion produced, $209,131.63 is estimated as receivable under the Emergency Gold Mining Assistance Act for the fiscal year 1954. An average price for gold of $34.18 per ounce was received from the Royal Canadian Mint as compared to $34.33 in the previous fiscal year. The resultant reduction in income of $11,817.86 on the year's production was due to further appreciation of the Canadian dollar in terms of the United States dollar. The price received for silver was $0.83 per ounce.

Cost of supplies consumed plus electric power, services, and freight decreased $43,280.34. They totaled $565,401.50 as compared with $608,681.84 last year.

Experienced underground men were scarce although other labour was in ample supply. This resulted in the lowest labour turnover experienced in several years.

The over-all production record shows that from the commencement of operations in 1921, a total of 8,050,663 tons of ore was milled at a value per ton of $17.33 for a gross value of $139,539,032, a recovery per ton of $16.55, and bullion production of $133,208,880.

Operating Costs

Description	Total cost	Cost per ton milled
Development, exploration, and pumping	$ 224,203.18	$ 1.168
Stoping	924,750.84	4.819
Transporting ore, hoisting, etc.	365,651.26	1.906
Milling charges	268,970.70	1.402
General surface, store-house, and miscellaneous mine buildings charges	104,273.68	0.543
Stock transfer, dividend, annual report expense, property taxes, and fire protection	68,581.33	0.357
Unemployment and employees' group life insurance, silicosis, workmen's compensation, and hospitalization	107,553.05	0.560
General and miscellaneous undistributed charges	55,431.91	0.289
Financial and corporate expense	6,674.64	0.035
Marketing bullion	6,301.74	0.033
Total	$2,132,392.33	$11.112
Provision for taxes	$ 180,000.00	
Royal mint special bullion handling tax	15,737.75	$ 1.132
Depreciation, buildings and equipment	21,417.36	
	$2,349,547.44	$12.244
Less estimated assistance	209,131.63	1.090
Estimated total	$2,140,415.81	$11.154

Milling Statistics
(September 1, 1953, to August 31, 1954)

Ore milled	tons	191,890
Average grade per ton		$14.53
Average grade gold	ounces	0.426
Gross value	$2,788,909.80	
Loss in tailings	81,294.74	
Net value recovered		$2,707,615.06
Average milled per day	tons	525.726
Solution precipitated	tons	765,400
Solution precipitated per ton of ore	tons	3.99
Recovery	percent	97.09
Zinc consumed per ton of solution	ounces	0.194
Zinc consumed per ton of ore	ounces	0.775

(MILLING STATISTICS—*Continued*)

Cyanide consumed per ton of ore ..... pounds		0.500
Lime consumed per ton of ore..... pounds		4.325
Steel balls consumed per ton of ore (ball mills)..... pounds		1.287
Average peak load, crushing and milling..... horsepower		1.383
Average peak per ton milled per day, crushing and milling..... horsepower		2.63
Power cost per horsepower year.....		$28.53
Yield per ton of ore.....		$14.11
Value per ton in tailings.....		$0.424
Average grade in ounces gold in tailings		$0.012
Average value of pregnant solution per ton.....		$3.54
Cost of flotation reagents consumed per ton of ore.....		$0.012
Cost of crushing per ton of ore milled ...	$0.121	
Cost of ball milling per ton of ore milled....	$0.221	
Cost of tube milling per ton of ore milled...	$0.143	
Cost of all other milling per ton of ore milled.....	$0.772	
Total milling costs per ton of ore milled.....		$1.257

Development and Exploration (August 31, 1954)

New ore developed was on the 7,050-foot level, it being the extension of the north *D* vein ore drifted the previous year. With the continuation of further exploration and development of the north and north-heading veins by drifting and raising, initial stope preparations for stoping operations are in progress.

Diamond-drilling totaled 10,127 feet in 29 holes as compared with 7,120 feet in 36 holes last year. Some of the drilling was for exploration of the veins below the 7,200-foot level.

The mill operated continuously at an average daily rate of 525.726 tons and treated 191,890 tons of ore, 20 tons more than the previous year. The average grade was 0.426 ounces or $14.53 per ton at $34.18, the average gold price received. The tailings loss was 0.012 ounces or $0.424 per ton, an extraction of 97.09 percent.

Operations were normal throughout the year with no major changes. Milling costs were lowered by 10 cents per ton which reflects reduction in the cost of supplies and power consumed. Included in last year's supplies was the new 8-inch tailings line to the Lake Shore mine, the charge for which amounted to 4 cents per ton.

Efficiency continued to improve in stope drilling and breaking and in development work of all classes, drifting and raising. This was owing to miners becoming more skilled in the use of the pusher-type rock-drill with the longer drill rods and tungsten carbide bits. Eight additional drills of this type were put into use. Good results are being obtained from the detachable tungsten carbide bits made in our own shop, which have now been in use for more than two years. One additional double-drum slusher hoist was added to the mining equipment.

In the deep levels of the No. 5 winze, further blocking out of ore by raises, drifts, and subdrifts continued, and stope preparation is under way. Appropriate ventilation measures are being provided for these operations. An ore-pass to No. 5 winze was driven from the 5,700-foot to the 5,250-foot level and serves the three levels above the 5,700-foot level.

An average of 447 men was employed, of whom 296 were underground and 151 on the surface. R. L. Healy is general manager.

Young-Davidson Mines, Limited

Young-Davidson Mines, Limited, was incorporated in April, 1926, with an authorized capitalization of 3,000,000 shares of $1 par value, of which 1,584,108 have been issued. The officers and directors are: A. R. McKay, president; W. T. Davidson, vice-president; G. W. Adams, secretary-treasurer; A. C. Ross and A. R. W. McKay, directors. The head office is at 320 Bay Street, Toronto. The mine address is Matachewan.

The property, consisting of 13 claims and surface rights to parts of 5 claims, is in Powell township, Matachewan area, district of Timiskaming. It is operated under agreement by Hollinger Consolidated Gold Mines, Limited. A reference to the 1954 operations appears on page 30 of this report.

Mining and milling continued throughout 1954. The mine is served by a vertical shaft and winze, as shown in the following table:

Shaft	Number of compartments	Depth below surface
		feet
No. 1	3	1,075
No. 2 (winze below 463-foot level)	2	1,530

The following table shows the development work done in 1954, and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
1st		2,290		1,055		1,271
2nd		3,032		1,048		2,001
3rd		1,597		1,256		2,081
4th		1,265		1,054		1,894
5th		1,043		813		1,263
6th	15	728	71	923	67	1,010
7th		347				291

Mining above the fourth level (865-foot) has been completed, and an open pit extends from surface to this level.

There was no diamond-drilling in 1954. Underground work consisted mainly of tramming broken ore.

There were 312,740 tons of ore hoisted. The mill treated 312,217 tons, at an average daily rate of 863 tons.

An average of 133 men was employed, of whom 77 were underground and 56 on the surface. J. G. Sparrow is resident manager.

GRAPHITE

Frobisher, Limited

(Black Donald Graphite Division)

Operations at the Black Donald mine on lots 17, 18, and 19, concession III, and lots 15 and 16, concession IV, Brougham township, Renfrew county, continued from January 1 to March 5, 1954.

About 4,780 tons of ore were milled. The ore was obtained from the open pit and from clean-up operations around the property.

Following the cessation of operations the complete plant was sold and dismantled, and the workings were allowed to fill.

B. G. Edward was manager, employing 22 men. The company's head office is at 25 King Street West, Toronto.

GYPSUM

Canadian Gypsum Company, Limited

The Canadian Gypsum Company, Limited, was incorporated in September, 1907. The authorized capitalization is 3,000 shares of $100 par value, of which 2,710 have been issued. The officers and directors are: O. M. Knode, president; H. F. Sadler and Edward Rembert, vice-presidents; F. L. Stellner, secretary-treasurer; S. L. Avery, J. E. MacLeish, F. B. Gibbs, and C. H. Shaver, directors. The head office is at Windsor, N.S. The business office is at 170 Bloor Street West, Toronto. The mine address is Box 99, Hagersville.

The company operates a gypsum mine and plant near Hagersville, in Oneida township, Haldimand county.

The mine is operated through a main, vertical shaft, 102 feet deep. There is also a vent and escapement shaft, 90 feet deep.

The mine and mill operated throughout 1954. A total of 193,495 tons of gypsum ore was hoisted. The mill treated 183,361 tons.

A new 36- by 60-foot dry-house of steel and hollow tile was built.

J. R. Burns is works manager. An average of 55 men was employed, of whom 54 were underground.

Gypsum, Lime and Alabastine, Canada, Limited

Gypsum, Lime and Alabastine, Canada, Limited, was incorporated in July, 1927, with an authorized capitalization of 500,000 shares of no par value, of which 440,043 have been issued. The officers and directors are: P. P. Tyler, president; J. E. McConnell and S. G. Dixon, vice-presidents; C. G. Cockshutt, chairman of the board; K. P. Hayes, secretary-treasurer; J. H. Robinson, director and general manager; R. W. Cooper, R. A. Bryce, and G. H. Dobbie, directors. The head office is at Paris. The Toronto office is at 50 Maitland Street. The mine address is Caledonia.

The company has two gypsum properties and a mill in Seneca township, Haldimand county. The old mine, on lot 10, range 1, was not operated in 1954. Operations at the new mine on lot 8, range 2, continued throughout the year. A total of 172,123 tons of gypsum ore was hoisted. The mill treated 169,859 tons.

A Joy loader and a Joy shuttle buggy similar to the one purchased in 1953 were added to the mine equipment.

Diamond-drilling consisted of 24 holes, totalling 2,230 feet, from surface.

An average of 33 men was employed. J. E. Gillespie is manager.

IRON

Algoma Ore Properties, Limited

Algoma Ore Properties, Limited, was incorporated in February, 1936, with an authorized capitalization of 50,000 shares of no par value, all of which have been issued. The officers and directors are: Sir James Dunn, president; D. S. Holbrook, executive vice-president; G. W. MacLeod, vice-president and general manager; J. A. McPhail, vice-president; H. G. MacAdam, secretary; W. E.

Morley, treasurer; J. B. Barber, comptroller; Lady Marcia Dunn, E. G. McMillan, G. C. Bateman, H. S. Hamilton, and E. W. Shell, directors. The head office is at Sault Ste. Marie. The mine address is Jamestown.

The company, which is a wholly owned subsidiary of the Algoma Steel Corporation, Limited, holds various iron properties in the district of Algoma, including the Helen, Victoria, and Alexander mines.

Mining operations on the Helen, Victoria, and Alexander orebodies continued throughout 1954. Operations are being carried on through the No. 3, or main, shaft on the Helen orebody, a vertical, three-compartment shaft 921 feet deep, with levels at 417, 725, and 851 feet. In 1954 the new vertical, two-compartment No. 4 winze, below the second level, was sunk a further 771 feet, to a total depth of 1,778 feet from surface. Levels were established from the winze at depths of 1,033, 1,341, and 1,649 feet from surface. Subdrifts were established at 78- to 100-foot intervals. Stope development work was begun on the new levels and sublevels. The vertical, three-compartment No. 5 shaft, which was begun in 1953, was sunk a further 1,855 feet in 1954, to a depth of 1,895 feet from surface. Levels were esta blished at depths of 335, 643, 951, 1,259, and 1,567 feet.

The following table shows the development work done during 1954, and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
No. 3 SHAFT:						
1st	3,401	18,028	386	2,268	2,698	12,563
subdrifts	5,036	23,277	.....	.....	.....	.....
2nd	2,607	13,117	277	5,573	2,116	17,760
subdrifts	232	12,411	.....	.....	.....	.....
3rd	.....	3,875	.....	718	.....	661
No. 4 WINZE:						
4th						
5th	794	794	95	95	463	463
6th						
subdrifts	693	693	.....	.....	.....	.....

A long drive from the second level of the Helen orebody to the Alexander orebody had been completed in 1953. In 1954 a raise from the drive was driven to surface in the Alexander orebody, a distance of about 700 feet.

A 20-degree-inclined tramway, 1,800 feet long, was sunk in 1954 for the development of the deeper ore.

Diamond-drilling in 1954 consisted of 23 holes totalling 3,722 feet, from surface, and 535 holes totalling 52,253 feet, from underground.

A total of 1,662,675 tons of ore was hoisted. Of this, 1,063,913 tons were treated in the concentrator before sintering. The 899,344 tons of concentrate obtained and 666,020 tons of ore were treated in the sinter plant at Jamestown and produced 1,105,976 tons of sinter.

Temporary structures were erected for the sinking of the No. 5 shaft and the new inclined tramway. A steel-reinforced concrete stack, 16 feet in diameter and 250 feet high, was erected at the sinter plant.

An average of 609 men was employed, of whom 301 were underground and 308 on the surface. R. F. Palmer is manager.

Bethlehem Mines Corporation

Bethlehem Mines Corporation is a wholly owned subsidiary of the Bethlehem Steel Corporation. It was incorporated in West Virginia, U.S.A., in 1916, with a capitalization of 2,000 shares of $100 par value. The officers and directors are: A. F. Peterson, president; R. H. Schlottman, auditor and vice-president; N. Berkeley, S. J. Cort, P. S. Killian, J. M. Larkin, and P. B. Entrekin, vice-presidents; R. E. McMath, secretary and vice-president; J. P. Bender, treasurer. The head office and mine office are at Marmora.

The corporation operates property in Marmora and Rawdon townships, Hastings county, under lease from Marmoraton Mining Company, Limited.

The work of stripping the overlying sedimentary limestone from the iron orebody in preparation for open-pit operations was continued in 1954. A total of 7,429,000 tons of overburden was stripped during the year.

The concentrating and pelletizing plant, begun in 1953, was completed and partly equipped in 1954. The following buildings of structural-steel construction were erected: a headframe, 101 feet high; a hoist-house; a 56- by 88-foot secondary crusher and cobbing building; a standpipe, 25 feet in diameter, having a capacity of 180,000 gallons; and four 20- by 20- by 23-foot rock-storage bins supported on structural columns over the railway to carry mill tailings to disposal. An outdoor electrical substation, two reinforced concrete ore-storage silos 25 feet in diameter and 60 feet high, and miscellaneous small pump-houses of concrete-block construction were built. The equipment installed included the following: a blast-hole drill for drilling 6-inch holes in the orebody; a 144- by 110-inch double-drum Canadian Ingersoll-Rand hoist, driven by a 1,250-horsepower motor; a 48-inch primary crusher; a 66-inch secondary crusher; a tertiary crusher; a set of heavy-duty vibrating screens; two rod mills and two ball mills; an overhead travelling crane, with a 25-ton hoist, in the secondary crusher building; a similar crane and hoist in the mill building; a travelling crane, with a 1¼-cubic-yard grab bucket, in the pellet plant; a 30-foot-diameter Dorr thickener, 12 feet deep, four balling drums, four pellet furnaces, and four 14,350-feet-per-minute turbo compressors in the pellet building; and a 100-foot-diameter Dorr thickener and two heavy-duty, 1,320-cubic-foot, Canadian Ingersoll-Rand XVHE-2 air compressors in the mill building.

An average of 220 men was employed. H. O. Olsen is general superintendent.

Caland Ore Company, Limited

Caland Ore Company, Limited, is a wholly owned subsidiary of the Inland Steel Company, Limited, of Chicago. It was incorporated in 1949 with an authorized capitalization of 1,000 shares of no par value. The officers are: P. D. Block, Jr., president; A. J. Cayia, vice-president and general manager; Graydon Megan, secretary; R. L. Peters, treasurer. The executive office is at 38 South Dearborn Street, Chicago, Illinois, U.S.A. The mine address is Atikokan.

The company holds a 99-year lease from Steep Rock Iron Mines, Limited, on a section of the *C* orebody at the east end of Steep Rock Lake. Further reference to the operation appears on page 102 of this report under Steep Rock Iron Mines, Limited.

A contract was let in 1953 for the removal of silt from *C* orebody. The dredging operation is thought to be the largest ever undertaken. The initial contract is for the removal of 160,000,000 cubic yards of material. The preparations for this operation were begun in 1954. The main projects undertaken during the year were the preparation for the dredging, the construction of dams for control of silt disposal in Marmion Lake, the building of a transformer station, and the erection of the necessary buildings for the plant and townsite. Four different contracting companies are engaged in this work.

A 2½-mile gravel road, 25 feet wide, was built to the plant site. The following buildings were erected: four Armco Steelox buildings, an office building, a bunk-house, a cook-house, an 80- by 60-foot shore booster station for the dredging system, an oil-storage shack, and a 20- by 40-foot transformer station. Fifty dwelling houses for employees were almost completed. The following pipelines were constructed: 10,000 feet of steel pipe, 36 inches in diameter, on pontoons; two parallel lines of 42-inch pipe, totalling 33,000 feet in length, to carry the dredge discharge from Steep Rock Lake to Marmion Lake; and 2,500 feet of water-supply lines. Two 36-inch dredges for moving the silt were almost completed, and two hulls, 176 by 50 by 14 feet, were built for them. The following equipment was also constructed or supplied by the contractors: two cable-reel barges, two monitor barges, two booster barges, two anchor barges, a 4,000-gallon fuel-oil barge, a work barge, two 40-foot tugboats, a 50-ton derrick, two Manitowoc cranes, a motor crane, two bulldozers, the necessary tractors and trucks for the operation, and the equipment for the machine shop.

Twenty-two diamond-drill holes, totalling 6,986 feet, were drilled during the year.

The Caland Ore Company, Limited, employed a staff of 18, and the contractors' force averaged 104 men. P. D. Pearson is manager.

Mag-Iron Mining and Milling, Limited

Mag-Iron Mining and Milling, Limited, was incorporated in April, 1949, with an authorized capitalization of 4,000,000 shares of $1 par value, of which 2,560,786 have been issued. The officers and directors are: A. L. Laing, president; W. G. Chipp, secretary-treasurer; F. N. McCallum and H. C. Elliott, directors. The head office is at 49 Wellington Street East, Toronto. The mine address is Millbridge.

The property, consisting of seven claims, is in Lake and Wollaston townships, Hastings county.

Operations in 1954 were carried on from March to November. The ore is mined by the open pit method and concentrated. The mill concentrates twelve tons of ore to about three tons of magnetite concentrate. Some 500 tons of concentrate were shipped before the operation was suspended for the winter.

Five men were employed. Stanley Lavender is superintendent.

Stanol Minerals, Limited

Stanol Minerals, Limited, was incorporated in June, 1954, with an authorized capitalization of 100,000 shares of $1 par value, 77,400 of which have been issued The officers are: W. F. Steinke, president and manager; M. B. Ranta, vice-

president; A. E. Steinke, secretary; Nicholas Hyduke, treasurer. The address of the head office and mine office is 205 Third Street East, Fort Frances.

The company's property, known as the Reef Point mine, consists of 30 claims in Watten township, district of Rainy River.

During 1954 the company built a road from Rocky Islet on the Canadian National railway to claim P.5168. Between October 14 and November 2 about 2,000 tons of iron ore were mined by the open-pit method and stockpiled. The company had a contract to sell ore of a specified tonnage and grade. The ore mined did not meet the specifications because of its high silica content, and operations were suspended.

Four men were employed during the period of operations.

Steep Rock Iron Mines, Limited

Steep Rock Iron Mines, Limited, was incorporated in February, 1939. During 1954 arrangements were made to change the authorized capitalization of 30,000 shares of preferred stock of $100 par value and 10,000,000 shares of common stock of $1 par value to 10,000 shares of preferred stock of $100 par value and 10,666,666 shares of common stock of $1 par value. The 20,000 previously issued shares of preferred stock were converted into 666,666 shares of common, The number of shares issued at December 31, 1954, was: common, 8,036,110; preferred, none. The officers and directors are: C. S. Eaton, chairman of the board; M. S. Fotheringham, president and general manager; Neil Edmonstone, secretary-treasurer and controller, W. R. Daley, J. G. Cross, D. H. McDougall, Hon. G. E. Allen, Mark McKee, John Paterson, F. H. Black, and C. J. Burchell, directors. The head office and mine office are at Steep Rock Lake.

The company owns 161 claims in Freeborn and Schwenger townships, district of Rainy River.

Operations continued throughout 1954. The amount of ore mined during the year is shown in the following table:

	Tons
A orebody:	
Open pit	1,032,795
B orebody:	
Underground	27,391
Total	1,060,186

Diamond-drilling in 1954 consisted of 143 holes, totalling 19,652 feet, from underground.

A (Hogarth) Orebody

Stripping of the overburden on the *A* orebody was completed in December, 1954, and preparations were made at the end of the year to move the dredging equipment to the *G* orebody early in 1955.

Two garages for heavy trucks were built during the year. An electric substation and a system for crushing, screening, and conveying the ore to the railway were installed.

B (Errington) Orebody

No open-pit mining has been done on the *B* orebody since 1953. Underground work is done from the vertical, three-compartment, No. 1 Errington (or Float

Ore Island No. 1B) shaft, 1,263 feet deep. The following table shows the amount of development work during 1954 and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
175-foot	.....	333	.....	.....	.....	1,182
500-foot	.....	.....	.....	536	.....	1,460
700-foot	2,749	5,571	1,328	4,578	453	1,373
900-foot	727	2,408	398	2,856	.....	1,510
1,100-foot	312	1,360	67	2,374	73	1,073

A 40- by 48-inch Birdsboro Buchanan jaw-crusher was installed on the 1,100-foot level.

G Orebody

The *G* orebody lies between the *A* and *B* orebodies. The dredges from the *A* orebody will be used to remove the silt from the *G* orebody, an operation expected to take four years. A tunnel has been driven from the *G* zone to the west arm of Steep Rock Lake to supply water for the dredging.

C Orebody

A 99-year lease on a section at the east end of Steep Rock Lake, in *C* zon, has been given to the Caland Ore Company, Limited, a Canadian subsidiary of the Inland Steel Company, Limited, of Chicago. Further details appear on page 100 of this report under Caland Ore Company, Limited.

The following is taken from the president's report to the shareholders for the year ending December 31, 1954:

Financially 1954 was the best year in the company's history. Operating profit before interest and write-offs totalled $5,537,881, while net profit after all charges equalled $4,251,180, exceeding the previous 1953 high by $800,000.

These 1954 records were established on shipments of 1,156,654 tons of high-grade iron ore, 145,034 tons less than in 1953. A sharp reduction in American and Canadian steel operations during 1954 caused a corresponding decline in iron-ore production throughout the Lake Superior region. While shipments from all upper lake ports fell almost 37 percent below the 1953 figure, Steep Rock was able to keep its shipments within 11 percent of the previous year's tonnage. Steep Rock's net profit per ton equalled $3.68 in 1954, as compared with $2.69 in 1953.

Expansion and Development Program

The four-year dredging program on the Hogarth open-pit mine was completed in December, 1954. This mine is now capable of sustaining an annual production of 2,000,000 tons. All 1954 shipments were made from the Hogarth open-pit mine.

Development work continued on the Errington No. 1 underground mine in 1954. This mine is now ready to be brought into substantial production on short notice, and its ultimate planned capacity will be 1,500,000 tons annually. Underground stope preparations and diamond-drilling at the north end of the Errington zone have established ore widths greater than those encountered in the open pit above. The high-grade character of the ore is maintained at these deeper horizons. As was mentioned in last year's report, deep drilling supports previous geological evidence that the Steep Rock orebodies will persist to very great depths.

Development drifts from levels on the Errington No. 1, have been started out towards the Errington No. 2 zone where gravimetric surveys and drilling indicate a second underground mine nearly comparable to the Errington No. 1.

Drilling on the *G* ore zone in 1954 provided additional evidence that this ore zone will compare favourably in size and grade to the Errington mine. When developed, the *G* ore zone is expected to yield a minimum annual open-pit production of 1,000,000 tons.

C Ore Zone (Inland Steel Lease)

The Inland Steel Company of Chicago, through its Canadian subsidiary, Caland Ore Company, Limited, has made excellent progress in constructing and assembling the two dredges and related shore plant that will strip the leased *C* ore zone. One dredge will go into operation immediately; the second dredge will follow very shortly. It has been estimated that about $50,000,000 will be expended to bring the Caland mine into operation. The company's royalty agreement with the Caland Ore company contemplates a fairly rapid build-up to an annual production of 3,000,000 tons, providing substantial royalty revenue to augment the company's income from its own operations. Estimates of Steep Rock's engineers indicate that the Caland ore zone is more than 8,000 feet long with the substantial widths characteristic of the other orebodies on the Steep Rock range, and that the ore reserves and potential in this zone will support the maximum annual production contemplated under the agreement during its full 99-year term.

Ore Reserves and Potential

The three ore-bearing zones (Hogarth, *G* zone, and Errington) in the middle arm of the bed of Steep Rock Lake, on which the company is concentrating its production and development work at present, have a combined length of about 15,000 feet and a width ranging from 100 to 400 feet. Ore is known to exist at depths as great as 2,100 feet and is expected to persist to much greater depths. Ore reserves in this area can be estimated conservatively at 186,000,000 tons per 1,000 feet of depth. This is the area from which the company is planning to produce 5,500,000 tons per year.

In addition, other zones with surface geological conditions similar to these three middle-arm ore zones have been given limited attention up to the present time. Among these is the *H* ore zone in the west arm of the lake, which gives promise of ore deposition similar to that found in the middle arm.

Capital Structure

The re-financing of the company's debt described in the 1953 report to shareholders, has been completed. A new issue of $17,000,000 of 4½ percent first-mortgage bonds was sold to insurance companies and institutional investors. The proceeds, in addition to retiring the company's original bonds and debentures, provided $4,750,000 additional working capital. Principal payments on the new bond issue commence on December 1, 1958, at the rate of $1,700,000 per year.

The 20,000 shares of Series B preferred capital stock were converted into 666,666 shares of common capital stock during the year.

Community

Further expansion took place in 1954 both in population, which is now over 5,000, and in the residential and business community of Atikokan. Two department stores have erected large new buildings in the business area, and a third bank is under construction. The municipal assessment has almost doubled during the year. Housing, land-assembly, and development are being actively assisted by the Canadian Government, through the Central Mortgage and Housing Corporation, and by the Ontario Government's Department of Planning and Development. The Ontario Government, which completed a 75-mile highway into Atikokan in 1954, has indicated that it intends to extend the highway a further 90 miles west to Fort Frances on the Canadian-United States border. These activities give pertinent evidence of the growing importance of Atikokan and Steep Rock in the local and national economy.

Earnings and Steel Markets

All the earnings for the year were plowed back into the expansion program, which involved the expenditure of $9,165,266 on development and $2,099,165 on plant and equipment. As a result, the new Hogarth open-pit mine is now capable of sustaining an annual production of 2,000,000 tons, and the Errington No. 1 underground mine has a capacity of 1,500,000 tons per year, or a combined total of 3,500,000 tons annually.

The steel industry in the United States and Canada has rallied strongly since the end of 1954. The prospect is for improved operations throughout 1955, and for a progressive and insistent demand for both steel and iron ore in the immediate years ahead. With its present expanded capacity, and capability of much greater expansion, the company is ideally situated to participate in the anticipated upward trend.

When the *G* ore zone and the Errington No. 2 underground are brought into full production, the company will have an annual productive capacity of 5,500,000 tons from them and the Hogarth open-pit and the Errington No. 1 underground. In addition, it is anticipated that the Inland Steel company's Caland operation will have a minimum annual capacity of 3,000,000 tons.

An average of 1,018 men was employed. of whom 667 were underground and 351 on the surface. W. E. Bennett is general superintendent.

LEAD

Jardun Mines, Limited

Jardun Mines, Limited, was incorporated in October, 1951, with an authorized capitalization of 4,000,000 shares of $1 par value, of which 3,450,007 have been issued. The officers and directors are: Steven Yackso, president; J. L. Elliott, vice-president; R. A. Whitely, secretary-treasurer; I. A. MacDonald, W. W. Dennis, and J. H. Parsons, directors. The address of the head office and mine office is Box 141, Sault Ste. Marie.

The company owns 2 claims and leases 11 in Jarvis and Duncan townships, district of Algoma.

Mining operations continued throughout 1954. A new vertical, three-compartment shaft, No. 5, was collared and sunk to a depth of 35 feet on mining location No. 30H. The first level of the old No. 1 Victoria shaft was dewatered, and some development work was done on it and on the No. 3 zone adit east of the camp. The following table shows the development work done in 1954, and the total amount done by the present company. No work by former operators is included.

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
No. 1 Victoria Shaft:						
50-foot	47	47	.....	.....	.....	.....
No. 4 Shaft:						
125-foot	354	370	.....	65	155	155
225-foot	339	339	45	89	187	187
No. 3 Zone Adit	208	208	26	26	.....	.....

A flotation mill capable of treating 250 tons of ore per day was built and equipped. It commenced operation on May 28 and continued for the rest of the year. A total of 26,748 tons of ore was mined during the year. The mill treated 28,838 tons, operating at an average daily rate of 133 tons.

The mill equipment included the following: a 10- by 20-inch Canadian Allis-Chalmers jaw-crusher; a 3-foot Symons cone crusher; a 8- by 3-foot Hardinge Tricone ball mill; an 18- by 4-foot Dorr classifier; two 4-cell and one 8-cell Denver flotation units; two 6- by 6-foot General Engineering conditioners; a 7- by 14-foot Diester Plato table; two 10- by 12-foot Dorr thickeners; and a 4-foot 6-inch American disc filter.

An average of 72 men was employed, 37 underground and 35 on the surface. M. C. Halstead is manager.

MAGNESIUM

Dominion Magnesium, Limited

Dominion Magnesium, Limited, was incorporated in February, 1941, with an authorized capitalization of 500,000 shares of no par value, of which 455,525 have been issued. The officers and directors are: R. J. Jowsey, president; C. C. Calvin, vice-president; Maurice Crabtree, secretary; H. B. Clearihue, treasurer;

L. G. White, director and general manager; W. B. Maxwell, J. G. Weir, Thayer Lindsley, H. D. Scully, and L. M. Pidgeon, directors. The head office is at 320 Bay Street, Toronto. The mine address is Haley.

Operations continued throughout 1954 at the company's quarry and plant about three miles from Haley in concessions V and VI, Ross township, Renfrew county.

An average of 450 persons was employed. D. J. McPhail is manager in charge at the property.

MICA

J. C. Donnelly (Otty Lake Mine)

J. C. Donnelly, Stanleyville, and one assistant operated the Otty Lake mine on lot 1, concession VIII, North Burgess township, Lanark county, for three months in 1954. About 2 tons of mine-run mica suitable for electrical purposes and 32 tons of scrap mica were produced.

MOLYBDENUM

Detta Minerals, Limited

Detta Minerals, Limited, has an authorized capitalization of 5,000,000 shares of $1 par value, 4,500,000 of which have been issued. The company was formed in May, 1945, under the name of Detta Red Lake Mines, Limited, with a capitalization of 3,500,000 shares of $1 par value. In July, 1950, the name was changed to Detta Minerals, Limited, and the capitalization was increased to 4,000,000 shares. In 1953 it was again increased to the present 5,000,000 shares. The officers and directors are: A. W. White, president and treasurer; C. B. Deller, vice-president; R. B. Law, secretary; L. W. McIlmurray, assistant treasurer; D. F. Burt and James Stewart, directors. The head office is at 145 Yonge Street, Toronto.

The company has various holdings in Ontario and other provinces, including 12 claims held under option in Echo township, Patricia portion of Kenora district. The gold property, formerly operated in Balmer township, Red Lake area, Patricia portion of Kenora district, was sold to New Dickenson Mines, Limited, in 1953.

Operations were carried on between October 19 and December 31, 1954, on a molybdenum showing on the property in Echo township.

Two diamond-drill holes, totalling 350 feet, were drilled from surface.

An adit, 73 feet long, was driven, and 255 tons of ore for bulk sampling were mined from it.

Five men were employed during the period of operation. K. J. Benner was manager.

NEPHELINE SYENITE

American Nepheline, Limited

American Nepheline, Limited, was incorporated in January, 1945, with an authorized capitalization of 3,000,000 shares of no par value, all of which have been issued. The officers and directors are: Thayer Lindsley, president; Ernest Craig, vice-president and general manager; H. R. Deeth, vice-president; M. R. Jennings, secretary; J. C. Rix, treasurer; C. R. Archibald, W. G. Hubler, A. L. A.

Richardson, and C. J. Koenig, directors. The head office is at Lakefield. The mine address is Nephton, via Lakefield.

The mine is on lot 14, concession IX, Methuen township, Peterborough county.

Operations continued throughout 1954. The ore was mined by benching methods from the open pit in the Cabin Ridge section of the property. A total of 206,625 tons of ore was mined, and 163,149 tons were milled after sorting. The mill operated at an average daily rate of 494 tons.

A railroad siding, 1,600 feet long, was built to facilitate the loading of the company's products. The machine shop and laboratory buildings were enlarged.

An average of 137 men was employed, 36 in the pit and 101 in the plant. E. B. Wright is superintendent.

NICKEL AND COPPER

Falconbridge Nickel Mines, Limited

Falconbridge Nickel Mines, Limited, was incorporated in August, 1928, with an authorized capitalization of 5,000,000 shares of no par value, of which 3,756,272 have been issued. The officers and directors are: Thayer Lindsley, president; H. J. Fraser, vice-president and general manager; R. Campbell, secretary; A. W. Coome, treasurer; W. B. Maxwell, W. S. Morlock, J. M. Cunningham-Dunlop, and W. F. James, directors. The head office is at 44 King Street West, Toronto. The mine address is Falconbridge.

The company operates nickel-copper mines, a concentrator and smelter in the Sudbury area, and a refinery at Kristiansand, Norway.

The following is taken from the annual report of the company for the year ending December 31, 1954:

Revenues and Expenses

Earnings for 1954, shown at $4,660,945, were the highest in the company's history and exceeded those of 1953 by $941,340. The earnings amounted to $1.24 per share and 11.8 cents per dollar of revenue compared with $1.00 and 12.7 cents respectively in 1953. Deliveries of nickel including recoveries from purchased ores and concentrates were 18 percent greater than the previous record established in 1953. Operating profit before providing for development, preproduction, depreciation and taxes on income was $1,406,563 greater than in 1953 owing to the increased quantity of metal sold, but this profit as measured against each dollar of revenue decreased from 33 cents in 1953 to 28 cents in 1954. Thus increased costs of production exceeded the improved revenues from sales.

Dividends

Two dividends paid in 1954 of 25 cents each amounted to $1,871,000 bringing the total distribution to shareholders to $21,739,000.

Operations

The story of the operations of the company in 1954 is one of recording the main features of the progress made in the year on the planned expansion program and the effect on production of previous years' expansion. There has been a continuation of the problems that arise from the interference with production by expansion, but these have been no greater than need be expected. With a few notable exceptions, there have been few delays due to slow delivery of equipment and supplies.

Production in 1954 for the fifth successive year reached record levels. Ore hoisted from company mines totalled 1,408,666 tons in 1954 compared with 1,165,953 tons in 1953. In addition, 113,530 tons of ore and concentrates were received for treatment from independent mines in the district, a reduction of 27,193 tons from 1953. The output of nickel in matte by the smelter increased over 1953 by 23 percent. Owing to the time lag in production between the smelter and the refinery, the production of nickel by the latter increased by 16 percent. The refinery's capacity

is sufficient to treat all matte produced by the smelter. Deliveries of metals in all forms to customers in 1954 compared with those of 1953 were as follows:

	1954	1953
	pounds	pounds
Nickel	38,790,538	32,823,136
Copper	22,486,142	16,014,481

Unfortunately, nickel production was insufficient to satisfy all the demands on the company by established and prospective customers.

Annual expenditures for work carried out in the current expansion program of developing new orebodies for production, construction of mine plant to handle the ores from these properties, and construction of treatment plant to recover the metals, may have reached a peak for this program in 1954. Heavy expenditures will continue, however, for a few years before balanced operations at a production level of 55,000,000 pounds of nickel per annum will have been reached. Of the six mines under development in 1953, three were brought into production in 1954. Additional milling capacity came into use at Falconbridge during the year, and a new mill at the Hardy mine was nearly ready to treat ore by the end of the year. A commercial-sized pilot plant for treatment of pyrrhotite concentrates was scheduled to commence experimental runs in the early spring of 1955. Refining capacity was increased in line with expected mining, milling, and smelting capacities.

Mines

Company mines	1954	1953
Ore delivered for treatment...tons	1,407,909	1,163,986
Development advances...feet	43,613	50,014
Diamond-drilling...feet	137,615	138,480

During 1954 mines in production for the entire year were Falconbridge and McKim; mines in production for part of the year were Mount Nickel, Hardy, and East, in order of their coming into production; and mines still under development are Longvack, Boundary, and Fecunis in order of their anticipated coming into production. Mines that came into production in 1954 are expected to produce one-third of the anticipated 1955 production. In 1954 the Falconbridge mine supplied about 55 percent of the ore from company mines, the balance came from McKim and the other new mines.

Production from the Falconbridge mine was less than in 1953 owing, in part, to preparations for stope production, poor ground conditions and, in part, to extension of ore-crushing and hoisting facilities to serve the lower block between the 3,325- and 4,025-foot levels. Production from the McKim mine was at a record level. Unless new ore is discovered this mine has a relatively short life.

The East mine reached the production stage late in the year. During the year development advances totalled 13,339 feet. Four stopes were commenced by the year's end, and eight were under preparation. Some 91,000 tons of ore were hoisted.

Mount Nickel delivered over 75,000 tons of ore. Underground work was chiefly stope preparation, diamond-drilling, and stoping. Ore is trucked to McKim siding and moved by rail to Falconbridge.

At Hardy, the ore-pass, fill pass, and ventilation systems and their controls were completed and placed in operation. Over 5,000 feet of lateral development was completed; some 4,000 feet of raising and 15,000 feet of test drilling aided in outlining the ore. Some 167,000 tons of ore were delivered from development and stoping operations. This mine is expected to be a steady contributor to production during succeeding years.

Original plans to mine the Longvack orebody by open-pit method were changed to an inclined shaft and conveyer-belt hoisting system to provide more complete extraction of the ore deposit. By the year's end the shaft had reached a slope depth of 597 feet.

Shaft-sinking at Fecunis mine is well ahead of schedule. The main shaft had reached a depth of 3,108 feet, and the service shaft a depth of 1,565 feet by the end of the year. Grading for an extension of the railway spur to connect Fecunis with Hardy is progressng, and a permanent structure to house all mine services and offices at Fecunis is well advanced.

Treatment Plants

Treated	1954	1953
	tons	tons
Company ores	1,409,830	1,158,211
Outside ores	52,353	133,517
Outside concentrates	61,177	7,206
Total	1,523,360	1,298,934
Total smelted	767,174	637,982

An addition to the Falconbridge mill increased its capacity by 500 tons towards the end of the year. The new Hardy mill of 1,500-tons capacity was nearing completion by the year's end. Provision was made in the Falconbridge mill for preparation of a pyrrhotite concentrate as feed for the pilot pyrrhotite treatment plant. Sintering efficiency was improved with steady production of feed from the new pelletizing plant. At the year's end construction of the dust-collecting Cottrell plant was progressing. A new chemical and metallurgical laboratory was completed and in service. Facilities for receiving concentrates by rail were under construction at the year's end. Throughout the year the treatment plants and smelter operated very efficiently to mill 11 percent more and smelt an increase of 20 percent over 1953. Matte production was up 22 percent.

Refinery

Output of the refinery was limited in 1954 by availability of matte. Production was about 16 percent greater than in 1953. Operating difficulties attendant upon process changes in 1952 have been virtually eliminated. Construction work continues to create operating difficulties. New gas-cleaning facilities were placed in service during the year to eliminate smoke problems and to improve metal recoveries. Addition of increased facilities for copper deposition were practically completed. Unfinished at the year's end were extensions to the smelting and metal deposition facilities, a cobalt refinery, and sundry services. A construction program to substantially increase the supply of electric power available to the city of Kristiansand and local industries, including the refinery, was making good progress. The refinery program for increased capacity appears to have reached the point where it will be able to take additional matte as rapidly as it can be provided from the mining and smelting division.

New Construction

Capital expenditures in 1954 reached a total of $11,958,619 of which $9,632,207 were spent in Canada and $2,326,412 in Norway. The capital expenditures in 1954 about equalled those of the first twenty years of the company's existence and were somewhat less than twice the amount spent in 1953. It is probable that the expenditures in the next few years, although high, will recede from the level of expenditures established in 1954.

The more important items of construction in terms of expenditures made and their status at the year's end included:

Hardy mill	nearly completed
Addition to Falconbridge mill	completed
Pilot pyrrhotite plant	partly completed
Central-heating plant	partly completed
Dust-collection (Cottrell) system	under construction
Additional thaw-shed capacity	completed
Concentrate-receiving stations	under construction
New electrical and machine shop at Falconbridge	under construction
Chemical-metallurgical laboratory	completed
Office and change-house facilities	mostly completed except at Fecunis
Employee housing	partly completed
Smelting and tank-house facilities	partly completed

Services and utilities of various kinds such as roads, railroad spur, transformer, and switching stations, water supply, telephone lines, and education and recreational facilities, were in various stages of completion at the different projects. Substantial expenditures remain to be made in the North Range area and the Fecunis mine, and in metallurgical changes.

Marketing

Deliveries, during 1954, of nickel, nickel sulphate, copper, cobalt, and the platinum-group metals were in each case higher than those made in any previous year of the company's history.

The demand for nickel and nickel sulphate was very strong during the entire year and exceeded the available supply. Because of very heavy deliveries of nickel against government contracts, it was again found necessary to allocate the remaining nickel to customers on a quota basis. The basic nickel price was raised by the United States 4.5 cents per pound in November, 1954.

In the latter part of the year the demand for copper became quite strong. The demand for cobalt was weaker than during 1953. The market for the platinum-group metals was not as favorable as in the previous year, chiefly because of the influx of substantial quantities of these metals from South African and Russian sources.

Prices for all the company's products are expressed in United States currency or in currencies related thereto. The Canadian dollar was about 1 percent str nger in relation to other currencies in 1954 than in 1953. The net prices realized by the company on conversion into Canadian dollars were depressed accordingly.

Ore Position

Additions to ore reserves in 1954 were sufficient to increase the combined developed and indicated reserves of a record total of 35,515,700 tons of practically the same grade as reported in 1953. This is an increase in the year of 944,600 tons after extraction of 1,408,600 tons during the year.

Intensive underground work at East, Mount Nickel, and Hardy mines permitted the reclassification of substantial tonnages from "indicated" ore to "developed" ore. New ore found in the Falconbridge and Hardy mines was also added to developed ore. The additions made to developed ore were enough to increase the total of this classification by 2,052,350 tons after deducting the ore extracted from the mines during the year. No change was made in the dilution factor applied.

The reduction in "indicated" ores by the reclassification mentioned above was somewhat offset by partially delimiting a new ore deposit east of the Boundary orebody. The net reduction in indicated ore amounted to 1,107,750 tons.

A substantial amount of subgrade material (not included in these reserves) was also outlined by further drilling during the year.

The following is a summary of the ore reserves at the end of the year:

	Total	Nickel	Copper
	tons	percent	percent
Developed ore:			
Falconbridge, East, McKim, Mount Nickel, and Hardy	15,612,550	1.58	0.84
Indicated ore:			
Sudbury district holdings	19,903,150	1.59	0.81
Total	35,515,700	1.59	0.82

Exploration and Research

In the Sudbury district, systematic drilling was continued in the Levack and Junior Frood areas. In both places the areas under investigation are at depth, and progress is slow. A substantial orebody is being outlined east of Boundary, and knowledge of the mineralization pattern of this area is growing slowly.

A number of prospects were examined outside of the Sudbury area, mostly in Manitoba and Ontario. Considerable drilling was done on the property of Kenora Nickel Mines, Limited, in western Ontario. Results were encouraging, but further investigation underground will be required to establish structural continuity and permit a realistic estimate of possible reserves and grade.

The investigations in the Concession area in Newfoundland had failed to indicate possibilities for nickel mineralization as encouraging as other areas in which the company was interested. Accordingly, the Concession was not renewed at its three-year termination date. However, the company continues to retain its interest in certain "fee simple" properties, on one of which active underground work was being carried on at the year's end by another mining group under an arrangement whereby the company has the right of future financial participation.

Apart from continuous research on process and product improvements, metallurgical investigation was concerned primarily with the development of the company's pyrrhotite treatment process. Based on prior small-scale pilot plant experience, a commercial-sized pilot plant was constructed. The success of this plant will not be established until it has been operated in 1955. The company's Richmond Hill laboratory has developed and advanced techniques for quantitative analyses of platinoid metals by spectroscopic methods. These techniques will facilitate control in the production of the metals.

Employees

Expanding employment has created a need for additional housing and recreational facilities. Forty-three new family dwelling units and various recreational facilities for the employees and their families were provided during the year. Plans were developed for additional housing and townsite utilities in the Hardy area.

An average of 2,403 men was employed in the Sudbury area operations in 1954. Of these, 966 were in the concentrator and smelter, 1,033 at the Falconbridge mine, 136 at the McKim mine, 200 at the Hardy mine, 32 at the Boundary mine, 16 at the Fecunis mine, 16 at the Longvack mine, and 4 at the Mount Nickel mine. R. C. Mott is manager of the Sudbury area operations.

International Nickel Company of Canada, Limited

The International Nickel Company of Canada, Limited, was incorporated in 1916 under Dominion of Canada charter. The authorized capitalization is $27,679,900 in preferred shares of $100 and $5 par value and 15,000,000 shares of common stock of no par value, of which 14,548,025 have been issued.

The officers, as of January 3, 1955, are: J. F. Thompson, chairman of the board; H. S. Wingate, president; J. R. Gordon and L. H. Cooper, vice-presidents; W. F. Kennedy, secretary; F. M. A. Noblet, treasurer; C. R. Whitehorne, comptroller.

The directors whose term expires in 1955 are: E. G. Baker, L. W. Douglas, J. R. Gordon, H. R. MacMillan, R. S. McLaughlin, Rt. Hon. Viscount Margesson, H. C. F. Mockridge, T. G. Montague, R. L. Prain, G. C. Sharp, J. F. Thompson, and Rt. Hon. Viscount Weir.

The directors whose term expires in 1956 are: I. C. R. Atkin, G. R. Ball, J. S. Duncan, W. J. Hutchinson, Rt. Hon. Lord McGowan, D. H. McLaughlin, P. D. Merica, Sir O. E. Niemeyer, L. S. Rockefeller, G. B. Shipley, R. E. Stavert, J. C. Traphagen, and H. S. Wingate.

The executive office is at 67 Wall Street, New York 5, N.Y., and the general offices are at Copper Cliff. The Toronto office is at 25 King Street West.

The company and its subsidiary companies operate hydro-electric plants at High Falls, Big Eddy, Wabageshik, and Nairn Falls, Ontario: nickel-copper mines in the district of Sudbury, Ontario: smelters at Copper Cliff and Coniston, Ontario: refineries at Copper Cliff and Port Colborne, Ontario; Acton, England; and Clydach, Wales: rolling mills at Birmingham, England; Huntington, W.Va.; and Glasgow, Scotland: and a foundry at Bayonne, N.J.

The following is taken from the annual report of the company for the year ending December, 31, 1954:

During 1954 the company established new records for deliveries of nickel, ore mined, net earnings, and dividend payments to its shareholders.

For the fifth successive year the company operated at a peak production rate as demand for nickel continued at a high level. It delivered 282,000,483 pounds of nickel in all forms, some 30,000,000 pounds more than in 1953. Total ore mined reached 14,456,254 tons.

While establishing these records, the company carried forward its extensive program of exploration for new nickel deposits. It further advanced the underground development of its producing mines and made substantial progress towards fuller utilization of its ores. Construction was speeded on the first unit of the new plant for the recovery of iron ore and for the improved recovery of nickel from the pyrrhotite in its ores. At the same time the first commercial production of electrolytic cobalt in Canada was achieved at the Port Colborne refinery.

The company's deliveries of nickel represented about 70 percent of total free-world supplies. The latter attained a new high of about 390,000,000 pounds, an increase of 50,000,000 pounds over 1953. Government stockpiling absorbed the greater part of the additional supplies and required also increased diversions from the normal supply intended for industry. Nevertheless, because of lower demand for defence, the quantity of nickel delivered to industry for its civilian requirements was improved, although still insufficient to completely satisfy these requirements.

Net Earnings

The net earnings for 1954 were $65,295,186 compared with $53,694,526 in 1953. The net earnings in 1952 were $58,891,282, and in 1951, the previous peak year in the company's history, were $62,875,571. After provision for dividends on the preferred shares, earnings were equivalent to $4.34 per share of common stock compared with $3.54, $3.90, and $4.17 in the years 1953, 1952, and 1951, respectively.

In addition, the company realized a non-recurring capital gain of $1,865,851 on the sale of Birlec, Limited, the company's electric-furnace-manufacturing subsidiary in England.

The improvement in the company's net earnings was principally owing to substantially increased output and to lower taxes resulting from the termination of excess-profits taxation in the United Kingdom and the United States.

Dividends

Common dividends of $42,276,690, or $2.90 per share, were paid, consisting of four quarterly dividends of 50 cents each and a year-end extra dividend of 90 cents. The total disbursement was the highest in the company's history. Dividend distributions per common share amounted to $2.35 in 1953 and $2.60 in each of the years 1952 and 1951.

Preferred dividends of $1,933,899 were paid in four quarterly distributions at the rate of 7 percent per annum of the par value of the preferred shares.

The combined dividends on the common and preferred shares represented $44,210,589 of the net earnings. The remaining $21,084,597 of the net earnings and the $1,865,851 non-recurring capital gain were retained in the business. By comparison, $17,501,930 was retained in 1953, $19,054,144 in 1952, and $23,038,433 in 1951.

Deliveries of Metal

Deliveries of nickel in all forms increased 30,582,711 pounds over 1953 and deliveries of refined copper increased 18,926,011 pounds.

The following table shows a comparative statement of the deliveries of the principal products and also gold and silver for the last two years:

	1954	1953
	pounds	pounds
Nickel:		
In refinery products	202,597,923	171,913,236
In rolling mill and foundry products	76,163,527	76,078,733
In salts and chemicals	3,239,033	3,425,803
Total nickel	282,000,483	251,417,772
Refined copper	253,275,426	234,349,415
Mill and foundry products[1]	95,374,189	99,491,148
	ounces	ounces
Platinum metals	263,227	270,562
Gold	37,472	38,410
Silver	1,152,758	1,106,733

In addition to the metals listed above, the company also recovers from its ores: cobalt, selenium, tellurium, and sulphur as sulphur-dioxide-bearing gas. Iron, in the form of high-grade iron ore, is scheduled to be added to this list during 1955.

Shipments of 24,000,000 pounds of nickel and 20,000,000 pounds of copper were made on schedule to the United States government for stockpile purposes in accordance with the five-year supply contract entered into with the government in 1953 and referred to in the annual report for that year. These quantities were in addition to the stockpile deliveries in 1954 made under earlier contracts with the United States government. A further contract, entered into in 1954, will result in the delivery to the United States government during 1955 of an additional 5,000,000 pounds or more of nickel smelted and refined by the company from concentrate produced by Sherritt Gordon Mines, Limited.

Markets

Sales of metals reflected the high level of industrial activity in the United States and Canada and the further progress in the United Kingdom and Europe.

The demand for nickel remained strong throughout the year. Free-world nickel production increased, reaching a record total. Because of the necessity of giving preferential consideration to stockpiling and defence needs, it was still not possible to satisfy all civilian demands. As in previous years, the company made every effort to ensure an equitable distribution of its nickel available for civilian consumption among customers in all markets.

With the easing of defence requirements there was a decline in demand for the rolling mill products produced by the company's mills in the United Kingdom and the United States. The demand for rolled nickel, however, increased during 1954 largely owing to the expansion in the chemical and electronic fields. The company's Nimonic and Inconel alloys retained their position as preferred metals in the production of gas turbines and jet engines. Monel, the nickel-copper alloy, continued to be used in a large number of industrial applications requiring a combination of high corrosion resistance and dependable mechanical properties.

The refined copper, marketed under the company's ORC brand trade-mark, continued to be sold principally in Canada and the United Kingdom with smaller quantities going to the Continent and the United States. Canada was by far the largest single consumer, absorbing approximately 45 percent of the total output. The bulk of the sales was in the form of vertically cast special shapes.

Deliveries of electrolytic cobalt from the new refining facilities at Port Colborne began in August and continued thereafter at an increasing rate. The company's electrolytic cobalt is particularly useful in many important applications that require cobalt metal of exceptional purity.

The volume of deliveries of platinum metals was slightly less than that for 1953. Free-world consumption of these metals continued at a high level, but the supply in the free-world markets was greater, primarily because of large expansion in the production facilities of the South African producers, and because of other offerings apparently of Russian origin.

Substantial quantities of platinum and palladium were taken by the chemical and electrical fields for use in numerous engineering applications. Additional large amounts were used in the jewelry and dental fields. Progress was made in the recent development of the use of platinum as a catalyst in the production of high-octane gasoline.

[1]The nickel content of the "Mill and foundry products" is also reported above opposite "In rolling mill and foundry products."

Research

The company's product research activities, which receive important assistance from similar work by its customers, have the primary objective of providing a broader and more secure basis for extending uses of nickel. During the year, efforts were intensified in those fields where future markets are most likely to be found.

Special attention is being given to alloys that provide the properties needed in an age of electronic devices, jet-propelled aircraft, and the generation of power by nuclear reaction. Progress in architectural and decorative metal work and in the chemical and process industries is being facilitated by improvements in plating and in the corrosion-resistant alloys and by the accumulation of knowledge of their behavior. The nickel-alloy irons, ductile cast iron, and the nickel-alloy steels continue to receive attention so as to extend these important uses.

Continuing process research is being carried on in plant laboratories. The progress recorded in the sections of this report on "Mines" and "Plants" reflects the value of this type of research.

Mines

Ore production was increased from the company's underground mines: Frood-Stobie, Creighton, Murray, Garson, and Levack. The underground production averaged more than 44,000 tons per mine-operating day. Reflecting the company's progress in the utilization of bulk-mining methods, over 70 percent of the total tonnage of underground ore mined resulted from block-caving and blast-hole operations.

Underground development in the operating mines reached a total of 1,981,873, or 375 miles. Much development work was necessarily postponed during World War II. Thereafter underground development proceeded at an accelerated pace until 1954, when the company was able to reduce its monthly development advance to a rate commensurate with current production.

Excavation work was started at the Frood-Stobie mine for the installation of facilities to provide for the underground storage and subsequent pumping from the mine of large quantities of water from spring run-offs and heavy rains. This volume has increased with the mining of additional stopes through to the surface in the open-pit area. Provision is being made to hold 25,000,000 gallons at a time. At the Creighton mine, development started for a third crusher station at the 28th level, and the main ore-pass and ventilation system was completed in the current caving areas.

Installation was started at the Murray mine of a new semi-automatic electric ore hoist using 15-ton, bottom-dump skips and operating to the 3,200-foot level. In the Garson mine, skips and cages now operate to the 3,800- and the 4,000-foot shaft stations, and new shaft stations have been established at the 3,200-, 3,400-, and 3,600-foot levels.

Important progress was made at the Levack mine on the program for developing the area below the 1,600-foot level down to the 2,650-foot level by the installation of a crusher and rotary tipple at the lower level. Shafts Nos. 2 and 3 were extended to total depths of 3,067 feet and 3,220 feet, respectively.

Plants

At the Copper Cliff smelter, the recently developed oxygen flash smelting process for treating all copper concentrates has now completed its first full year of successful routine operation and has reduced copper smelting costs. Smelting capacity of the furnace is about 1,000 tons dry solid charge daily. The copper concentrates are melted by their combustion with low-cost oxygen, thereby eliminating the need for a substantial tonnage of coal formerly purchased. Use of oxygen for smelting also results in the production and sale of a high-quality furnace gas from which Canadian Industries (1954), Limited, produced about 70,000 tons of liquid sulphur dioxide during the year for use by the Canadian sulphite-pulp industry. That company also produced approximately 65,000 tons of 100 percent sulphuric acid from our smelter gas.

Production of cobalt metal was initiated during year at the Port Colborne refinery. Heretofore all the cobalt output has been marketed as oxides and salts, produced at the Clydach, Wales, refinery of the company's subsidiary, The Mond Nickel Company, Limited. A new process, developed by the company's research staff, now permits part of the cobalt output to be sold as electrolytically refined metal.

The $16,000,000 pyrrhotite plant unit for the recovery of iron ore, analyzing about 68 percent iron, is in process of construction. The several plant buildings are nearing completion, the world's tallest smelter chimney -637 feet above the ground—has been erected, equipment foundations have been installed, and equipment manufacture is well under way. Operations are expected to begin late this year. An atmospheric-pressure ammonia leaching process developed by the company's research staff will be employed. This new and flexible process is suitable also for the treatment of nickel-bearing sulphide concentrates low in precious-metal content.

In the United Kingdom, work was begun by the Mond Nickel Company, Limited, on a new power station for its Clydach nickel refinery. Henry Wiggin & Company, Limited, had its first full year of experience in operating the new plant, which it constructed in 1953 under arrangements with the British government. Progress was made in increasing production efficiency, and better yields of finished materials are being obtained.

At Huntington, West Virginia, production of round ingots for direct extrusion of high-nickel alloys was established on a commercial basis. The result of three years of research by the company, the round ingot eliminates forging and some rolling. Also at Huntington, new equipment was installed and brought into full operation as part of the expansion of cold drawing capacity.

Ore Mines

The following table gives the tonnages of ore mined from underground and surface during the year, with comparative data for the previous year:

	1954	1953
	tons	tons
Underground	11,988,208	11,095,199
Surface	2,468,046	2,571,896
Total	14,456,254	13,667,095

Ore mined in 1954 was at a new high, as to both underground and total. This achievement is the result of years of research in mining methods and extraction processes and of very large expansion of the underground mines and the related surface plants. This expansion had its origin during World War II when production to meet the sharply increased nickel demands required the acceleration of the program of mining the Frood-Stobie open-pit ores. It became evident that the accelerated production rate would make it necessary to begin immediately to develop additional ore to satisfy the future needs of the market. Accordingly, the company launched a major long-range program to expand underground mining capacity. Simultaneously, it undertook the adaptation of mining methods accommodated to the underground ore that would be encountered and the development of new and improved processes to treat those ores. The record nickel production is now largely supported by ores hoisted from underground, although open-pit production is continuing in progressively smaller tonnages.

Ore Reserves

Proven ore reserves stood at 261,619,020 tons at December 31, 1954. This compares with 261,541,259 tons at the end of 1953. The nickel-copper content at the year's end was 7,874,998 tons, compared with 7,816,669 tons at the end of 1953. The tonnages of ore and of nickel-copper content are both the highest in our history.

Exploration

Constant exploration for nickel deposits is essential to assure the replacement of the large tonnage of ore which capacity production schedules consume. In search for new sources of nickel, the company spent $5,255,462 in 1954, compared with $6,084,742 in 1953. Over the course of the past five years of capacity production, 72,834,149 tons was added to ore reserves, thus not only making up for the 63,020,286 tons mined during that period but also providing a net addition of 9,813,863 tons.

Exploration work in the Sudbury district was continued at a higher rate than in 1953, when a new record was established. About 480,000 feet of drilling were accomplished in this area.

At the same time, the company conducted field exploration in northern Manitoba, the Northwest Territories, Saskatchewan, and in Ontario outside the Sudbury district, as well as in twelve countries outside of Canada. Exploration activities in Canada were again centred in the West, particularly in Manitoba, where airborne geophysical surveys, extensive geological mapping, and many comprehensive drilling operations were conducted. The program in the Northwest Territories involved airborne reconnaissance surveys, examination on the ground of some 70 different areas, and detailed mapping of the Ferguson Lake area.

In the Mystery Lake area of Manitoba, the company is investigating what may prove to be an important source of nickel-bearing ore adjacent to Moak Lake. Extensive surface drilling has been carried on, and, in order to obtain additional information on the nature of the deposit as well as the underground conditions and geology of that area, a program of underground exploration and drilling is being undertaken. A 1,300-foot shaft is to be sunk, to be followed by 10,000 feet of crosscutting and drifting at an estimated total cost of $2,000,000.

Airborne Surveys for Others

The company has been engaged in a continuous program to develop methods and equipment for airborne electromagnetic surveying. The notable improvements that have resulted from this research led to an agreement with The American Metal Company, Limited, under which International Nickel conducted the air surveying of certain properties in New Brunswick, which that company then explored on the ground. During the year, as a consequence of these air surveys, American Metal discovered on one of these properties what may prove to be important lead-zinc-copper ore deposits. Under the agreement International Nickel has a 25 percent interest in this property.

Management

As announced by J. F. Thompson, chairman of the board of directors, at the last annual meeting Dr. P. D. Merica and W. J. Hutchinson had asked the board that they not be re-elected as president and treasurer respectively, and that the responsibilities of these positions be assumed by other experienced officers. Although Dr. Merica and Mr. Hutchinson have now retired as officers and from membership on the executive committee, their counsel and wide experience will continue to be available to the company. They remain as directors and have been appointed by the board as alternate members of the executive committee.

The board of directors met immediately following the annual meeting, electing H. S. Wingate as president of the company and as a member of the executive committee. He has also become a member of the advisory committee of the company and president of the company's principal United States subsidiary, The International Nickel Company, Incorporated. Mr. Wingate joined the company in 1935, and was elected secretary in 1939 and a vice-president in 1949. He has been a director since 1942.

J. R. Gordon, vice-president and director of the company, who at the end of the year transferred from Copper Cliff to New York, has been elected to membership on the executive committee and a director and vice-president of The International Nickel Company, Incorporated.

F. M. A. Noblet, assistant treasurer since 1942, was elected treasurer of the company, as reported in the letter to shareholders. He has also become Treasurer of The International Nickel Company, Incorporated

R. D. Parker, assistant vice-president, was elected general manager of Canadian operations, succeeding Mr. Gordon in this post.

The Hon. L. W. Douglas, a director of the company since July 9, 1951, has been elected to membership on the executive committee.

R. D. Parker is general manager; C. H. Stewart, superintendent of the Frood-Stobie mine; H. J. Cullen, superintendent of the Frood-Stobie open pits; E. E. Mumford, superintendent of the Creighton mine; F. M. McAteer, superintendent of the Levack mine; B. T. King, superintendent of the Garson mine; H. W. Smith, superintendent of the Murray mine; R. H. Brown, superintendent of the Crean Hill mine; E. G. Stoneman, superintendent of the Copper Cliff and Creighton concentrators; R. R. Saddington, superintendent of the Copper Cliff smelter; F. G. Murphy, superintendent of the Coniston smelter; R. Hewgill, superintendent of the Copper Cliff refinery; R. G. Dow, superintendent of the Lawson quarry; and R. C. McQuire, superintendent of the Port Colborne nickel refinery.

During 1954 an average of 5,604 persons was employed at the Copper Cliff concentrator and smelter; 806 at the Copper Cliff refinery; 1,759 at the Port Colborne nickel refinery; 713 at the Coniston smelter; 2,322 at the Creighton mine; 3,015 at the Frood-Stobie mine; 237 at the Frood-Stobie open pit; 960 at the Garson mine; 880 at the Levack mine; 467 at the Murray mine; 45 at the Crean Hill mine; and 35 at the Lawson quarry.

Jonsmith Mines, Limited

Jonsmith Mines, Limited, was incorporated in January, 1947, with an authorized capitalization of 3,500,000 shares of no par value, 2,919,431 of which have been issued. The officers and directors are: E. C. MacLeod, president; J. M. Macintosh, vice-president; A. B. Whitelaw, secretary-treasurer; C. S. Darrach, W. T. Green, J. R. Stratton, and F. G. MacLeod, directors. The head office is at 357 Bay Street, Toronto. The mine address is Capreol.

The company owns 29 claims in lot 5, concession II, Parkin township, district of Sudbury, and has an option on 19 claims adjacent to the old Whistle mine in Norman township, district of Sudbury.

A section of the property in Parkin township was leased to Milnet Mines, Limited, from October, 1952, to July 18, 1954. The vertical, three-compartment shaft, 478 feet deep, was sunk by Milnet Mines, Limited, in 1952, during the early part of the lease period.

Jonsmith Mines, Limited, began operations on July 19, 1954, the day following the termination of the lease, and they were continued for the rest of the year.

The following table shows the development work done by Jonsmith Mines, Limited, in 1954, and the total amount by both companies as at December 31, 1954:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
190-foot	.....	299	.....	432	....	220
300-foot	1,433	1,676	.....	486	....	179
425-foot loading-pocket	.....	.....	.....	21	.....	219
465-foot	652	742	448	1,009	...	316

Diamond-drilling, in 1954, by Jonsmith Mines, Limited, consisted of 26 holes totalling 6,068 feet, from surface, and 58 holes totalling 7,229 feet, from underground.

An average of 11 men was employed, 7 underground and 4 on the surface. C. E. Bowker is manager.

Milnet Mines, Limited

Milnet Mines, Limited, was incorporated in November, 1951, with an authorized capitalization of 40,000 shares of no par value, all of which have been issued. The officers and directors are: Dr. F. R. Burton, president; John Drybrough, vice-president; E. E. Ritchie, secretary-treasurer; A. W. Burt, C. C. Calvin, and E. C. MacLeod, directors. The head office is at 320 Bay Street, Toronto. The mine address is Capreol.

The company held a lease on a section of the Jonsmith property, in lot 5, concession II, Parkin township, district of Sudbury, and carried on operations from October, 1952, to July 18, 1954, when the lease was terminated. The property reverted to Jonsmith Mines, Limited, which also acquired the mining plant.

During its period of operation on the property Milnet Mines, Limited, sank a vertical, three-compartment shaft 478 feet deep and did development work on levels at 190, 300, and 465 feet.[1] The following table shows the development work done by Milnet Mines, Limited, in 1954, and the total amount when the lease ended:

Level	Drifts		Crosscuts		Raises	
	1954	Total at July 18, 1954	1954	Total at July 18, 1954	1954	Total at July 18, 1954
	feet	feet	feet	feet	feet	feet
190-foot	...	299	.....	432	.....	220
300-foot	122	243	.....	486	.....	179
425-foot loading-pocket	.....	...	.....	21	.....	219
465-foot	90	90	46	561	216	316

[1]See *Mining Operations*, Ont. Dept. Mines, Vol. LXII, 1953, pt. 2 and Vol. LXIII, 1954, pt. 2.

Ten diamond-drill holes, totalling 636 feet, were drilled from underground by Milnet Mines, Limited, in 1954.

Milnet Mines, Limited, mined 52,352 tons of ore in 1954, all of which was shipped to the Falconbridge Nickel reduction plant for treatment.

An average of 21 men was employed during Milnet's operating period, 14 underground and 7 on the surface. C. E. Bowker was manager.

Nickel Offsets, Limited

Nickel Offsets, Limited, was incorporated in April, 1938, with an authorized capitalization of 3,000,000 shares of no par value, of which 2,667,457 have been issued. The officers and directors are: D. W. Lang, president; Albert Wende, vice-president; B. L. Gale, Jr., secretary-treasurer; Ralph Hochstetter, H. H. Wende, S. H. Knox, P. G. Bixby, L. G. Harriman, and B. S. Crocker, directors. The head office is at 50 King Street West, Toronto. The mine address is Chelmsford.

The company owns 51 claims in Foy and Bowell townships, district of Sudbury.

Mining and milling operations continued throughout 1954. There are two vertical, three-compartment shafts on the property; No. 1 is 1,600 feet deep, and No. 2 is 1,106 feet deep. The following table shows the development work done in 1954 and the total amount at December 31, 1954:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
No. 1 SHAFT:						
200-foot		454		186	91	362
350-foot		1,029		165		217
500-foot		28		266		143
650-foot		1,021		265		200
800-foot subdrift		44				
950-foot		1,486		723		632
1,100-foot	49	49		123		
1,250-foot		1,558			286	519
1,550-foot	53	2,529		67		
No. 2 SHAFT:						
150-foot		145		215		156
300-foot		342		90		253
450-foot (station only)						
600-foot		2,502		65		
750-foot (station only)						
900-foot (station only)						
1,050-foot		2,513		65		

Diamond-drilling in 1954 consisted of 34 holes, totalling 4,506 feet, from underground.

There were 69,640 tons of ore hoisted in 1954, of which 11,894 tons of magnetic ore were separated and shipped. The balance, 57,746 tons, was treated, and the concentrates were shipped to the Falconbridge Nickel smelter.

An average of 80 men was employed, 40 underground and 40 on the surface. B. H. Budgeon was manager until the fall of 1954 and was succeeded by C. C Fischer.

Nickel Rim Mines, Limited

East Rim Nickel Mines, Limited, was incorporated in October, 1950, with an authorized capitalization of 3,500,000 shares of $1 par value. In September, 1952, the capitalization was increased to 4,500,000 shares of $1 par value, 2,750,000 of which have been issued. In November, 1954, the name of the company was changed to Nickel Rim Mines, Limited. The officers and directors are: G. H. Johnson, president; N. F. Tisdale and T. J. Day, vice-presidents; G. M. Marshall, secretary-treasurer; R. C. Henson, J. H. Westell, E. M. Cohan, and Eric Cradock, directors. The head office is at 100 Adelaide Street West, Toronto. The mine address is Box 393, Sudbury.

The company holds 23 claims in Maclennan township, district of Sudbury, including the former Ontario Nickel property.

Operations continued throughout 1954. The new concentrating mill began operations on January 12, and continued for the rest of the year.

There are two vertical shafts on the property, as shown in the following table:

Shaft	Number of compartments	Depth
		feet
No. 1	2	265
No. 2	3	728

The present development is being done from No. 2 shaft. The working from No. 2 shaft are connected on the 250-foot level with the old workings from No. 1 shaft. The following table shows the development work done during 1954, and the total amount at the end of 1954:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
No. 1 SHAFT:						
1st[1]		2,980		700		380
No. 2 SHAFT:						
1st	415	1,600	8	650	768	891
2nd	184	1,439	244	961	556	1,593
3rd	902	1,573	293	901	663	840
Sump crosscut				137		
Ore and waste pass						1,060

Diamond-drilling in 1954 consisted of 4 holes, totalling 1,684 feet, from surface; and 100 holes, totalling 13,301 feet, from underground.

A residence for the manager, a five-car garage, a concrete-block steel-shop, and a wood-stave concentrate bin supported on steel columns 10 feet high, were built in 1954.

There were 201,915 tons of ore hoisted in 1954, of which 199,520 tons were sent to the crushing plant and mill.

An average of 162 men was employed, 86 underground and 76 on the surface. J. M. Kilpatrick is manager.

[1]Work done by former operators.

Quebec Nickel Corporation, Limited

Quebec Nickel Corporation, Limited, was incorporated in April, 1952, with an authorized capitalization of 5,000,000 shares of $1 par value, 3,850,008 of which have been issued. The officers and directors are: S. A. Perry, president; A. E. Rosen, vice-president; Andrew Robertson, vice-president and managing director; G. D. Pattison, secretary-treasurer; R. H. Thomson, V. H. Smith, and Samuel Ciglen, directors. The head office is at 56 Wellington Street North, Sherbrooke, Quebec. The mine address is c/o Ontario Central Airlines, Kenora.

The company holds 233 claims in the Werner Lake area, Patricia portion of Kenora district.

Operations began on July 1, 1954, and continued for the rest of the year. A vertical, three-compartment shaft was sunk to a depth of 360 feet. A level was established at 300 feet, on which 397 feet of drifting and 555 feet of crosscutting were done.

Diamond-drilling consisted of 11 holes, totalling 8,230 feet, from surface.

The following buildings were erected: a 30-foot timber headframe, two bunkhouses, a cookery, a combined dry- and warehouse, a boiler-house, and a machine shop. An 8- by 10-inch single-drum Canadian Ingersoll-Rand hoist, and a 550-cubic-feet-per-minute Gardner-Denver compressor were installed.

There were 3,305 tons of ore hoisted.

An average of 24 men was employed, 18 on the surface and 6 underground. A. M. Grant is manager.

NIOBIUM (Columbium)

Beaucage Mines, Limited

Beaucage Mines, Limited, was incorporated in February, 1953, with an authorized capitalization of 3,000,000 shares of $1 par value, 2,310,005 of which have been issued. The officers and directors are: D. D. Thomson, president; Karl Graber, vice-president; K. R. Valin, secretary-treasurer; C. H. Carmichael, D. H. McDougall, Dr. J. E. Gill, J. J. Kenmey, and John Kennedy, directors. The address of the head office and the mine is 170 Regina Street, North Bay.

The company holds a licence of occupation on the Manitou Islands and surrounding waters in Lake Nipissing, district of Nipissing.

Three deposits carrying niobium (columbium) and uranium have been discovered on the islands. Mining operations on Newman Island began on October 1, 1954, and continued for the rest of the year. The immediate objective is the obtaining of a large metallurgical test sample of several thousand tons of ore.

A 700-kilowatt Ruston-Paxman diesel generator, a used 48- by 36-inch, double-drum Canadian Ingersoll-Rand hoist, and a 1,000-cubic-feet-per-minute Broomwade compressor, with a 200-horsepower electric motor, were installed.

The sinking of a vertical, four-compartment shaft was begun. The shaft had reached a depth of 300 feet at the end of the year.

Fourteen diamond-drill holes, totalling 10,011 feet, were drilled from the surface.

An average of 5 men was employed. T. M. Kerr was mine manager.

RADIUM

Canada Radium Corporation, Limited

Canada Radium Corporation, Limited, was incorporated in 1954 to succeed Canada Radium Mines, Limited. The authorized capitalization is 7,500,000 shares of no par value; the number of shares issued is 4,329,616, of which 2,499,611 are pooled. The officers and directors are: L. J. Belzer, president; W. L. Hodgson, vice-president; H. D. Baker, secretary-treasurer; Samuel Taylor, assistant secretary-treasurer; J. F. MacKay, director. The executive office is at 85 Richmond Street West, Toronto.

The property in Cardiff township, Haliburton county, has not been operated since 1942. In 1954 the present company pumped out the workings and did some sampling. The workings were then allowed to refill.

SALT

Canadian Rock Salt Company, Limited

The Canadian Rock Salt Company, Limited, was incorporated in September, 1952, with an authorized capitalization of 50,000 shares of no par value, of which 2,700 have been issued. The officers and directors are: Daniel Peterkin, president; N. C. Hobson, vice-president; J. H. Burtch, secretary-treasurer; G. M. Duck, Garfield King, H. R. Milner, E. G. Smith, F. H. Sobey, H. R. Stratford, and R. C. Vail, directors. The address of the head office and the mine office is 30 Prospect Avenue, Windsor.

The company owns parts of lots 36 to 43 inclusive, concession I, Sandwich West township, Essex county, on the shore of the Detroit River.

Operations continued throughout 1954. The preparations for shaft-sinking, which were begun in 1953, were completed, and the vertical, circular shaft was sunk to a depth of 900 feet. The work was done by contracting companies.

The following buildings were erected: hoistroom, mill, storage building, loading docks, and the necessary conveyer housing to connect the mill and the docks.

A 68- by 144-inch double-drum Bertram-Nordberg hoist, driven by a 1,250-horsepower Canadian General Electric motor, was installed.

M. F. O'Day is manager.

SILVER AND COBALT

Castle-Trethewey Mines, Limited

Castle-Trethewey Mines, Limited, was incorporated in January, 1922, with an authorized capitalization of 3,000,000 shares of $1 par value, of which 2,709,002 have been issued. The officers and directors are: Balmer Neilly, chairman of the board; W. B. Dix, president; D. H. McDougall, vice-president; F. T. McKinney, secretary; S. R. Varley, treasurer; B. E. Smith and Kelley Butler, directors. The address of the head office and the mine is O'Brien. The executive office is at 25 King Street West, Toronto.

The company's property is in Haultain and Nicol townships, Gowganda area, district of Timiskaming.

The property is in two sections, the Castle and the Capitol. All operations at present are in the Capitol section.

Mining continued throughout 1954. The following table shows the depths of the shaft and two winzes that serve the Capitol section:

	Inclination	Number of compartments	Depth from surface
			feet
Capitol shaft	vertical	2	819
Capitol winze (below 800-foot level)	vertical	2	1,188
Inclined winze (below 1,125-foot level)	27 degrees	2	1,425

The following table shows the development work done in 1954, and the total amount at December 31, 1954:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
160-foot (pump station)	.....	.....	.....	.....	.....	.....
525-foot (pump station)	.....	.....	.....	.....	.....	.....
800-foot	.....	1,395	.....	2,682	.....	233
875-foot	.....	273	.....	198	.....	239
950-foot	.....	33	.....	12	.....	.....
1,025-foot	.....	286	.....	115	.....	24
1,125-foot	250	2,720	412	3,136	18	571
1,200-foot	618	1,782	137	768	114	496
1,275-foot	652	2,391	710	979	133	532
1,350-foot	617	1,676	142	482	116	239
1,425-foot	514	804	16	30	304	440

Diamond-drilling in 1954 consisted of 110 holes, totalling 13,793 feet, from underground.

There were 16,771 tons of ore mined during the year.

The mill operated from May 3 to November 30 and treated 16,132 tons of ore at an average daily rate of 90 tons.

The company's fiscal year was changed to coincide with the calendar year. The following is taken from the manager's report for the nine-month period ending December 31, 1954:

Production

CONCENTRATE PRODUCED AND SHIPPED:	
High-grade concentrates, 212.2 dry tons at..ounces per ton	4,291
Low-grade flotation concentrates, 691 dry tons at ..... ounces per ton	112
Total fine silver recovered ..... ounces	992,017
Total cobalt recovered ..... pounds	29,637
GROSS VALUE:	
Silver (992,017 ounces at 82.6 cents per ounce)	$819,638.48
Cobalt (29,637 pounds at 81.8 cents per pound)	24,242.88
Total value	$843,881.36

Development

Underground exploration and development was done on the 1,200-, 1,275-, 1,350-, and 1,425-foot levels. Of the 1,907 linear feet of drifting on veins, 399 feet was in ore.

Vein No. 134 development, described last year as being productive and promising, resulted in that vein being the highest producer of the year. Though the vein appears to exist only above a

45-degree fault down which the ore rakes to the northeast, the ore to the southwest persists almost to the overlying Keewatin contact at 1,100 feet below surface. In the other veins the ore does not come within 100 feet of that contact. Though vein No. 134 does not there penetrate the Keewatin, some cobalt-bearing stringers have been cut in diamond-drilling in the immediate vicinity. There is hope that silver may be found in that Keewatin.

No. 134 vein stope is estimated to contain 1,685 tons of 70-ounce ore. More ore may be developed down the rake of this vein on and below the 1,350-foot level.

The best new development has been on vein No. 129 on the 1,200-, 1,275-, and 1,350-foot levels. On the 1,350-foot level the ore has a length of 50 feet with further development to the northeast promising.

The 1,125-foot-level, north crosscut will be advanced towards the 800-foot-deep Capitol hoisting shaft, 370 feet distant. Diamond-drilling from the face has confirmed the estimated location of the overlying Keewatin at 50 feet above that level.

A due-east crosscut on the 1,275-foot level has been advanced to 600 feet east of the most easterly known ore (vein No. 134) and 150 feet beyond the 100-foot wide "later than ore" quartz diabase dike, which cuts across all the rock formations of the area. Small calcite cobalt veinlets have been cut east of the dike. The crosscut is at a favourable distance from the overlying Keewatin and will be continued at least another 200 feet to the east boundary of claim L.M.111.

Development advances were at the average rate of 410 linear feet a month for the year, and will be accelerated during the winter months.

Sources of Ore from the Mine Hoisted to Surface

	Tons	Ounces per ton	Total ounces
Development	2,860	40.5	116,090
Mining	10,220	58.5	597,810
Total	13,080	54.6	713,900

Since the comparatively short, but high-grade, silver ore shoots are found in extensive vein areas, a high proportion of the development work is necessarily in waste rock. The tonnage of waste broken is thus greater than the tonnage of ore broken in stoping.

Waste Rock

	Tons
Hoisted to surface	7,726
Back-fill	3,512
Total waste broken	11,238

Mining

All stoping was in the diabase sill and from the incline-haulage levels below the 1,125-foot level and to the 1,425-foot level. The bulk of the ore came from an area 300 by 500 feet mostly in the southwest quarter of claim H.S.355. That area is at a horizontal distance of 3,500 feet by haulage ways from the 800-foot-deep Capital shaft. The silver content of the ore hoisted from the various veins was estimated as:

	Ounces
Vein 115	6,490
Vein 130	119,720
Vein 133	227,240
Vein 134 and branch veins 135 and 137	269,700
Vein 129	90,750
Total	713,900

Broken ore reserves are estimated at 6,000 tons of ore containing 332,000 ounces of silver, of which 1,900 tons is on the surface dump.

Milling

Milling recommenced early in May, 1954, and continued until December 1. Only a few temporary employees were then laid off, the others to continue in the mine until milling is resumed next spring.

Ore treated from mine and surface dump	tons	16,132
Silver recovered (61.5 ozs. per ton)	ounces	992,017
Silver put into the mill (63.5 ozs. per ton)	ounces	1,023,975

Recovery was 96.8 percent as compared with 96.9 percent in the previous year. The jigs and tables recovered 92.2 percent of the silver in the form of high-grade concentrate averaging 14.7 percent silver and 7.0 percent cobalt.

Grades of concentrate were:

	Ounces per ton
Jigs	4,798
Sand tables	3,862
Fine tables after flotation	3,426
Total average high-grade concentrate	4,291

Such a grade represents a 77 to 1 ratio of concentration on the 92.2 percent of the silver so recovered and a consequent cost reduction in shipping, sampling, and smelting.

The flotation equipment continued to make a satisfactory extraction of silver from the coarse table tailings.

Operating Costs

Owing to this being a nine-month fiscal period, over-all costs appear lower than for the previous year. They will be somewhat higher but not proportionate to extra rock work done.

Additional compressor capacity, added a year ago, made possible monthly increases of 16 percent in development footage, 12 percent in stoping tonnage and 300 percent in diamond-drilling footage. Unit costs consequently decreased.

Operating costs were:

Development and exploration:	
Drifting and crosscutting	$117,174.41
Raising	17,185.27
Diamond-drilling	20,310.32
Total	$154,670.00
Mining	116,666.68
Milling	46,821.77
Total production costs	$318,158.45
Administration and general expense	9,434.61
Total	$327,593.06

Plant and Equipment

Capital expenditures were the lowest for any year since the commencement of operations five years ago.

The expenditures made were:

Surface equipment including motor car at mine	$3,530.00
Underground equipment	2,575.00
Total	$6,105.00

Although no main plant expenditures are planned at present, the new development at greater distances from the shaft and winze will require more ore cars, another compressed air-drive locomotive, and added ventilation equipment, which is now on order and will be at work soon.

General

The year's production of 992,017 ounces of silver was practically the same as for the previous year. Although the New York price of silver at 85.25 cents per ounce did not vary through the year, the lower discount rate decreased the price in Canadian dollars.

Owing to the 7 months of milling all being in the shorter fiscal period, more ore was milled than was broken. The balance should be resorted by the end of the winter's development. Broken ore reserves and ore to be broken ensure a fair production in 1955. Whether that production will be up to the 1,000,000-ounce-per-year standard of the past two years will depend on the fortunes of development and stoping.

Development continues promising, particularly on northeastward extensions of veins Nos. 129 and 134. More venturous chances are being followed in the area of vein No. 131 and in a Keewatin area on the eastward projection of veing No. 124.

Newly located contacts of the ore-vein-bearing diabase sill with the overlying Keewatin rock to a depth of 1,100 feet below surface conform closely to the working estimates on which the underground exploration has been based. The indications are that this contact, which is at surface ½ mile to the west, and which has been located at various depths to 1,100 feet below surface, will not dip deeper than 1,250 feet below surface.

Practically all the ore so far located in this Miller Lake Basin area has been in the diabase sill, and the major part of that ore within 300 feet of the upper contact of the sill. That contact is thus the limiting guide of the mine exploration.

The upper part of the diabase contact underlying most of the company's ground and the more extensive area of the 1,100 foot deeper lower contact, which underlies all the 23 claims, offers an attractive area for future exploration and development. Exploration, however, is limited by the practical considerations of known production and costs.

Intensive exploration development and mining continues in the vicinity of discovered silver-showings, no matter how small, but with some work always reaching out to more remote areas.

The present broken ore and the underground exploration and development under way assure the resumption of milling in May, 1955.

An average of 74 men was employed, of whom 43 were underground and 31 on the surface. A. D. Campbell is manager. G. D. McLeod is manager in charge at the mine.

Coballoy Mines and Refiners, Limited

Coballoy Mines and Refiners, Limited, was incorporated in August, 1952, with an authorized capitalization of 5,000,000 shares of $1 par value. The officers and directors are: J. J. Gray, president; C. L. Murray, secretary-treasurer. The head office is at 80 Richmond Street West, Toronto. The mine address is Cobalt.

The company acquired by purchase and lease a number of properties, including several former producing mines in Coleman township and the Gillies Limit, district of Timiskaming. At the end of December, 1954, the company bought the Colonial mill from the Cobalt Consolidated Mining Corporation, Limited.

The Trinova property, formerly called the Nova Scotia, in Coleman township, was leased from Trinova Cobalt Silver Mines, Limited. The work of preparing the property for operation was carried on from August to the end of December, 1954. There are three shafts available for servicing the mine, collared one below the other on the slope of a hill. The lowest shaft was used for dewatering.

An average of 6 men was employed. E. B. E. De Camps was manager.

Cobalt Consolidated Mining Corporation, Limited

The Cobalt Consolidated Mining Corporation, Limited, was incorporated in January, 1953, with an authorized capitalization of 3,500,000 shares of $1 par value, of which 2,879,026 have been issued The officers and directors are: Leslie Blackwell, president; P. H. Hershey, vice-president; J. T. Symons, secretary; G. E. Buchanan, treasurer; Andrew Robertson, managing director; Dalton Dean and Martial Dumulon, directors. The head office is at 100 Adelaide Street West, Toronto. The mine office is at Cobalt.

The company acquired properties formerly held by Silanco Mining and Refining Company, Limited; Cobalt Lode Silver Mines, Limited; Penn-Cobalt Silver Mines, Limited; Gilgreer Mines, Limited; Keylode Cobalt Silver Mines, Limited; Hellens Mining and Reduction Company, Limited; and others in the Cobalt, South Lorrain, and Gowganda areas, district of Timiskaming. It also owns or has an interest in a number of claims in the Blind River area, district of Algoma. The total number of claims held by ownership or lease in 1954 was 258, amounting to 9,370 acres.

All operations in 1954 were confined to the company's properties in the Cobalt area of Coleman and Bucke townships.

A total of 187 men was employed on all the properties, 104 of whom were underground and 83 on the surface. A. D. Hellens was general manager.

AGAUNICO MINE

The Agaunico property consists of 32 claims in lots 15 and 16, concession I, Bucke township. Operations continued throughout 1954.

The mine is served by a vertical, two-compartment shaft about 400 feet deep, which is dewatered to the 275-foot level. The following table shows the development work done during 1954:

Level	Drifts	Crosscuts	Raises
	feet	feet	feet
200-foot	179	44	1,283
275-foot	2,126	889	732

Diamond-drilling consisted of 5 holes totalling 1,168 feet, from surface, and 69 holes totalling 10,853 feet, from underground.

Most of the ore mined came from No. 5-12 stope on the 275-foot level. A total of 58,338 tons of ore was hoisted, and 52,918 tons were treated in the Colonial and "104" mills.

G. P. Thoday was mine superintendent.

CHRISTOPHER MINE

The Christopher mine adjoins the south boundary of the Cobalt Lode mine, in lot 2, concession III, Coleman township. It was originally known as the Columbus mine and was, at one time, operated by the Pittsburgh Cobalt Silver Mining Company, Limited. In 1954 it was operated by the Cobalt Consolidated Mining Corporation, Limited, from July 1 to December 31, under lease from Christopher Silver Mines, Limited.

A connection was made between the Cobalt Lode workings and the Christopher workings on the 400-foot level, and all work was done through the Cobalt Lode shaft. The following development work was done in 1954:

Level	Drifts	Raises
	feet	feet
200-foot	230	77
400-foot	479	227

Twelve diamond-drill holes, totalling 4,489 feet, were drilled from underground.

A total of 1,124 tons of ore was hoisted and stockpiled,

Roy Stewart was mine superintendent.

COBALT LODE MINE

This property, also known at one time as the Adanac mine, consists of three 20-acre claims on lot 2, concession III, Coleman township.

Mining continued throughout 1954. The present operations are conducted through the vertical, two-compartment No. 1 shaft, 622 feet deep, and the vertical, two-compartment No. 401 winze. The winze runs from the 400-foot level to a depth of 480 feet from surface and has levels at 455 and 480 feet, which are

not connected with the No. 1 shaft workings. The following table shows the development work done during 1954, and the total at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
No.1 SHAFT:						
100-foot		40		123		
200-foot	231	2,872	28	1,099	297	1,266
275-foot sublevel		175				
310-foot		1,745		350	253	602
321-foot sublevel	27	74		285	30	230
400-foot	134	2,205	52	1,874	249	1,706
500-foot		707		385	61	448
600-foot	9	323	44	572	105	131
No. 401 WINZE:						
455-foot		363		60		215
480-foot		50		102		19

Diamond-drilling in 1954 consisted of 48 holes, totalling 5,534 feet, from underground.

A total of 30,208 tons of silver-cobalt ore was hoisted during the year and treated in the Colonial and "104" mills.

Roy Stewart was mine superintendent.

COLONIAL MINE

The Colonial mine, which was acquired from the Silanco Mining and Refining Company, Limited, is on lot 3, concession VI, Coleman township.

Operations in 1954 were carried on from January 1 to June 30. No work was done through the shaft. Development work consisted of 27 feet of drifting and 78 feet of raising on No. 1902 sublevel, which is 50 feet below the adit level, in the northeastern part of the property. There were 1,572 tons of ore trammed from the adit; 2,006 tons were sent to the Colonial mill for treatment.

J. H. Price is mine superintendent.

CROWN RESERVE-KERR LAKE-PENN-CANADIAN-FOSTER GROUP

The Crown Reserve, Kerr Lake, Penn-Canadian, and Foster mines are all part of the group in lots 3 and 4, concession IV, Coleman township, acquired from Penn-Cobalt Silver Mines, Limited. The Crown Reserve and Kerr Lake are adjoining properties on lot 3. No work was done on the Crown Reserve, Penn-Canadian or Foster sections in 1954.

Operations on the Kerr Lake mine were carried on from January 1 to February 10, and from April 19 to December 23. Development work amounted to 222 feet of drifting and 705 feet of raising on the 225-foot level, and 67 feet of drifting on the 175-foot sublevel. Fourteen diamond-drill holes, totalling 852 feet, were drilled from underground.

A total of 13,149 tons of cobalt ore was mined and treated in the Colonial and "104" mills.

H. B. McLean was superintendent.

RIGHT-OF-WAY MINE

The Right-of-Way property was acquired with the assets of the Hellens Mining and Reduction Company, Limited. It consists of one 17-acre claim underlying the right-of-way of the Ontario Northland railway, on lot 5, concession VI, Coleman township.

Mining continued throughout 1954. The vertical, No. 2 shaft, which is about 380 feet deep, is being used for the present operation. It is dewatered to the 358-foot level, and the vertical, No. 1 winze, below that level, is dewatered to the 410-foot level. Two new sublevels from No. 2 shaft were established at depths of 133 and 258 feet in 1954. The following table shows the development work done from No. 2 shaft and No. 1 winze in 1954, and the total amount down to the 410-foot level from these at the end of the year:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
No. 2 SHAFT:						
83-foot		2,460				
133-foot sublevel	150	150			50	50
143-foot		1,120				
258-foot sublevel	435	435			324	324
358-foot	48	460		425	100	105
No. 1 WINZE:						
410-foot		65		20		

Diamond-drilling in 1954 consisted of 6 holes, totalling 587 feet, from underground.

A 500-cubic-feet-per-minute Canadian Ingersoll-Rand compressor and a 100-horsepower English Electric motor, both used, were installed in 1954.

There were 3,204 tons of ore, mainly cobalt, mined and treated in the Colonial and "104" mills.

Pumping operations were carried on for five months in the year to lower the water level of the following interconnected mines: McKinley-Darragh, Cobalt Lake, Townsite, City of Cobalt, Buffalo, and Nancy Helen.

J. H. Price is mine superintendent.

COLONIAL MILL

The Colonial mill, on the Colonial mining property, lot 3, concession VI, Coleman township, operated from January 1 to February 28 and from July 13 to December in 1954, treating ore from the company's own mines. No custom milling was done.

A total of 21,069 tons of ore was treated, an average of 94 tons per day.

T. Cawley was mill superintendent.

The mill was sold to Coballoy Mines and Refiners, Limited, at the end of 1954

THE "104" MILL

The stamp mill known as the "104" is in the township of Bucke, at mileage 104 on the Ontario Northland railway. It was originally operated by O'Brien Mines, Limited, and later by Cobalt Lode Silver Mines, Limited.

The mill operated throughout 1954, treating 76,182 tons of ore from the company's various mines at a daily average-of 212 tons. No custom milling was done.

The following used equipment was installed in the mill: eight No. 24 Denver flotation cells, a 3- by 4-inch Allis-Chalmers ball mill, an 18- by 24-inch Denver mineral jig, and six Deister tables.

T. Cawley was mill superintendent.

Cordon Cobalt Mines, Limited

Cordon Cobalt Mines, Limited, was incorporated in February, 1951, with an authorized capitalization of 3,000,000 shares, of which 2,698,010 have been issued. The officers and directors are: J. J. Chalmers, president; A. G. Smith, vice-president; E. E. Ott, secretary-treasurer; H. A. Loffree, assistant secretary-treasurer; M. A. McNair and A. S. Taylor, directors. The head office is at 129 Adelaide Street West, Toronto. The mine address is Cobalt.

The company owns the property formerly known as the Hudson Bay, consisting of two claims on the north half of lot 6, concession VI, Coleman township, district of Timiskaming. In addition, the company owns two claims in block 8 in the Gillies Limit, district of Timiskaming, on which no work was done in 1954.

During the early part of 1954 a small, one-compartment shaft, 90 feet deep, inclined at 75 degrees, on the Hudson Bay property, was dewatered, and 19 diamond-drill holes, totalling 1,841 feet, were drilled from underground. There were 59 diamond-drill holes, totalling 3,184 feet, drilled from surface.

The operation was again suspended on July 29, and the shaft was allowed to refill.

H. R. Bischoff was consulting engineer, and A. Towson was in charge at the property.

Harrison-Hibbert Mines, Limited

Harrison-Hibbert Mines, Limited, was incorporated in May, 1935, with an authorized capitalization of 2,000,000 shares of $1 par value. In 1950 the capitalization was increased to 3,000,000 shares of $1 par value, and in 1953 it was increased to 5,000,000 shares of $1 par value; 3,800,000 shares have been issued. The officers and directors are: A. W. White, president; J. D. Reilly, vice-president; L. W. McIlmurray, secretary-treasurer; Matthew Grimes and H. R. Heard, directors; J. E. Armstrong, director and mine manager. The head office is at 145 Yonge Street, Toronto. The mine address is Box 148, Cobalt.

The company owns three claims and has an interest in one claim owned by Pittsonto Mines, Limited, near the village of North Cobalt, in Bucke township, district of Timiskaming. Of the three claims owned by the company, the Harrison-Hibbert and the Ruby claims are on lot 13, concession I, and the Law claim is on lot 13, concession II. The Pittsonto claim is immediately south of the Ruby claim.

Operations are conducted through the vertical, two-compartment No. 1 shaft on the Harrison-Hibbert claim, which is 258 feet deep with levels at 150, 190, and 240 feet, and sublevels at 120 and 170 feet. The electric hoisting plant is at this shaft.

Mining continued from January 1 to August 30, 1954, when the operation was suspended. The following table shows the development work done in 1954:

Level	Drifts	Crosscuts	Raises
	feet	feet	feet
150-foot	102	.....	75
190-foot	87	10	115
240-foot	284	136	218

Diamond-drilling consisted of 7 holes totalling 1,771 feet, from surface, and 48 holes totalling 4,195 feet, from underground.

A total of 17,128 tons of silver-cobalt ore was hoisted and sent to the custom mill of United Cobalt Mines, Limited, for treatment.

An average of 22 men was employed, 19 underground and 3 on the surface.

Juno Metals Corporation, Limited

Juno Metals Corporation, Limited, has an authorized capitalization of 3,500,000 shares of $1 par value. Lucien Boutet is president, and F. A. Rutherford is secretary-treasurer. The head office is at 4235 Iberville Street, Montreal, Quebec. The mine address is Cobalt.

The company acquired the former Reliance property, a 20-acre claim in lot 3, concession V, Coleman township, district of Timiskaming.

Operations were resumed in September, 1954, and continued for the rest of the year. The vertical, two-compartment shaft was sunk a further 168 feet to a total depth of 227 feet. There was no lateral development work or diamond-drilling done.

R. Stewart was in charge. Twenty-three men were employed, 13 underground and 10 on the surface.

Langis Silver and Cobalt Mining Company, Limited

Langis Silver and Cobalt Mining Company, Limited, was incorporated in February, 1953, with an authorized capitalization of 300,000 shares of $1 par value. The company is a wholly owned subsidiary of the Signal Oils and Metals Company, Limited. The officers are: Oscar Beaudoin, president; Benjamin Milrot, vice-president; R. Staines, secretary-treasurer. The executive office is at 265 Craig Street, Montreal, Quebec.

The company owns nine claims in Casey and Harris townships, district of Timiskaming, including the former Casey Cobalt property.

No underground work was done in 1954. A 24- by 45-inch single-drum 75-horsepower Canadian Ingersoll-Rand hoist was installed at No. 3 shaft. The following buildings were erected: diesel building, carpenter and machine shop, boiler house, and smelter building. Electric power was supplied by a diesel-operated generator.

Vincent Landers was manager.

Lost Lake Mines, Limited

Lost Lake Mines, Limited, was incorporated in August, 1953. The authorized capitalization is 200 shares of $100 par value. The company is a wholly-owned subsidiary of Siscoe Metals, Limited. The officers and directors are: J. B. Lynch, president; C. M. Masterman, secretary-treasurer; Thomas Guerin, comptroller; J. G. Ahern, J. G. Carrique, and H. F. Strong, directors. The head office address is Box 1107, Cornwall. The mine address is O'Brien.

The company holds leases on four claims, including the Morrison and W.J.9 properties, four miles east of Gowganda, in Nicol township, district of Timiskaming.

There is a vertical, two-compartment shaft, 590 feet deep, on claim T.C.315

of the Morrison property, through which all the work in the present operation has been done. The 400-foot shaft on the W.J.9 property is not used.

Mining continued from January 1 to September, 1954, when operations were suspended. The following table shows the development work done from the Morrison shaft in 1954, and the total when work ceased:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
175-foot	66	161	82	114	96	96
250-foot (station only)	.....	.....	.....	.....	.....	.....
300-foot	.....	82	.....	76	23	23
375-foot	26	26	44	44	105	180
425-foot	38	587	.....	36	85	85
500-foot	104	866	.....	529	.....	57
575-foot	.....	466	.....	35	.....	.....

Diamond-drilling in 1954 consisted of 92 holes, totalling 9,057 feet, from underground.

There were 6,429 tons of ore hoisted and sent to the Siscoe Metals mill for treatment in 1954.

G. Shartner is manager, and E. A. Pearson is general manager. An average of 14 men was employed, 11 underground and 3 on the surface.

Mayfair Mines, Limited

Mayfair Mines, Limited, was incorporated in May, 1945, with an authorized capitalization of 3,000,000 shares of $1 par value. In February, 1951, the capitalization was increased to 4,000,000 shares and in February, 1953, to 5,000,000 shares of $1 par value, of which 3,409,910 have been issued. The officers and directors are: N. E. Gough, president and general manager; P. M. Klopstock, Jr., vice-president; W. G. White, secretary-treasurer; A. L. Campbell, A. E. Hilliard, and L. N. Gough, directors. The head office is at 330 Bay Street, Toronto. The mine address is Haileybury.

The company's property is on lot 2, concession II, in the extreme southeast corner of Coleman township, district of Timiskaming, and extends westward across the Coleman township boundary into block 6 of the Gillies Limit. It includes the property that has been known as both the John Black and People's mine.

The vertical, two-compartment No. 1 shaft is 420 feet deep. The two-compartment No. 3 winze is collared at the 400-foot level, about 1,500 feet west of No. 1 shaft and runs at an angle of 20 degrees to a depth of 557 feet below the surface.

No development work or diamond-drilling was done on the Mayfair property in 1954.

The Mayfair mine and the adjoining Silver Crater mine are connected on the 200- and 400-foot levels. An agreement was made under which Mayfair Mines, Limited, did some development work and mined ore on the Silver Crater, using

the Mayfair No. 1 shaft as a means of access. Details of the work appear on page 133 of this report under Silver Crater Mines, Limited.

An average of 10 men was employed, 6 underground and 4 on the surface. W. R. Garbutt is mine manager.

Mensilvo Mines, Limited

Mensilvo Mines, Limited, was incorporated in November, 1946, with an authorized capitalization of 2,000,000 shares of $1 par value, of which 1,981,525 have been issued. The officers are: L. C. Herdman, president; H. D. Baker, vice-president; J. C. Wylie, secretary-treasurer. The head office is at 73 King Street West, Toronto. The mine address is Cobalt.

The company owns a property consisting of 25 acres in lot 6, concession IV, Coleman township, district of Timiskaming, formerly known as the Silver Bar mine.

Operations continued from January to the late fall of 1954. The vertical, two-compartment No. 7 shaft was deepened 57 feet to a total depth of 214 feet, and a new level was established at 200 feet. Lateral development work consisted of 107 feet on the 105-foot level, and about 500 feet on the 200-foot level.

At the end of November the property was leased to Silver Crater Mines, Limited.

An average of 16 men was employed. L. Cunningham succeeded W. D. Taylor as manager.

Nipissing-O'Brien Mines, Limited

Nipissing-O'Brien Mines, Limited, was incorporated in January, 1952, with an authorized capitalization of 2,500,000 shares of $1 par value, of which 1,600,005 have been issued. The officers and directors are: B. A. O'Brien, president; J. M. Cunningham-Dunlop, vice-president; C. C. Calvin, secretary-treasurer; W. H. Woods and Alan Scott, directors. The head office is at 25 King Street West, Toronto. The mine address is Cobalt.

The company acquired the properties of M. J. O'Brien, Limited, and Nipissing Mines Company, Limited, in the township of Coleman, district of Timiskaming.

Mining operations continued throughout 1954. The following table shows the depths of the various shafts on the O'Brien property, and the number of compartments in each. All the shafts are vertical:

Shaft	Number of compartments	Depth
		feet
Main	3	345
No. 2	2	250
No. 6	2	300
No. 14	2	176
No. 81	2	581

Most of the work in 1954 was done through the main shaft. No. 81 shaft was dewatered. The following table shows the development work done during the year:

	Drifts	Crosscuts	Raises
	feet	feet	feet
MAIN SHAFT AREA:			
3rd level	.....	.....	45
4th level	572	139	144
5th level	70	.....	.....
No. 2 SHAFT AREA:			
2nd level	31	.....	178
No. 6 SHAFT AREA:			
1st level	46	.....	205
No. 14 SHAFT AREA:			
2nd level	.....	.....	132

Diamond-drilling in 1954 consisted of 32 claims, totalling 2,895 feet, from underground.

A total of 11,793 tons of ore was mined.

A 100-ton mill was built and equipped. It operated from September 1 to the end of the year and treated 11,840 tons of ore.

An average of 45 men was employed, 19 underground and 26 on the surface. Basil Jackson was manager.

Ramardo Mines, Limited

Ramardo Mines, Limited, was incorporated in January, 1946, with an authorized capitalization of 3,000,000 shares of $1 par value, of which 1,525,000 have been issued. The officers and directors are: R. V. Arntfield, president; H. W. Crossin, vice-president; A. D. Clelland, secretary; D. R. Arntfield, treasurer; T. J. Boodell and G. C. Crawford, directors. The head office is at 67 Yonge Street, Toronto.

The company owns the property formerly known as the Trout Lake mine, in South Lorrain township, district of Timiskaming.

Operations were carried on from June to October 14, 1954. The No. 2 shaft and No. 1 winze, both sunk by former operators, were dewatered. The shaft is 350 feet deep, and the winze runs from the 350-foot level to a depth of 850 feet from surface. The 850-foot level was sampled, and three diamond-drill holes, totalling 1,800 feet, were drilled.

A timber headframe and a small office were built.

W. Hammerston was in charge.

Roy Silver Mines, Limited

Roy Silver Mines, Limited, was incorporated in July, 1949, with an authorized capitalization of 3,000,000 shares of $1 par value. The capitalization was increased to 4,500,000 shares in 1952, and to 5,500,000 shares in 1953. The number of shares issued at December 31, 1954, was 5,355,575. The officers and directors are: Maurice Marcus, president; S. M. Goldberg, vice-president and treasurer; George Scott, secretary; I. A. Wechsler, L. S. Joseph, and Louis Cohen, directors. The head office is at 357 Bay Street, Toronto. The mine address is Elk Lake.

The company holds claims in Coleman, South Lorrain, Haultain, and Farr townships, district of Timiskaming, and Strathy township, district of Nipissing.

Operations were continued at the property in Farr township, 7 miles west of the town of Elk Lake, from January 1 to May 18, 1954. The vertical, two-compartment No. 1 shaft was sunk a further 100 feet to a total depth of 390 feet, and a new level was established at 300 feet. The following table shows the development work done in 1954, and the total when operations were suspended:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
66-foot	20	107	20	92	94	94
135-foot	.....	67	.....	70	.....	18
205-foot	42	371	.....	110	.....	117
300-foot	.....	.....	98	98	.....	.....

Diamond-drilling in 1954 consisted of 2 holes, totalling 105 feet, from surface.

A total of 3,007 tons of cobalt ore was mined.

The building and equipment of an 80-ton flotation mill was completed. The mill operated from February 16 to May 18 and treated 2,472 tons of ore. The concentrates were sent to Cobalt Chemicals, Limited, for further treatment.

Following the suspension of operations on May 18 the shaft was kept dewatered.

An average of 17 men was employed, 12 on surface and 5 underground. J. G. Pollard was manager while the mine was in operation. Ray Menasse, the mill superintendent, has been in charge since that time.

Silver Crater Mines, Limited

Silver Crater Mines, Limited, was incorporated in February, 1951, with an authorized capitalization of 3,000,000 shares of $1 par value, of which 2,533,880 have been issued. The officers and directors are: A. R. Kenny, president; D. R. Wills, secretary-treasurer; Bernhard Day, managing director; E. L. Munson, B. L. Geist, A. Loveland, H. L. Pratt, G. H. Carey, G. A. Hall, and C. H. Augspurger, directors. The head office is at 696 Yonge Street, Toronto. The mine address is Cobalt.

The company acquired the Silver Banner and Ophir properties in Coleman township, district of Timiskaming, and carried on mining operations from April 1 to December 31, 1954.

The vertical, two-compartment No. 3 shaft on the Silver Crater mine was sunk a further 49 feet to a total depth of 520 feet. A new level was established at 500 feet, and 1,094 feet of crosscutting was done on it.

Twelve diamond-drill holes totalling 2,781 feet were drilled from surface, and 12 holes totalling 3,231 feet were drilled from underground.

The Mayfair property adjoins the south boundary of the Ophir section of the Silver Crater. Mayfair Mines, Limited, under contract, did 295 feet of drifting on the 200-foot level of the Ophir section and mined 2,515 tons of ore in the same area. The ore was hoisted through the Mayfair No. 1 shaft and taken to the Mensilvo property where it was stockpiled.

In November, Silver Crater Mines, Limited, took a lease on the Mensilvo property and kept the workings unwatered.

An average of 5 men was employed. D. A. McDonald was resident engineer.

Silver-Miller Mines, Limited

Silver-Miller Mines, Limited, was incorporated in January, 1946, with an authorized capitalization of 3,000,000 shares of $1 par value. In 1952 the number of shares was increased to 4,000,000, and in 1953 to 5,000,000, of which 4,789,181 have been issued. The officers and directors are: Murray Cooper, president and treasurer; J. D. Streit, vice-president; J. M. Wainberg, secretary; George Scott, assistant treasurer; Harry Harris, John Meyers, and Maurice Hill, directors. M. D. Calder is general manager in charge of all operations. The head office is at 357 Bay Street, Toronto. The mine address is Box 922, Cobalt.

The company owns properties having a total area of 788 acres in Coleman township and the Gillies Limit, district of Timiskaming. The following properties are in Coleman township: Brady Lake group, lots 2 and 3, concession III, and lot 12, concession IV; Princess, lot 7, concession V; La Rose-Chambers-Ferland group, parts of lots 4 and 5, concession VI; Fisher-Eplett-Silver Hill group, lot 1, concession IV; Lawson-University-Silver Mountain group, parts of lots 3, 4, and 5, concession IV. The Cleopatra claims lie partly in lot 5, concession IV, Coleman township, and partly in the part of the Gillies Limit immediately to the south.

BRADY LAKE MINE

The Brady Lake property, which has also been called the Silver-Miller mine, includes the old Lumsden, Rochester, Gillies, Cobalt Central, and Coleman Development (Pan Silver) mines.

Mining operations continued throughout 1954. The work was done from the No. 1 (Lumsden) and No. 4 shafts. The No. 4 shaft is 632 feet deep. A new sublevel was established at a depth of 400 feet. A vertical, two-compartment winze, No. 3, was collared at the 610-foot level and sunk a distance of 15 feet. The following table shows the development work done during the year:

Level	Drifts	Crosscuts	Raises
	feet	feet	feet
No. 1 (LUMSDEN) SHAFT:			
285-foot	147		61
No. 4 SHAFT:			
360-foot	197		20
400-foot sublevel	71		
440-foot	42		323
500-foot	316		247
560-foot	589		202
610-foot	354	702	286

Diamond-drilling in 1954 consisted of 40 holes, totalling 4,095 feet, from underground.

A total of 34,195 tons of cobalt-silver ore was mined and milled. The mill operated from January 17 to December 31, at an average of 102 tons per day.

A 10- by 12-inch, single-drum Flory air-hoist was installed at the No. 3 winze.

An average of 82 men was employed, 47 underground and 35 on the surface.

CHAMBERS-FERLAND MINE

The 425-foot vertical, two-compartment No. 4 shaft on the Chambers-Ferland property was dewatered in 1954, but no development work was done, and no ore was mined.

Eight men were employed.

FISHER-EPLETT MINE

Work on the Fisher-Eplett property in 1954 consisted of 6 diamond-drill holes, totalling 1,270 feet, from surface.

LA ROSE MINE

Mining and milling operations at the La Rose property continued throughout 1954. The vertical, two-compartment Main shaft is 250 feet deep, the bottom level being at 240 feet. A vertical, two-compartment winze, collared at the 240-foot level, runs to a depth of about 665 feet from surface. It was kept unwatered to the bottom, but no development was done below the 240-foot level. The following table shows the development done from the Main shaft in 1954:

Level	Drifts	Crosscuts	Raises
	feet	feet	feet
62-foot	540	85	102
62-12 sublevel	108	.....	.....
157-foot	1,036	.....	101
240-foot	772	353	80

Diamond-drilling consisted of 23 holes, totalling 3,370 feet, from underground.

A total of 46,206 tons of ore, mainly cobalt, was hoisted. The mill treated 52,641 tons.

An average of 97 men was employed, 52 underground and 45 on the surface.

LA ROSE EXTENSION MINE

The 400-foot vertical, two-compartment No. 10 shaft on the La Rose extension property was dewatered in 1954, but no development work was done, and no ore was mined.

LAWSON MINE

Operations at the Lawson mine continued throughout 1954. Hoisting is done through the vertical, two-compartment No. 8 shaft, which is 400 feet deep. The workings of the old Lawson Main shaft, which is 185 feet deep, are connected to the No. 8 shaft workings on the 88- and 185-foot levels, and the Main shaft is now used as a manway. The following table shows the development work done during 1954:

Level	Drifts	Raises
	feet	feet
88-foot	.....	94
185-foot	479	273
240-foot	950	50
300-foot	465	.....

Diamond-drilling consisted of 20 holes, totalling 3,048 feet, from underground.

A total of 27,629 tons of ore was mined in 1954. Some was shipped to the La Rose mill and some to the Brady Lake mill for treatment.

An average force of 61 men was employed, 43 underground and 18 on the surface.

UNIVERSITY MINE

The two-compartment, vertical Main shaft and the two-compartment, inclined shaft on the University property were dewatered in 1954 to allow diamond-drilling to be done. Fourteen holes totalling 1,988 feet, from surface, and 21 holes totalling 570 feet, from underground, were drilled in the inclined-shaft area. Three holes, totalling 455 feet, were drilled from underground in the Main-shaft area.

Siscoe Metals of Ontario, Limited

Siscoe Metals of Ontario, Limited, is a wholly owned subsidiary of Siscoe Gold Mines, Limited. It was incorporated in September, 1950, to succeed Siscoe Metals, Limited. The authorized capitalization is 4,000 shares of no par value. The officers and directors are: J. B. Lynch, president; Auguste Desilets, vice-president; C. M. Masterman, secretary-treasurer; Thomas Guerin, A. K. Cameron, G. C. Smith, W. F. James, and J. G. Ahern, directors. The head office is at 907 Dominion Square Building, Montreal. The mine address is O'Brien.

The company owns 14 claims, about 547 acres, in Nicol and Haultain townships, Gowganda area, district of Timiskaming. It also operates the property of its wholly owned subsidiary, Lost Lake Mines, Limited,[1] in Nicol township.

Mining operations at the Siscoe Metals property continued throughout 1954. No. 11 winze, which is collared at the 850-foot level, was sunk a further 52 feet to a total depth of 1,267 feet from surface, and a new level was established at 1,200 feet. The following table shows the development work done in 1954:

Level	Drifts	Crosscuts	Raises
	feet	feet	feet
350-foot	272	29	
400-foot			20
450-foot			31
525-foot	54	25	5
585-foot	43	38	
650-foot			36
730-foot	9		101
790-foot	5		
850-foot	185		
1,000-foot	400		
1,075-foot	176		
1,150-foot	16		10
1,200-foot	953	21	
1,250-foot	135	32	

Diamond-drilling consisted of 212 holes, totalling 16,094 feet, from underground.

There were 24,542 tons of ore mined. The mill treated a total of 63,227 tons, from the following sources:

	Tons
Siscoe Metals:	
Mine ore	24,542
Surface rock dump	5,098
Tailings reclamation	27,158
Lost Lake Mines	6,429
Total	63,227

An average of 88 men was employed, 43 underground and 45 on the surface. G. Shartner is mine manager.

[1]See report on Lost Lake Mines, Limited, on page 129.

United Cobalt Mines, Limited

United Cobalt Mines, Limited, was incorporated in April, 1944, to succeed the Ausic Mining and Reduction Company. In June, 1951, the company was reorganized, and new shares were issued on a basis of one new for two old shares. The authorized capitalization is 4,000,000 shares of $1 par value, of which 1,360,973 have been issued. The officers and directors are: A. W. White, president; T. M. Fyshe, vice-president; L. W. McIlmurray, secretary-treasurer; W. R. Salter, H. G. Miller, and W. S. Jamieson, directors. The head office is at 145 Yonge Street, Toronto. The mine address is Box 250, Cobalt.

The company owns four claims in lot 9, concession I, Bucke township, district of Timiskaming, known as the Genesee group, and one claim in lot 3, concession VI, Coleman township, district of Timiskaming, known as the Silver Cliff.

No underground work was done in 1954. The mill on the Silver Cliff property was operated from January 1 to August 15 and treated 17,128 tons of ore from the property of the affiliated Harrison-Hibbert Mines, Limited. The plant operated at an average daily rate of 76 tons.

An average force of 3 men was employed. J. E. Armstrong was manager.

TALC

Canada Talc Industries, Limited

Canada Talc Industries, Limited, was incorporated in July, 1951, with an authorized capitalization of 1,000,000 shares of no par value, of which 850,007 have been issued. The officers are: H. L. Roscoe, president; N. C. Urquhart, vice-president; C. H. Windeler, secretary-treasurer. The head office and mine office are at Madoc.

The company's property in Huntingdon, Elzevir, and Madoc townships, Hastings county, includes the Conley and Henderson mines.

Operations continued throughout 1954. The following table shows the development work done during the year:

Location	Drifts	Crosscuts	Raises
	feet	feet	feet
Conley mine (270-foot level)	415	45	.....
Henderson mine (443-foot level)	110	130	35

Thirty diamond-drill holes, totalling 2,046 feet, were drilled from underground.

A total of 13,940 tons of talc was hoisted and milled. The mill operated at an average daily rate of 50 tons.

H. E. Roscoe is manager. An average of 21 men was employed, 11 underground and 10 on the surface.

URANIUM

Algom Uranium Mines, Limited

Algom Uranium Mines, Limited, was incorporated in July, 1953, with an authorized capitalization of 6,000,000 shares of $1 par value, of which 2,750,007 have been issued. The officers and directors are: F. R. Joubin, president; W. H.

Bouck, vice-president; L. I. Hall, secretary-treasurer; J. H. Hirshhorn, G. B. Langford, W. A. Hutchison, S. A. Hayden, and G. A. Fallis, directors. The head office is at 111 Richmond Street West, Toronto. The mine address is Algoma Mills.

The company owns 632 claims, totalling about 25,280 acres, in the Blind River area, district of Algoma. There are four separate groups of claims, as shown below:

Property	Number of Claims
Elliot Lake (Nordic)	295
Pecors Lake	146
Pistol Lake	48
Quirke Lake	143
Total	632

In 1954 the following diamond-drilling was done from surface:

Property	Number of holes	Feet
Elliot Lake (Nordic)	168	65,191
Pecors Lake	10	3,587
Pistol Lake	13	4,680
Quirke Lake	118	51,873
Total	309	125,331

In township 150, on the Quirke Lake property, a vertical, five-compartment shaft, known as Quirke No. 1, was sunk to a depth of 490 feet. Levels were established at 126, 238, 343, and 434 feet, and 42 feet of crosscutting was done on the 434-foot level. An adit was driven 77 feet into the surface outcrop. These two projects were undertaken to provide samples for test purposes and metallurgical research.

An office and a cookery-bunk-house were built.

In township 149, on the Elliot Lake (Nordic) property, a vertical, 5-compartment shaft, Nordic No. 1, was sunk a distance of 36 feet.

The following is taken from the manager's report for the year ending December 31, 1954:

At the Quirke Lake property the drilling indicates a sheet-like orebody 7,300 feet in length, 12.2 feet thick, dipping 30 to 35 degrees to the south. The deepest hole drilled to date encountered ore 3,400 feet down the dip slope. In addition to this orebody, drilling has indicated some additional ore will be won from other horizons both in the footwall and hanging wall.

In late 1953 and early 1954 an orebody was found towards the east end of the Elliot Lake property in what is now known as the Nordic Lake section. Eighty-eight holes, totalling 37,790 feet, have shown this deposit is similar to the one at Quirke. The indicated length is 5,600 feet, thickness 9.5 feet, and dip 18 degrees to the north. The deepest hole drilled to date on this property encountered ore 6,000 feet down the dip slope.

On other sections of the properties widely spaced holes failed to indicate ore comparable to the Quirke and Nordic, although encouraging assays were obtained at some points that will warrant additional drilling in the future.

In conjunction with exploration, metallurgical work on pilot-plant scale has proceeded in Ottawa. An excellent recovery of uranium oxide can be accomplished by a conventional leach process, and the decision to use this process has been made.

An average of 39 men was employed by the company. R. C. Hart is manager.

Beaucage Mines, Limited

The property of Beaucage Mines, Limited, on the Manitou Islands in Lake Nipissing, district of Nipissing, has deposits containing columbium and uranium. Mining operations began on Newman Island on October 1, 1954. Details regarding the work done appear in the Niobium (Columbium) section of this report, under Beaucage Mines, Limited, on page 119.

Buckles Algoma Uranium Mines, Limited

Buckles Algoma Uranium Mines, Limited, was incorporated in April, 1954, with an authorized capitalization of 3,000,000 shares of $1 par value, 2,100,005 of which have been issued. The officers and directors are: J. B. Aird, president; F. R. Joubin, vice-president; F. D. Redfern, secretary-treasurer; H. R. Buckles, Stephen Kay, and J. H. Hirshhorn, directors. The head office is at 44 King Street West, Toronto. The mine address is Algoma Mills.

The company holds 66 claims, about 2,640 acres, in Eston township and township 149, Blind River area, district of Algoma. The claims lie immediately south of the Nordic Lake property of Algom Uranium Mines, Limited.

Mining operations were carried on in November and December, 1954. A vertical, two-compartment shaft, called No. 1, was sunk to a depth of 77 feet, on claim S.68948, near the north boundary of the property, and a test sample of ore was taken.

Diamond-drilling consisted of 35 holes, totalling 3,334 feet, from surface.

R. N. Sexsmith is manager.

Cardiff Uranium Mines, Limited

Cardiff Fluorite Mines, Limited, was incorporated in September, 1943, with an authorized capitalization of 2,000,000 shares of $1 par value. In October, 1951, the capitalization was increased to 2,500,000 shares of $1 par value, of which 1,718,754 have been issued. In 1953 the name was changed to Cardiff Uranium Mines, Limited. The officers and directors are: F. R. Marshall, president; E. H. Bronson, vice-president; Ivy Murphy, secretary-treasurer; G. T. Pepall and F. P. Hunt, directors. The head office is at 26 Queen Street East, Toronto. The mine address is Box 59, Wilberforce.

The company owns 11 claims, about 580 acres, in Cardiff township, Haliburton county.

Mining operations were resumed on April 29, 1954, and continued for the rest of the year.

The two-compartment, No. 1 shaft runs at an angle of 49 degrees to a depth of 275 feet from surface. There are levels at 125 and 250 feet from surface. The workings were dewatered in 1954, and 66 feet of drifting was done on the 125-foot level. The following table shows the total amount of development from the No. 1 shaft at the end of 1954:[1]

Level	Drifts	Crosscuts
	feet	feet
125-foot	594	40
250-foot	175	50

[1]An account of the history of the development of the property is given by J. Satterly and D. F. Hewitt in *Some Radioactive Mineral Occurrences in the Bancroft Area*, Ont. Dept. Mines, Geol. Circ. No. 2, March, 1955.

About 270 feet of surface-trenching, 3 feet deep, was done in 1954.

The following buildings were erected: 28-foot wooden headframe, power-house, 16,000-gallon water tank, machine shop and boiler-room, office, magazine, cap-house, and pump-house.

Plant equipment included a diesel generator unit; a Canadian Ingersoll-Rand compressor; and a 42- by 30-inch, single-drum Canadian Ingersoll-Rand hoist, driven by a 60-horsepower motor.

An average of 11 men was employed. R. E. Miller is manager.

Centre Lake Uranium Mines, Limited

Centre Lake Uranium Mines, Limited, was incorporated in January, 1953, with an authorized capitalization of 3,000,000 shares of $1 par value, 2,160,008 of which have been issued. The officers and directors are: D. R. Michener, president; J. M. Cunningham-Dunlop, vice-president; R. A. Cranston, secretary; J. T. McWhirter, treasurer; W. H. Woods, J. H. Crang, A. G. Fulton, E. D. Scott, and W. A. Smith, directors. The head office is at 25 King Street West, Toronto. The mine address is R.R.3, Bancroft.

The company holds a block of 54 claims, containing about 2,160 acres, in lots 23–30, concessions IX–XIII, Cardiff township, Haliburton county.

Operations were carried on from March to October, 1954. A vertical, three-compartment shaft was sunk on claim E.O.5936 to a depth of 234 feet, and a level was established at 205 feet. The following table shows the development work done during 1954, and the total when the operation ceased in October:

Level	Drifts		Crosscuts		Raises	
	1954	Total	1954	Total	1954	Total
	feet	feet	feet	feet	feet	feet
Adit level	.....	995	.....	510	.....	.....
2nd level (205 feet)	1,320	1,320	419	419	188	188

Diamond-drilling consisted of 6 holes totalling 2,700 feet, from surface, and 13 holes totalling 1,143 feet, from underground.

Three men were employed. S. C. Brown was manager.

Croft Uranium Mines, Limited

Croft Uranium Mines, Limited, was incorporated in September, 1953, with an authorized capitalization of 3,000,000 shares of $1 par value, 2,300,005 of which have been issued. The officers and directors are: R. A. Bryce, president; Larmour Soliague, vice-president; H. W. Salthouse, secretary-treasurer; J. D. Bryce, J. H. Crang, and E. D. Scott, directors. The head office is at 85 Richmond Street West, Toronto. The mine address is Bancroft.

The company holds a block of 51 claims on the east boundary of Cardiff township, Haliburton county, and in adjoining Faraday and Herschel townships, Hastings county. The property is 10 miles west of Bancroft.

In 1954 an adit was driven about a mile south of the Bancroft-Wilberforce road, and 1,211 feet of drifting and 485 of crosscutting were done on it.

Diamond-drilling in 1954 consisted of 70 holes totalling 27,794 feet, from surface, and 93 holes totalling 3,053 feet, from the adit workings.

The work was all done by a contractor. Six men were employed.

Faraday Uranium Mines, Limited

Faraday Uranium Mines, Limited, was incorporated in June, 1949, with an authorized capitalization of 2,500,000 shares of $1 par value. In January, 1954, the number of shares was increased to 5,000,000, of which 3,493,324 have been issued. The officers and directors are: A. H. Shore, president; A. W. Johnston, vice-president; William McKee, secretary-treasurer; J. C. Rogers and W. C. Campbell, directors. The head office is at 100 Adelaide Street West, Toronto. The mine address is Bancroft.

The company holds about 2,600 acres in concessions A, B, IX, X, and XI, Faraday township, Hastings county.

Mining operations began in January, 1954, and continued until December 22. Two adits were driven on claim E.O.5789. The following table shows the amount of development on each at the end of he year:

	Drifts	Crosscuts
	feet	feet
East adit	736	799
West adit	530	424

Diamond-drilling consisted of 56 holes totalling 22,985 feet, from surface, and 49 holes totalling 2,633 feet, from the adits.

About 1,025 feet of surface-trenching, 3 feet deep, was cut.

An office, a core-house, and a sampling- and change-house were built, and a 44,000-volt power transmission line, a mile long, was constructed.

A. W. Jeckell is manager.

Pronto Uranium Mines, Limited

Pronto Uranium Mines, Limited, was incorporated in June, 1953, with an authorized capitalization of 5,000,000 shares of $1 par value, of which 2,400,007 have been issued. The officers and directors are: W. H. Bouck, president; F. R. Joubin, vice-president; F. D. Redfern, secretary-treasurer; G. A. Fallis, J. D. Bateman, J. H. Hirshhorn, D. S. Beatty, and S. G. Sharpe, directors. The head office is at 44 King Street West, Toronto. The mine address is Algoma Mills.

The company owns 139 claims, about 5,560 acres, in Long and Spragge townships, district of Algoma.

Mining operations were carried on from May 18, 1954, to the end of the year. A vertical, three-compartment shaft, called No. 1, was sunk to a depth of 591 feet, and levels were established at 110, 207, 283, 372, and 464 feet from surface.

Diamond-drilling consisted of 126 holes totalling 37,749 feet, from surface, and 7 holes totalling 456 feet, from underground.

The following buildings were erected: 10 staff residences, carpenter shop, pump-house, powder magazine, machine shop, concentrator building, service building, and 250,000-gallon steel water tank.

A 250-kilovolt-ampere, 550-volt, 3-phase, 60-cycle General Electric generator was installed. A two-stage, 2,000-cubic-feet-per-minute Bellis and Morcom air compressor driven by a 400-horsepower electric motor, and a 1,000-cubic-feet-per-minute XVHE-2 Canadian Ingersoll-Rand air compressor driven by a 200-horsepower electric motor, were purchased but not installed.

Most of the work was done by contractors. The company employed an average of 4 men. P. E. Young is manager.

METALLURGICAL WORKS

Algoma Steel Corporation, Limited

The Algoma Steel Corporation, Limited, was incorporated in December, 1934. The authorized capitalization is 4,000,000 shares of no par value, 1,650,800 of which have been issued. The officers and directors are: Sir James Dunn, president; H. G. MacAdam, secretary; W. E. Morley, treasurer; J. A. McPhail, E. G. McMillan, J. A. Simard, L. H. Timmins, Hon. T. A. Crerar, H. S. Hamilton, D. S. Holbrook, G. C. Bateman, P. G. Dunn, and T. R. McLagan, directors. The head office and blast furnaces are at Sault Ste. Marie.

Operations continued throughout 1954. Nos. 1, 2, and 3 blast furnaces did not operate. The following table shows the dates of operation of the other three furnaces, and the number of tons of iron produced by each:

Furnace	Dates of operation	Production
No. 4	November 4–December 31	24,789
No. 5	January 1–November 22	321,516
No. 6	January 1–December 31	317,762
Total		664,067

The sinter plant operated throughout the year and produced 1,105,976 tons of sinter.

A steel and concrete stack, 160 feet in diameter and 250 feet high, was erected.

An average of 432 men was employed, 335 at Sault Ste. Marie and 97 in the sinter plant. Douglas Joyce was blast furnace superintendent.

Canadian Furnace Company, Limited

The Canadian Furnace Company, Limited, was incorporated in June, 1951, to succeed Canadian Furnace, Limited. The authorized capitalization is 50,000 shares of no par value, of which 25,000 have been issued. The officers and directors are: Sir James Dunn, president; H. J. Allen, vice-president and general manager; D. S. Holbrook and E. G. McMillan, vice-presidents; H. G. MacAdam, secretary; J. B. Barber, treasurer; T. R. McLagan, director. The head office is at Sault Ste. Marie. The plant is at Port Colborne.

No. 1 furnace operated for 141 days in 1954 and produced 71,788 tons of pig iron. No. 2 furnace did not operate.

Thomas Cordner is superintendent. An average of 104 men was employed

Canadian Industries, Limited

The sulphuric acid plant of Canadian Industries, Limited, at Copper Cliff continued to operate throughout 1954 and produced 64,532 tons of sulphuric acid, a daily average of 176 tons.

The liquid sulphur dioxide plant operated for 305 days and produced 69,656 tons of liquid sulphur dioxide.

An average of 85 men was employed. R. W. Allgood is works manager.

Cobalt Chemicals, Limited

The Cobalt Chemical and Refinery Company, Limited, was incorporated in January, 1939. In May, 1952, the company was reorganized, and the name was changed to Cobalt Chemicals, Limited. The authorized capitalization is 3,000,000

shares of no par value, of which 2,750,000 have been issued. The officers and directors are: P. H. Hershey, president; A. D. Hellens, vice-president; Samuel Ciglen, secretary-treasurer; L. J. Lichty and N. A. O'Donnell, directors. The address of the head office and plant is Cobalt.

Early in 1954 operations began at the newly equipped, custom smelting and refining plant in the Gillies Limit, district of Timiskaming, about six miles south of Cobalt. The concentrates treated were obtained from mines in the Cobalt and Gowganda areas. Quebec Metallurgical Industries, Limited, operated the plant, and on August 31, 1954, bought all the assets of Cobalt Chemicals, Limited.

The following table shows the production of the plant during 1954:

Refined silver	ounces	114,469
Semi-refined silver	ounces	37,492
Cobalt	pounds	11,087
Copper	pounds	4,014
Arsenic	pounds	102,537

An average of 154 men was employed. V. W. Moore was manager.

Deloro Smelting and Refining Company, Limited

The Deloro Smelting and Refining Company, Limited, was incorporated under Dominion charter in July, 1916. In November, 1936, it was converted into a private company by supplementary letters patent. The officers and directors are: B. A. O'Brien, president; Alan Scott, vice-president and managing director; N. P. Langford, secretary-treasurer; J. A. O'Brien, M. J. O'Brien Jr., J. S. Carter, and W. S. Kirkpatrick, directors. The head office and plant are at Deloro.

Operations at the plant continued throughout 1954. The following table shows the production during the year:

Silver	ounces	2,847,417
Arsenic	pounds	1,085,813
Cobalt metal	pounds	1,065,864
Black cobalt oxide	pounds	28,305
Amorphous cobalt sulphate	pounds	31,103
Nickel oxide	pounds	190,411

An average of 260 men was employed. R. G. Walsh is manager.

Dominion Foundries and Steel, Limited

Dominion Foundries and Steel, Limited, was incorporated in May, 1917, with an authorized capitalization of 80,000 shares of preferred stock of $100 par value and 5,000,000 shares of common stock of no par value. There have been 75,142 preferred shares and 2,400,000 common shares issued. The officers are: F. A. Sherman, chairman of the board; A. G. Wright, president and treasurer; F. A. Loosley and F. H. Sherman, executive vice-presidents; D. F. Hassel, D. O. Davis, A. C. Anderson, and R. R. Craig, vice-presidents. The head office and plant are at Hamilton.

The plant operated throughout 1954.

An average of 72 men was employed. H. C. Taylor is blast furnace superintendent.

Noranda Mines, Limited

Noranda Mines, Limited, was incorporated in May, 1922. The original authorized capitalization was 5,000 shares of $100 par value, which was increased to 10,000 shares of $100 par value in 1924. In 1925 it was increased to 20,000

shares of $100 par value, then changed to 2,000,000 shares of no par value; in 1927 it was increased to 2,500,000 shares of no par value; 2,239,772 shares have been issued. The officers and directors are: J. Y. Murdoch, president and chairman of the board; H. L. Roscoe and J. R. Bradfield, vice-presidents; C. H. Windeler, secretary; R. G. Rudolf, treasurer; Russell Horsfall, assistant secretary; Harold Pinnock, assistant treasurer; F. M. Connell, Hon. G. B. Foster, J. I. Rankin, Hon. Alphonse Raymond, L. H. Timmins, J. R. Timmins, and N. C. Urquhart, directors. The head office is at 44 King Street West, Toronto.

SULPHUR-IRON DIVISION
(Port Robinson Plant)

The company's new sulphur-iron plant near Port Robinson, in Stamford township, Welland county, adjoining the Welland plant of North American Cyanamid, Limited, was completed in 1954. The plant is designed to process iron pyrite and pyrrhotite concentrates from the company's mines. The products are iron sinter, sulphur dioxide gas, and sulphur. The process consists chiefly of a wet pelletizing of the iron sulphide concentrates, followed by two sintering operations. In the first operation the sulphur is removed. The second operation gives an acceptable iron sinter, with a low sulphur content. The sulphur dioxide gas produced in both sintering operations is combined and purified, then piped directly to the North American Cyanamid plant.

Operations began in November, 1954, and test runs were made during the rest of the year.

About 65 men were employed during the period of operation. B. H. Morrison is plant manager. The plant address is Box 185, Niagara Falls.

Steel Company of Canada, Limited

The Steel Company of Canada, Limited, was incorporated in June, 1910, with an authorized capitalization of 2,000,000 preferred shares of $5 par value, and 3,000,000 common shares of no par value. In April, 1953, the capitalization was changed to 5,133,328 common shares of no par value, 3,701,850 of which have been issued. The officers and directors are: R. H. McMaster, chairman of the board; H. G. Hilton, president; G. B. Elwin, vice-president and treasurer; H. M. Griffith and L. T. Craig, vice-presidents; V. W. Scully, vice-president and comptroller; H. S. Alexander, secretary; E. G. Baker, G. R. Ball, W. Taylor-Bailey, Hon. C. A. Dunning, Frederick Johnson, L. L. Lang, R. A. Laidlaw, Hon. S. C. Mewburn, Rt. Hon. Sir Thomas White, directors. The address is Hamilton.

The following table shows the number of days each furnace operated in 1954 and the number of tons of pig iron produced:

Furnace	Operated	Pig iron produced
	days	tons
A	210	51,705
B	127	74,169
C	354	349,326
D	362	459,565
Total	.....	937,765

An average of 251 men was employed. J. S. McMahan is blast furnace superintendent.

INDEX, PART II

NOTE—All places referred to are in Ontario unless otherwise designated.

A

PAGE

Acid plant 113, 142
Acton, England, nickel refinery 111
Adams, G. W. 96
Adamson, J. C. 41
Adanac silver m. 125
Agaunico silver m. 124
Ahern, J. G. 129, 136
Aird, J. B. 139
Alexander, H. S. 144
Alexander iron m. 99
Algom Uranium Mines, Ltd.
  Capital; officers; operations 137, 138
Algoma dist.
  Copper mg. 2
  Iron mg. 99
  Lead mg. 105
  Uranium mg. 138, 139, 141
Algoma Ore Properties, Ltd.
  Capital; officers, operations 98, 99
Algoma Steel Corp., Ltd.
  See also Algoma Ore Properties.
  Capital; officers; operations 142
Allen, Hon. G. E. 102
Allen, H. J. 142
Allen, J. C. 21
Allgood, R. W. 142
American Nepheline, Ltd.
  Capital; officers; operations 106, 107
Anderson, A. C. 143
Andrecheck, E. J. 11
Archibald, C. R. 106
Armstrong, J. E. 128
Armstrong-Booth gold claim 17
Arntfield, D. R. 132
Arntfield, R. V. 132
Asbestos, mining report 1
Ashmore tp., gold mg. 58
Atkin, I. C. R. 111
Augspurger, C. H. 133
Aunor Gold Mines, Ltd.
  Capital; officers; operations 6–8
Ausic Mining and Reduction Co. 137
Avery, S. L. 98

B

Baird tp., gold mg. 60, 82
Baker, E. G. 111, 144
Baker, H. D. 120, 131
Baker J. W. 58
Baker, R. D. 1
Ball, G. R. 111, 144
Ball, H. M. 1
Balmer tp., gold mg. 11, 64
Bancroft area, uranium mg. 139–141
Banner Porcupine Mines, Ltd. 9
Barber, J. B. 99, 142
Barhoff, R. H. 6
Barrington, J. D. 46
Baseline Mines, Ltd. 41
Bateman, G. C. 99, 142
Bateman, J. D. 141
Beaton, N. S. 37
Beattie, I. 24
Beatty, D. S. 141
Beatty tp., asbestos mg. 1

PAGE

Beaucage Mines, Ltd. 139
  Capital; officers; operations 119
Beaudoin, Oscar 129
Beland, J. L. 2
Belzer, L. J. 120
Bender, J. P. 100
Benner, K. J. 106
Bennett, W. E. 104
Berkeley, N. 100
Bethlehem Mines Corp. 100
Big Eddy, power plant 111
Bird, S. J. 60
Birks, R. T. 5
Birmingham, Eng.
  Internat. Nickel Co. mills 111
Bischoff, H. R. 128
Bishop, A. L. 17
Bishop shaft 18
Bixby, P. G. 117
Black, F. H. 102
Black Donald graphite m. 97
Black silver m. 130
Blackwell, Leslie 124
Bland, J. 71, 82
Blast furnaces, iron 142–144
Blind River area.
  Silver claims 124
  Uranium mg. 138, 139
Block, P. D., Jr. 100
Blomfield, A. L. 41
Bonetal gold m. 9
Bonwhit Mines, Ltd.
  Capital; officers; operations 8–10
Boodell, T. J. 132
Botsford, J. H. 93
Bouck, W. H. 63, 75, 138, 141
Boundary nickel m. 108, 110
Boutet, L. 129
Bowell tp., nickel mg. 117
Bowker, C. E. 116, 117
Bowley, F. J. 9
Bradfield, J. R. 5, 6, 27, 65, 144
Brady Lake silver m. 134, 135
Bronson, E. H. 139
Brougham tp., graphite 97
Broulan Reef Mines, Ltd. 8
  Capital; officers; operations 9–11
Brown, A. 1
Brown, J. A. W. 91
Brown, R. H. 115
Brown, R. R. 91
Brown, S. C. 140
Brown, W. F. 9, 11, 34
Brunie, H. C. 24
Bryce, J. D. 79, 140
Bryce, R. A. 48, 79, 98, 140
Buchanan, G. E. 124
Bucke tp.
  Silver mg. 125, 128, 137
  mill 127
Buckles, H. R. 139
Buckles Algoma Uranium Mines, Ltd.
  Capital; officers; operations 139
Budgeon, B. H. 117
Buffalo silver m. 127

PAGE

Burchell, C. J. 102
Burn, M. J. 2
Burns, C. F. W. 75
Burns, J. R. 98
Burt, A. W. 116
Burt, D. F. 106
Burtch, J. H. 120
Burton, F. R. 116
Butler, K. 120

C

Caland Ore Co., Ltd. 104
Capital; officers; operations 100, 101
Calder, M. D. 134
Calvin, C. C. 11, 24, 105, 116, 131
Cam Copper m. 1
Cameron, A. K. 136
Cameron, C. H. 1
Cameron feldspar m. 5
Campbell, A. D. 124
Campbell, A. L. 130
Campbell, G. P. 55
Campbell, H. A. 3
Campbell, R. 107
Campbell Red Lake Mines, Ltd.
Capital; officers; operations 11–13
Canada Radium Corp., Ltd.
Capital; officers; property 120
Canada Talc Industries, Ltd.
Capital; officers; operations 137
Canadian Furnace Co., Ltd.
Capital; officers; operations 142
Canadian Gypsum Co., Ltd.
Capital; officers; operations 97
Canadian Industries, Ltd. 113, 142
Canadian Johns-Manville Ont., Ltd.
Capital; officers; operations 1
Canadian Rock Salt Co., Ltd. 120
Capitol silver m. 121–124
Cardiff Fluorite Mines, Ltd. 139
Cardiff tp., uranium 120, 139, 140
Cardiff Uranium Mines, Ltd.
Capital; officers; operations 139, 140
Carey, G. H. 133
Carmichael, C. H. 119
Carrique, J. S. 129
Carson, J. L. 24
Carter, J. S. 143
Casakirk gold m. 49
Casey Cobalt silver m. 129
Casey tp., silver mg. 129
Cassidy, H. F. 37
Cassidy, L. M. 1
Castle-Trethewey Mines, Ltd.
Capital; officers; operations 120–124
Caty, J. J. 33
Cave, A. E. 21
Cavin, G. A. 34
Cawley, T. 127
Cayia, A. J. 100
Cecil Lake 41
Central Porcupine Mines, Ltd. 17
Capital; officers; operations 14
Centre Lake Uranium Mines, Ltd.
Capital; officers; operations 140
Chalmers, J. J. 128
Chalmers silver claims 134
Chip Mines, Ltd. 41
Chipp, W. G. 101
Chisholm, J. 13

PAGE

Christopher silver m. 125
Ciglen, S. 119, 143
Cincinnati gold claims 77, 79
City of Cobalt silver m. 127
Clearihue, H. B. 105
Clelland, A. D. 132
Cleopatra silver claims 134
Clydach, Wales, nickel refinery 111, 113
Coballoy Mines and Refiners, Ltd. 127
Capital; officers; operations 124
Cobalt Central silver m. 134
Cobalt Chemicals, Ltd.
Capital; officers; operations 142
Cobalt Consolidated Mining Corp., Ltd.
Capital; officers; operations 124–127
Cobalt Lake silver m. 127
Cobalt Lode silver m. 125
Cobalt Lode Silver Mines, Ltd. 124, 127
Cobalt silver area 124–137
Cochenour, E. C. 14
Cochenour, W. M. 14
Cochenour Willans Gold Mines, Ltd.
Capital; officers; operations 14–17
Cochrane, A. L. 58
Cochrane dist.
Asbestos mg. 1
Gold mg. *See* Deloro, Hislop, Murphy, Shaw, Tisdale, Whitney tps.
Cockshutt, Arthur 58
Cockshutt, C. G. 98
Cohan, E. M. 118
Cohen, Louis 132
Coleman Development silver m. 134
Coleman tp., silver mg. 124–137
Colonial silver m. 124–127
Columbium, mg. report 119
Columbus silver m. 125
Coniaurum Mines, Ltd. 14
Capital; officers; operations 17–21
Coniston, smelter 111, 115
Conley talc m. 137
Connell, F. M. 27, 34, 144
Connell tp., gold mg. 71
Consolidated Golden Arrow Mines, Ltd. 1
Consolidated Mosher Mines, Ltd.
Capital; officers; operations 21
Consolidated Sudbury Basin Mines, Ltd.
Capital; officers; operations 3–5
Cook, C. E. 68, 71
Cooper, L. H. 111
Cooper, M. 134
Cooper, R. W. 98
Copper, mining reports 1–5
See also Nickel-copper.
Copper Cliff.
Acid plant 142
Nickel-copper. *See* Internat. Nickel Co. of Can.
Cordner, T. 142
Cordon Cobalt Mines, Ltd.
Capital; officers; operations 128
Cort, S. J. 100
Crabtree, M. 105
Cradock, Eric 118
Craig, Ernest 106
Craig, L. T. 144
Craig, R. R. 143
Craig, W. J. 93

PAGE

Crang, J. H. 140
Cranston, R. A. 33, 140
Crawford, G. C. 132
Crayston, E. G. 63
Crean Hill nickel m. 115
Creighton nickel m. 113, 115
Creighton tp., copper-zinc mg. 3
Crerar, Hon. T. A. 142
Crocker, B. S. 117
Croft Uranium Mines, Ltd.
Capital; officers; operations 140
Cross, J. G. 102
Crossin, H. W. 132
Crown Reserve silver m. 126
Cryderman, J. R. 46
Cubar Uranium Mines, Ltd.
Capital; officers; operations 6
Cullen, H. J. 115
Cumming, R. D. 3
Cunningham, L. 131
Cunningham-Dunlop, J. M. 3, 14, 17, 21, 107, 131, 140
Custis, W. E. 6

D

Daley, W. R. 102
Dalton, J. A. 37
Dana tp., garnet mg. 6
Darrach, C. S. 115
Davidson, W. T. 96
Davis, D. O. 143
Day, Bernhard 133
Day, T. J. 91, 118
Dean, Dalton 124
De Camps, E. B. E. 124
Deeth, H. R. 106
Deller, C. B. 106
Delnite Mines, Ltd.
Capital; officers; operations 21–24
Deloro Smelting and Refining Co., Ltd.
Officers; operations 143
Deloro tp., gold mg. 6, 21, 64, 68
Demers, A. 2
Dennis, W. W. 105
Desilets, A. 136
Detta Minerals, Ltd.
Capital; officers; operations 106
Dickenson Red Lake Mines, Ltd.
See New Dickenson Mines.
Dickson, J. A. 91
Diebold, C. R. 64
Dike, K. C. 6
Dix, W. B. 52, 120
Dixon, L. C. 41
Dixon, S. G. 98
Dobbie, S. G. 98
Doggett, G. F. 41
Dome Mines, Ltd. 11
Capital; officers; operations 24–27
Dome tp., gold mg. 14, 55
Dominion Foundries and Steel, Ltd.
Capital; officers; operations 143
Dominion Magnesium, Ltd.
Capital; officers; operations 105, 106
Donnelly, J. C., mica mg. 106
Dorfman, André 34
Douglas, Hon. L. W. 111, 115
Dow, R. G. 115
Drybrough, J. 116
Duck, G. M. 120

PAGE

Dumulon, M. 124
Duncan, J. S. 111
Duncan tp., lead mg. 105
Dunlap, D. M. 29
Dunn, Sir James 98, 142
Dunn, Lady Marcia 98
Dunn, P. G. 142
Dunning, Hon. C. A. 144

E

East nickel m. 108, 110
East Rim Nickel Mines, Ltd. 118
Eaton, C. S. 102
Echo tp., molybdenite 106
Edmonstone, N. 102
Edward, B. G. 97
Elk Lake area, copper mg. 2
Elliot Lake uranium property 138
Elliott, H. C. 101
Elliott, J. L. 105
Elliott, R. M. 14
Elwin, G. B. 144
Elzevir tp., talc mg. 137
Emery, V. H. 37
Entrekin, P. B. 100
Eplett silver claims 134, 135
Errington copper m. 3, 4
Errington iron m. 102–104
Errington tp., gold mg. 21, 58
Essex co., salt 120
Eston tp., uranium mg. 139
Eva tp., gold mg. 46
Ex-Mother Lode Mines, Ltd.
Capital; officers; operations 2

F

Fahlgren, J. E. J. 17
Fairbank tp., copper-zinc mg. 3
Falconbridge Nickel Mines, Ltd.
Capital; officers; operations 107–110
Fallis, G. A. 138, 141
Faraday tp., uranium mg. 140, 141
Faraday Uranium Mines, Ltd.
Capital; officers; operations 141
Farr tp., cobalt mg. 133
Fecunis nickel-copper m. 108–110
Feldspar, mining report 5
Fell, F. A. 65
Ferland silver claims 134
Feuer, A. J. 68
Findlay, R. E. 8, 64
Finlay, P. C. 29
Fischer, C. C. 117
Fisher, A. R. 1
Fisher silver claims 134, 135
Fluorspar, mining report 5, 6
Foskett, W. W. 41
Foster, D. A. 5
Foster, G. B. 114
Foster silver m. 126
Fotheringham, M. S. 102
Fox, E. D. 52
Foy, B. C. 24
Foy tp., nickel mg. 117
Fraser, H. J. 107
Fraser, J. C. 52
Freeborn tp., iron mg. 102
Frobisher, Ltd. 97
Frood-Stobie nickel m. 113–115

PAGE

Fuller, A. S. 68
Fulton, A. G. 3, 17, 140
Fyshe, T. M. 64, 137

G

Gale, B. L., Jr. 117
Garbutt, W. R. 131
Garnet, mining report 6
Garson nickel m. 113, 115
Gauthier tp., gold mg. 91
Geco Mines, Ltd.
Capital; officers; operations 5
Geist, B. L. 133
Genesee silver m. 137
Gerhard, P. H. 93
Gibbs, F. B. 98
Gilchrist, G. G. 90
Gilgreer Mines, Ltd. 124
Gill, J. E. 119
Gillespie, J. E. 98
Gillies Limit.
Silver mg. 124, 128, 130, 134
refinery 143
Gillies silver m. 134
Girdwood, C. P. 27
Glasgow, Scotland.
Internat. Nickel Co. mills 111
Gold, Aaron 2
Gold mines.
Operations, reports on 6–97
Goldale shaft 17, 18
Goldberg, S. M. 132
Gordon, J. R 111, 115
Gough, L. N. 130
Gough, N. E. 130
Gowganda silver area.
See Haultain, Nicol tps.
Graber, Karl 119
Graham, J. A. 5
Grant, A. M. 119
Graphite, mining report 97
Gray, J. J. 124
Gray, K. C. 6, 21, 84
Green, W. T. 115
Griffith, H. M. 144
Grimes, M. 128
Guerin, T. 129, 136
Gulick, L. R. 21, 84
Gypsum, mining reports 98
Gypsum, Lime and Alabastine, Canada, Ltd.
Capital; officers; operations 98

H

Hackett, J. A. 33
Hackney, R. 1
Hagersville, gypsum 98
Haldimand co., gypsum mg. 98
Haley. *See* Dominion Magnesium, Ltd.
Haliburton co., uranium mg. 120, 139, 140
Hall, F. E. 46
Hall, G. A. 133
Hall, L. I. 75, 138
Hallnor Mines, Ltd.
Capital; officers; operations 27–29
Halstead, M. C. 105
Hamilton, C. S. 71, 82
Hamilton, H. S. 99, 142

PAGE

Hamilton, P. D. H. 5
Hamilton, R. M. P. 5
Hamilton, blast furnaces 143, 144
Hammell, J. E. 71, 82
Hammerston, W. 132
Hard Rock gold m. 21
Hardy nickel-copper m. 108–110
Harriman, L. G. 117
Harris, H. 134
Harris tp., silver claims 129
Harrison, W. 5
Harrison-Hibbert Mines, Ltd. 137
Capital; officers; operations 128, 129
Hart, R. C. 138
Hassel, D. F. 143
Hastings co.
Fluorspar mg. 6
Iron mg. 100, 101
Talc mg. 137
Uranium mg. 140, 141
Hattie, A. G. 71, 75, 82
Haultain tp., silver mg. 120, 133, 136
Hawker, Ernest 2
Hayden, S. A. 75, 138
Hayes, K. P. 98
Healy, R. L. 93, 96
Heard, H. R. 64, 128
Helen iron m. 99
Hellens, A. D. 124, 143
Hellens Mining and Reduction Co., Ltd. 124, 126
Henderson talc m. 137
Henson, R. C. 118
Herdman, L. C. 131
Herschel tp., uranium 140
Hershey, P. H. 124, 143
Hewett, F. V. C. 93
Hewgill, R. 115
Heyson tp., gold mg. 60
High Falls, power plant 111
Hill, M. 134
Hilliard, A. E. 130
Hilton, C. M. 41
Hilton, H. G. 144
Hirshhorn, J. H. 75, 138, 139, 141
Hislop tp., gold mg. 33
Hobson, N. C. 120
Hochstetter, R. 117
Hodgson, W. L. 120
Hogarth iron m. 102–104
Holbrook, D. S. 98, 142
Hollinger Consol. Gold Mines, Ltd.
See also Young-Davidson Mines.
Capital; officers; operations 29–33
Horsfall, Russell 27, 144
Howes, G. A. 48, 79
Hubler, W. G. 106
Hudson Bay silver m. 128
Huffine, K. W. 1
Hugh-Pam Porcupine Mines, Ltd. 9, 10
Capital; officers; operations 33, 34
Hunt, F. P. 139
Huntingdon Fluorspar Mines, Ltd.
Capital; officers; operations 5, 6
Huntingdon tp.
Fluorspar mg.
Talc mg. 137
Huntington, W. Va., nickel mill 111, 114
Hutchinson, W. J. 111, 115
Hutchison, W. A. 75, 79, 138

PAGE

Huycke, G. M. 71, 82
Hyduke, N. 102

I

Ingram, J. 34, 63
Inland Steel Co. 100
International Nickel Co. of Can., Ltd.
Capital; officers; operations 110–115
Iron.
Blast furnaces 142–144
Mining reports 98–104

J

Jackson, Basil 132
James, W. F. 9, 11, 107, 136
James tp, copper mg. 2
Jamieson, W. S. 137
Jardun Mines, Ltd.
Capital; officers; operations 105
Jarvis tp., lead mg. 105
Jeckell, A. W. 141
Jennings, M. R. 106
Jodrey, R. A. 64, 76, 87
John Black silver m. 130
Johnson, F. 144
Johnson, G. H. 118
Johnston, B. 21
Jonsmith Mines, Ltd.
Capital; officers; operations 115, 116
Jordan tp., gold claims 21
Joseph, L. S. 132
Joubin, F. R. 75, 137, 139, 141
Jowsey, R. J. 105
Joyce, D. 142
Juno Metals Corp., Ltd.
Capital; officers; operations 129

K

Kay, Stephen 139
Keith, W. H. 87
Kenmey, J. J. 119
Kennedy, John 119
Kennedy, W. F. 111
Kenny, A. R. 133
Kenora dist.
See also Patricia portion.
Gold mg. 21
Kenora Nickel Mines, Ltd. 110
Kerr, T. M. 119
Kerr-Addison Gold Mines, Ltd.
Capital; officers; operations 34–37
Kerr Lake silver m. 126
Keylode Cobalt Silver Mines, Ltd. 124
Killebrew, R. H. 75
Killian, P. S. 100
Kilpatrick, J. M. 118
King, B. T. 115
King, Garfield 120
Kirkland, J. C. 5
Kirkland Lake gold area.
See Gauthier, Teck tps.
Kirkland Lake Gold Mining Co., Ltd.
Capital; officers; operations 37–41
Kirkpatrick, W. S. 143
Klopstock, P. M., Jr. 130
Knode, O. M. 98
Knox, S. H. 117
Koenig, C. J. 107
Kreiner, W. E. 93

PAGE

Kristiansand, Norway.
Nickel refinery 107, 109
Kristina Copper Mines, Ltd.
Capital; officers; operations 2

L

La Bine, G. A. 87
Lafontaine, W. O. 14, 21
Laidlaw, R. A. 144
Laing, A. L. 101
Lake Nipissing, niobium-uranium deposits 119, 139
Lake Shore Mines, Ltd.
Capital; officers; operations 41–46
Lake tp., iron mg. 101
Lanark co., mica mg. 106
Landers, Vincent 129
Lang, B. W. 9
Lang, D. W. 117
Lang, L. L. 144
Langford, G. B. 75, 138
Langford, N. P. 143
Langis Silver and Cobalt Mining Co., Ltd.
Capital; officers; operations 129
Langley, S. 55
La Palme Porcupine gold claims 65
Larder Lake gold area 35
Larkin, J. M. 100
La Rose silver m. 134, 135
Lavender, S. 101
Law, R. B. 64, 106
Law silver claim 128
Lawson, F. G. 9
Lawson silver m. 134, 135
Lead-zinc, mining reports 3–5, 105
Leather, H. 34
Lee, M. G. 75
Leeson tp., gold mg. 79
Leguerrier, A. 2
Leitch Gold Mines, Ltd.
Capital; officers; operations 46–48
Leonard, C. R. 48
Levack nickel m. 113, 115
Lichty, L. J. 143
Lindell, K. V. 1
Lindsay, W. W. 68
Lindsley, Thayer 3, 17, 21, 106, 107
Loffree, H. A. 128
Logan, H. J. 2
Long tp., uranium mg. 141
Longvack nickel-copper m. 108, 110
Loosley, F. A. 143
Lord, R. D. 79
Lost Lake Mines, Ltd. 136
Capital; officers; operations 129, 130
Loveland, A. 133
Lumsden silver m. 134
Lynch, J. B. 129, 136

M

MacAdam, H. G. 98, 142
Macassa Mines, Ltd.
See also Renabie Mines.
Capital; officers; operations 48–51
McAteer, F. M. 115
McBean, J. W. 91
McBrien, W. W. 46
McCallum, F. N. 101
McCausland, J. K. 11
McClelland, J. H. C. 46

PAGE
McCloskey, A. A. 82
McCloskey, P. H. 87
McConnell, J. E. 98
McCullagh tp., gold mg. 71
McDonald, D. A. 133
MacDonald, I. A. 105
McDonough, J. 60
McDougald, J. A. 29, 55
McDougall, D. H. 52, 102, 119, 120
McGarry tp., gold mg. 35
McGowan, Rt. Hon. Lord 111
McIlmurray, L. W. 64, 106, 128, 137
Macintosh, J. M. 58, 115
McIntyre Porcupine Mines, Ltd.
Capital; officers; operations 52–55
McKay, A. R. 96
McKay, A. R. W. 96
McKay, G. A. 48
Mackay, Hugh 60
MacKay, J. F. 120
McKee, Mark 102
McKenzie Red Lake Gold Mines, Ltd.
Capital; officers; operations 55–57
McKim nickel-copper mg. 108, 110
McKinley-Darragh silver m. 127
McKinney, F. T. 120
McLagan, T. R. 142
McLaughlin, D. H. 111
McLaughlin, R. S. 52, 111
McLean, H. B. 126
MacLeish, J. E. 98
MacLennan tp., nickel mg. 118
MacLeod, E. C. 115, 116
MacLeod, F. G. 58, 115
McLeod, G. D. 124
MacLeod, G. W. 98
MacLeod-Cockshutt Gold Mines, Ltd.
Capital; officers; operations 58, 59
McMahan, J. S. 144
McMartin, A. A. 29
McMaster, R. H. 144
McMath, R. E. 100
McMillan, E. G. 99, 142
MacMillan, H. R. 111
McNair, M. A. 128
McPhail, D. J. 106
McPhail, J. A. 98, 142
McQuire, R. C. 115
McWhirter, J. T. 140
Madoc.
Fluorspar mg. near 5
Talc mg. near 137
Madsen, Marius 60
Madsen Red Lake Gold Mines, Ltd.
Capital; officers; operations 60–63
Maedel, W. H. 33
Magee, E. B. 64
Mag-Iron Mining and Milling, Ltd.
Capital; officers; operations 101
Magnesium 105, 106
Maguire, W. S. 87
Malone, W. B. 17
Manitou Islands 119, 139
Manitouwadge Lake area 41
Copper-zinc mg. 5
Marcus, M. 132
Marcus Gold Mines, Ltd. 14, 17
Margesson, Rt. Hon. Viscount 111
Marmion Lake, gold mg. 75
Marmora tp., iron mg. 100
Marmoraton Mining Co., Ltd. 100
Marshall, F. R. 60, 139
Marshall, G. M. 118
Marshall, W. J. 29
Masterman, C. M. 129, 136
Masterson, M. 60
Matachewan area.
Copper mg. 3
Gold mg. 96
Matthews, A. B. 24
Maxwell, W. B. 106, 107
Mayfair Mines, Ltd. 133
Capital; officers; operations 130, 131
Megan, Graydon 100
Menasse, Ray 133
Mensilvo Mines, Ltd. 133
Capital; officers; operations 131
Merica, P. D. 111, 115
Metallurgical works, operations 142–144
Methuen tp., nepheline syenite 107
Mewburn, Hon. S. C. 144
Meyers, John 134
Mica, mining report 106
Michel, C. W. 11, 24
Michener, D. R. 9, 140
Midcamp Mines, Ltd. 77, 79
Capital; officers; operations 63, 64
Miller, E. L. 93
Miller, G. F. 93
Miller, H. G. 137
Miller, R. E. 140
Miller Lake area, silver mg. 124
Mills, F. J. 14
Milner, H. R. 120
Milnet Mines, Ltd.
Capital; officers; operations 116, 117
Milrot, B. 129
Mockridge, H. C. F. 111
Molybdenum, mining report 106
Mond Nickel Co., Ltd. 113
Montague, T. G. 111
Moore, V. M. 143
Moot, W. V. 21, 84
Morley, W. E. 99, 142
Morlock, W. S. 3, 17, 107
Morrison, B. H. 144
Morrison silver m. 129, 130
Mosher, M. C. 14, 21
Mosher Long Lac Gold Mines, Ltd. 21
Mott, R. C. 110
Mount Nickel nickel m. 108, 110
Mumford, E. E. 115
Mungovan, T. 14
Munro tp., asbestos mg. 1
Munroe, G. V. 75
Munson, E. L. 133
Murchison tp., feldspar mg. 5
Murdoch, J. Y. 6, 27, 29, 34, 63, 65, 95, 144
Murphy, F. G. 115
Murphy, Ivy 139
Murphy tp., gold mg. 9
Murray, C. L. 124
Murray nickel m. 113, 115

N

Nairn Falls, power plant 111
Nancy Helen silver m. 127
Nauss, H. E. 21
Neilly, Balmer 52, 120
Nepheline syenite, mining report 106, 107

PAGE

New Dickenson Mines, Ltd. 106
Capital; officers; operations 64, 65
New Mosher Longlac Mines, Ltd. 21
New Ryan Lake Mines, Ltd.
Capital; officers; operations 3
Newfoundland, nickel-copper mg. 110
Newray gold m. 17
Niagara Garnet Co. 6
Nickel-copper, mining reports 107–119
Nickel Offsets, Ltd.
Capital; officers; operations 117
Nickel Rim Mines, Ltd.
Capital; officers; operations 118
Nicol tp., silver mg. 120, 129, 136
Niemeyer, Sir Otto E. 111
Niobium, mining report 119
Nipissing dist.
Cobalt mg. 133
Feldspar mg. 5
Garnet mg. 6
Niobium-uranium deposits 119, 139
Nipissing-O'Brien Mines, Ltd.
Capital; officers; operations 131, 132
Noblet, F. M. A. 111, 115
Noranda Mines, Ltd.
Capital; officers; operations 143, 144
Nordic uranium property 138
Norman tp., nickel mg. 115
North American Cyanamid, Ltd. 144
North Burgess tp., mica mg. 106
Northern Canada Mines, Ltd. 41
Norway, nickel refinery 107, 109
Nova Scotia silver m. 124

O

O'Brien, B. A. 131, 143
O'Brien, J. A. 143
O'Brien, M. J., Jr. 143
O'Brien Mines, Ltd. 127
O'Brien silver m. 131
O'Day, M. F. 120
O'Donnell, N. A. 143
Olsen, H. O. 100
Oneida tp., gypsum 98
Ontario Nickel property 118
Ontario Pyrites Co., Ltd. 3
Ophir silver m. 133
O'Reilly, E. L. 68
Osborn, A. F. 21, 84
Ott, E. E. 128
Otty Lake mica m. 106
Ox Lake feldspar m. 5

P

Pacaud tp., copper mg. 2
Palmer, R. F. 99
Pamour Porcupine Mines, Ltd.
Capital; officers; operations 65–67
Pan Silver silver m. 134
Parker, Jane 5
Parker, R. D. 115
Parkin tp., nickel mg. 115, 116
Parsons, J. H. 105
Paterson, J. A. H. 5
Paterson, John 102
Patricia portion of Kenora.
Gold mg. *See* Pickle Lake area; Red Lake area.
Molybdenum mg. 106
Nickel mg. 119

PAGE

Pattison, G. D. 119
Paymaster Consolidated Mines, Ltd. 64
Capital; officers; operations 67–71
Pearson, E. A. 130
Pearson, P. D. 101
Pecors Lake uranium property 138
Penn-Canadian silver m. 126
Penn-Cobalt Silver Mines, Ltd. 124, 126
Peoples silver m. 130
Pepall, G. T. 139
Perrin, J. D. 48
Perry, E. A. 29
Perry, J. C. 87
Perry, S. A. 119
Pershing, F. W. 24
Peterborough co.
Nepheline syenite 107
Peterkin, Daniel 120
Peters, R. L. 100
Peterson, A. F. 100
Pickle Crow Gold Mines, Ltd.
Capital; officers; operations 71–75
Pickle Lake area, gold mg. 71
Pidgeon, L. M. 106
Pinnock, Harold 27, 144
Pistol Lake uranium property 138
Pittsburgh Cobalt Silver Mining Co., Ltd. 125
Pittsonto Mines, Ltd. 128
Plator Gralouise Gold Mines, Ltd.
Capital; officers; operations 75
Plator Porcupine Gold Mines, Ltd. 75
Pollard, J. G. 133
Poole, H. D. 14
Porcupine gold area.
Asbestos mg. 1
Gold mg. *See* Deloro, Murphy, Shaw, Tisdale, Whitney tps.
Porcupine Grande gold m. 65
Porcupine Lake 24
Porritt, R. V. 63, 91
Port Colborne.
Blast furnace 142
Nickel refinery 111–113, 115
Port Robinson, sulphur-iron plant 144
Porteous, H. M. 48, 79
Poulin, A. 2
Powell tp.
Copper mg. 3
Gold mg. 96
Prain, R. L. 111
Pratt, H. L. 133
Preston East Dome Mines, Ltd. 64
Capital; officers; operations 75–79
Price, J. H. 126, 127
Princess silver m. 134
Pronto Uranium Mines, Ltd.
Capital; officers; operations 141
Pryale, H. M. 68
Puddy Lake, iron claims 41

Q

Quebec Metallurgical Industries, Ltd. 143
Quebec Nickel Corp., Ltd.
Capital; officers; operations 119
Quirk Lake uranium property 138

R

Radium 120
Rainville, G. H. 65

PAGE
Rainy River dist.
Gold mg. 75
Iron mg. 102
Ramardo Mines, Ltd.
Capital; officers; operations 132
Rankin, J. I. 29, 144
Ranta, M. B. 101
Rassweiler, C. F. 1
Rattray, J. H. 34
Rawdon tp., iron mg. 100
Raymond, Hon. A. 29, 144
Rea, T. H. 17, 21
Red Lake gold area.
See Baird, Balmer, Dome, Heyson, Todd tps.
Redfern, F. D. 139, 141
Redpath, J. B. 11, 24
Reef gold m. *See* Broulan Reef Mines.
Reef Point iron m. 102
Refineries.
Nickel 107–109
Silver 143
Reid, F. D. 17
Reilly, J. D. 128
Reliance silver m. 129
Rembert, E. 98
Renabie Mines, Ltd.
Capital; officers; operations 79–82
Renfrew co.
Graphite 97
Magnesium 106
Rennie tp., gold mg. 79
Richardson, A. L. A. 107
Right of Way silver m. 126
Ritchie, E. E. 116
River Valley, garnet 6
Rix, J. C. 106
Roberts, A. K. 21
Robertson, Andrew 119
Robinson, J. H. 98
Robinson, S. H. 46
Robson, W. T. 46
Rochester silver m. 134
Rockefeller, L. S. 111
Roscoe, H. E. 137
Roscoe, H. L. 27, 34, 65, 137, 144
Rosen, A. E. 119
Ross, A. C. 96
Ross gold m. 31–33
Ross tp., magnesium 106
Rothwell, H. D. 68
Row, W. S. 6, 37
Roy Silver Mines, Ltd.
Capital; officers; operations 132, 133
Ruby silver m. 128
Rudd, H. E. 59
Rudolf, R. G. 6, 27, 63, 65, 144
Rutherford, F. 129
Ryan Lake Mines, Ltd. 3

S

Saddington, R. R. 115
Sadler, H. F. 98
Salt, mining report 120
Salter, W. R. 137
Salthouse, H. W. 48, 79, 140
Sandwich West tp., salt 120
Sault Ste. Marie, blast furnaces 142
Savage, James 21
Savage, L. A. 6

PAGE
Schlottman, R. H. 100
Schmitt, D. E. G. 67
Schwenger tp.
Gold mg. n. of 75
Iron mg. 102
Scott, Alan 131, 143
Scott, E. D. 14
Scott, George 33, 132, 134
Scully, H. D. 106
Scully, V. W. 144
Seguin, A. H. 60
Seneca tp., gypsum 98
Sexsmith, R. N. 139
Sharp, G. C. 111
Sharp, A. H. 21, 84
Sharpe, S. G. 87, 141
Shartner, G. 130, 136
Shaver, C. H. 98
Shaw, E. W. 75
Shaw, I. W. 75
Shaw tp., gold mg. 24
Shell, E. W. 99
Sherman, F. A. 143
Sherman, F. H. 143
Shipley, G. B. 111
Signal Oils and Metals Co., Ltd. 129
Silanco Mg. and Refining Co., Ltd. 124, 162
Silver.
Mining reports 120–137
Refineries 143
Silver Banner silver m. 133
Silver Bar silver m. 131
Silver Cliff silver m. 137
Silver Crater Mines, Ltd.
Capital; officers; operations 133
Silver Hill silver m. 134
Silver-Miller Mines, Ltd.
Capital; officers; operations 134–136
Silver Mountain silver m. 134
Simard, J. A. 142
Simons, H. L. 3
Simpson Lake 24
Siscoe Metals of Ontario, Ltd. 129
Capital; officers; operations 136
Slaght, A. G. 48
Smelters.
Nickel-copper 107–113, 115
Silver 143
Smith, A. G. 128
Smith, B. E. 52, 120
Smith, E. G. 120
Smith, G. C. 136
Smith, H. W. 115
Smith, V. H. 119
Smith, W. A. 140
Smith, W. D. 34
Smith, William 58
Snively, A. C. 55
Snyder, F. H. 9
Sobey, F. H. 120
Soliague, L. 48, 79, 140
South Lorrain tp., silver mg. 124, 133
Sparrow, J. G. 97
Spragge tp., uranium mg. 141
Springer, K. J. 46
Staines, R. 129
Stamford tp.
Sulphur-iron plant 144
Stanol Minerals, Ltd.
Capital; officers; operations 101, 102

PAGE

Starratt Olsen Gold Mines, Ltd.
Capital; officers; operations....82, 83
Stavert, R. E.... 111
Steel Co. of Canada, Ltd.
Capital; officers; operations.... 144
Steep Rock Iron Mines, Ltd.... 100
Capital; officers; operations....102–104
Steinke, A. E.... 102
Steinke, W. F.... 101
Stellner, F. L.... 98
Stephenson, J. W.... 87
Stern, M. F.... 24
Stewart, C. H.... 115
Stewart, C. H. E.... 14
Stewart, James.... 106
Stewart, R.....125, 126, 129
Stoneman, E. G.... 115
Stovel, J. H.... 24
Stratford, H. R.... 120
Strathy tp., cobalt mg.... 133
Stratton, J. R.... 115
Streit, J. B.... 9, 33
Streit, J. D.... 134
Strong, H. F.... 129
Strong Bow gold claims.... 17
Sudbury dist.
Copper-lead-zinc mg.... 5
Gold mg.... 79
Nickel-copper mg.....107–118
Sullivan, F. C.... 3, 21
Sulphuric acid plant.....113, 142
Sulphur-iron plant.... 144
Summers, G. F.... 91
Summers tp., gold mg.... 46
Superior copper m.... 2
Sylvanite Gold Mines, Ltd.
Capital; officers; operations....84–87
Symon, Alein.... 5
Symon, W. J.... 5
Symons, J. T.... 124

T

Talc, mining report.... 137
Tapley, P. N.... 87
Tashota area, copper.... 41
Taylor, A. S.... 128
Taylor, D. G.... 2
Taylor, H. C.... 143
Taylor, Samuel.... 120
Taylor, W. D.... 131
Taylor-Bailey, W.... 144
Teck-Hughes Gold Mines, Ltd.
Capital; officers; operations....87–90
Teck tp., gold mg.....37, 41, 48, 84, 87, 93
Thoday, G. P.... 125
Thompson, J. F.....111, 115
Thomson, D. D.... 119
Thomson, R. H.... 119
Three Nations gold m.... 65
Thunder Bay dist.
Copper-zinc.... 5
Gold mg.....21, 46, 58
Tilley, E. A.... 6
Timiskaming dist.
Copper mg.... 1–3
Gold mg. *See* Kirkland L. area; McGarry, Powell tps.
Silver-cobalt mg.....120–137
refinery.... 143

PAGE

Timmins, J. R.....29, 63, 65, 144
Timmins, L. H.....27, 29, 65, 142, 144
Timmins, N. A., Jr.... 29
Tisdale, N. F.... 118
Tisdale tp.
Gold mg....9, 14, 17, 24, 29, 52, 64, 68, 76
Townsite silver m.... 127
Towson, A.... 128
Traphagen, J. C.... 111
Trethewey-Ossian copper m.... 2
Trinova Cobalt Silver Mines, Ltd.... 124
Trout Lake silver m.... 132
Tudhope tp., copper mg.... 2
Tyler, P. P.... 98
Tyrrell, J. B.... 37

U

United Cobalt Mines, Ltd.
Capital; officers; operations.... 137
University silver m.....134, 136
Upper Canada Mines, Ltd.
Capital; officers; operations.....91–93
Uranium, mining reports.....119, 137–141
Urquhart, M. L.... 55
Urquhart, N. C.....5, 6, 137, 144

V

Vail, R. C.... 120
Valin, K. R.... 119
Van Meter, Russell.... 5
Varley, S. R.... 120
Vermillion Lake copper m.... 3, 4
Victoria lead m., Alg.... 105
Victoria iron m.... 99

W

Wabageshik, power plant.... 111
Wainberg, J. M.... 134
Walker, E. H.....63, 68
Walsh, R. G.... 143
Walton, W. S.....21, 37, 84
Warren, R. W.... 57
Watt, Alexander.... 83
Watten tp., iron mg.... 102
Wechsler, I. A.... 132
Weir, J. G.... 106
Weir, Rt. Hon. Viscount.... 111
Weldon, L. S.... 29
Welsh, E.... 3
Welsh, G. S.... 3
Wende, Albert.....41, 117
Wende, H. H.... 117
Werner Lake area, nickel mg.... 119
Westell, J. H.... 118
Weston, W. G.... 64
White, A. W.....64, 106, 128, 137
White, L. G.... 106
White, Sir Thomas.... 144
White, W. G.... 130
Whitehorn, C. R.... 111
Whitelaw, A. B.... 115
Whitley, R. A.... 105
Whitney tp. gold mg.....9, 24, 27, 34, 65
Wilkinson, W. R.... 1
Wills, D. R.... 133
Windeler, C. H.....6, 27, 63, 65, 137, 144
Wingate, H. S.....111, 115
W. J. 9 silver m.....129, 130
Wollaston tp., iron mg.... 101

PAGE
Woods, W. H.....14, 131, 140
Wright, A. G..... 143
Wright, E. B..... 107
Wright-Hargreaves Mines, Ltd.
Capital; officers; operations.....93–96
Wylie, J. C..... 131
Yackso, Steven..... 105
Yates, Harry.....21, 84
Young, H. G.....55, 60
Young, P. E..... 141
Young-Davidson gold m.,
operations.....32, 96, 97
Young-Davidson Mines, Ltd.
Capital; officers.....96, 97

Z

Zinc, mining reports..... 3–5

Box #2

INTRODUCTORY LETTER

To the Honourable Philip T. Kelly,
Minister of Mines.

Sir,—The undersigned has the honour to submit the Sixty-fourth Annual Report of the Department of Mines, issued in eights parts, as follows:

Part 1

Statistical Review of the Mineral Industry for 1954, by M. G. Arnoldi.
Mining Accidents in 1954, by the Staff of the Mines Inspection Branch.
Classes for Prospectors, 1954–55, by W. D. Harding.

Part 2

Mining Operations in 1954, by D. J. Field.

Part 3

Geology of the Montreal River Area, with map No. 1955-1, by E. W. Nuffield.

Part 4

Geology of the O'Sullivan Lake Area, with map No. 1955-2, by W. W. Moorhouse.

Part 5

Geology of the Miller Lake Portion of the Gowganda Silver Area, with map No. 1955-3, by E. S. Moore.

Part 6

Geology of Lount Township, with map No. 1955-4, by J. Satterly.

Part 7

Pleistocene Geology and Ground-Water Resources of North York Township, with maps Nos. 1955-6 and 1955-7, by A. K. Watt.

Part 8

Geology of Dungannon and Mayo Townships, with map No. 1955-8, by D. F. Hewitt.

Respectfully submitted,

H. C. Rickaby,
Deputy Minister of Mines.

Department of Mines,
Toronto, 1955.

Box #2



PROVINCE OF ONTARIO

DEPARTMENT OF MINES

HON. PHILIP T. KELLY, *Minister of Mines* H. C. RICKABY, *Deputy Minister*

M. E. HURST, *Provincial Geologist*

SIXTY-FOURTH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. LXIV, PART 3, 1955

Geology of the Montreal River Area

By

E. W. NUFFIELD

PRINTED BY ORDER OF

THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO

Printed and Published by Baptist Johnston, Printer to the Queen's Most Excellent Majesty

1956

TABLE OF CONTENTS

Vol. LXIV, Part 3

	PAGE
Introduction	1
Acknowledgments	2
Means of Access	2
Previous Geological Work	3
Topography	4
General Geology	7
Table of Formations	7
Pre-Algoman	7
Algoman (?)	7
Keweenawan	8
Lower Keweenawan	8
Middle Keweenawan	9
Upper Keweenawan	10
Pleistocene and Recent	10
Economic Geology	11
Copper	11
Uranium	11
Showings in Granite or Pegmatite	12
Showings in or near and related to Diabase	13
Properties	13
Batachawana Uranium Mines, Limited	13
Economic Geology—*Continued*	
Properties—*Continued*	
Bobcam Mines, Limited	13
Breton Showing	14
Camray Mines, Limited	15
Canagau Mines, Limited, and Dickenson Properties	20
Franz Property	20
Jalore Mining Company, Limited	21
La Bine-McCarthy Uranium Mines, Limited	21
Murmac Lake Athabaska Mines, Limited	24
Patrick Uranium Mines, Limited	24
Ranson Dike Showings	25
Falconbridge Nickel Mines, Limited	25
Ranwick Uranium Mines, Limited	25
F. D. Roche Property	26
Summary	26
Prospecting and Development	29
Future of the Area	30
INDEX	31

ILLUSTRATIONS

	PAGE
Theano Point from across Alona Bay	1
Typical view of the rocky shore of Lake Superior	3
Crevice formed by the erosion of a diabase dike	4
Lake Islay	5
The Montreal River near its mouth	6
Faulted aplite cutting diabase dike	8
Alona Bay	9
Ossifrage Island	13
The cove in which Robert Campbell made his discovery of pitchblende	17
Bunk-house and cookery of Camray Mines, Limited	19
A granite point, Montreal River harbour	23

KEY MAP AND GEOLOGICAL SKETCH MAPS

	PAGE
Key map showing the location of the Montreal River area	2
Geological sketch map of the Breton showing	14
Geological sketch map of the Camray Prospecting Syndicate property	*facing* 18
Geological sketch map of the La Bine-McCarthy showing	22

COLOURED GEOLOGICAL MAP

(In pocket at back of report)

Map No. 1955-1—Montreal River Area, District of Algoma, Ontario.
Scale, 1 inch to ½ mile.

Geology of the Montreal River Area

By E. W. Nuffield

INTRODUCTION

The area described in this report is in the district of Algoma and is located on the east shore of Lake Superior, about 70 miles north of Sault Ste. Marie by way of highway No. 17. It includes townships 29 of ranges XIV and XV; parts of the two adjoining townships 28 of ranges XIV and XV; and part of the Rankin Location of the Quebec and Lake Superior Mining Association. Recent scientific articles and newspaper reports have described the region as the "Alona Bay," "Theano Point," or "Montreal River Uranium" area.



Theano Point. View across Alona Bay from highway No. 17.

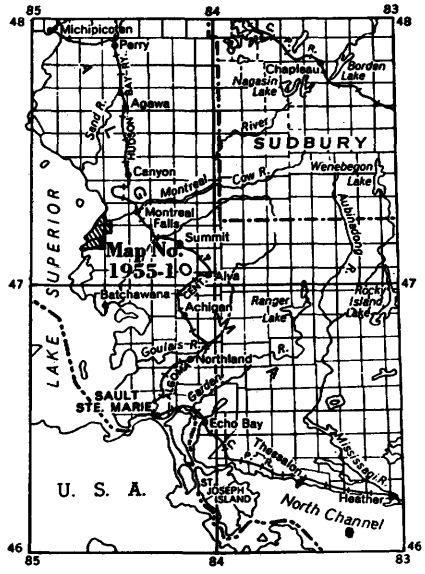
The discovery of pitchblende on Theano Point by Robert Campbell in September, 1948, created considerable interest in mining circles; the announcement of the strike resulted in an extensive staking rush. About 2,000 claims were rapidly staked in the discovery township and surrounding townships. Active exploration and development work by companies and individuals was carried on in 1949 and 1950, but by the fall of 1951 activity had tapered off.

A geological survey of the area was begun by the author in early June of 1949; the work was continued during the field season of 1950 and completed in midsummer of 1951. Mapping was done on a scale of 1 inch to 1,320 feet

by pace-and-compass traverses spaced at intervals of 400 feet. Picket lines, surveyed by plane table or transit, were used as control points, usually at half-mile intervals. Freshly cut township lines, which were resurveyed in 1949 by the Ontario Department of Mines, made for more accurate mapping.

Acknowledgments

The courtesy and assistance extended to the author and his assistants by the various mining companies operating in the area was much appreciated. The many kindnesses of the forest rangers at Mica Bay, particularly Gibson Goodfellow, did much to facilitate the work. The mining recorder at Sault Ste. Marie, W. N. Miller, and his two assistants, Jane Berlangette and Mary Moore, compiled much useful data and provided office facilities.



Key map showing the location of the Montreal River area, district of Algoma. Scale, 1 inch to 50 miles.

It is a pleasure to acknowledge the cheerful and efficient help of the men who acted as field assistants: D. M. Shaw, L. Burgess, R. S. Woolverton, F. T. Clifton, H. C. Jamieson, and H. Hotchkiss in 1949; R. S. Woolverton, J. McAndrew, H. Taylor, and R. Gemmell in 1950; and R. J. Cook, G. I. MacInnis, W. A. Nethery, and J. K. Gray in 1951. Mr. Woolverton undertook a responsible share in the preparation of the map manuscript and did petrographic studies of several rock types at McGill University.

Means of Access

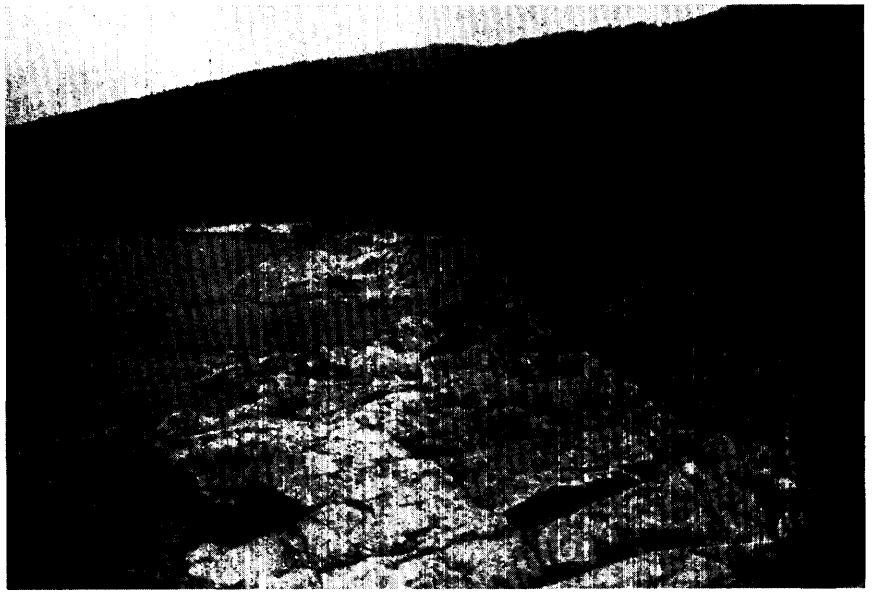
Access to the area is by highway No. 17, which crosses township 29, range XIV, near and roughly parallel to the coast, and in 1951 ended at the Montreal River in township 29, range XV. By the fall of 1951 this highway was hard-surfaced for most of its length from Sault Ste. Marie, with the remainder gravelled and in good condition. The continuation of the highway across the

Montreal River was a one-lane road in fair condition, which crossed township 29, range XV, and ended just inside township 28 of the same range.

The Rankin Location of the Quebec and Lake Superior Mining Association in the southern part of the area is crossed by a network of lumber roads. However, only a few of these can be traversed by passenger car and then only during spells of dry weather. During July and August of 1950 it was possible to drive into the northeast corner of this location and along the south shore of Queminico Lake.

In 1949 Camray Mines, Limited, built a road west from highway No. 17 to their mine buildings near the tip of Theano Point. This road is steep and twisting over much of its length and in 1951 was passable for cars only in dry weather.

Another road was constructed during 1949 and 1950 to the La Bine-McCarthy campsite in the northwest quarter of township 28, range XIV. This road lacks an adequate surface and in places is too steep for passenger cars.



A typical view of the rocky shore of Lake Superior with the hills rising sharply in the background.

Previous Geological Work

In 1925 E. S. Moore[1] made a geological survey of the area extending from the mouth of the Montreal River south to Batchawana Bay and eastward from the coast for about 25 miles. The report gives an excellent description of the geology of the region and includes a map on a scale of 1 inch to 2 miles. The extensive program, which was completed in a single field season, did not permit of a detailed examination except in those areas easily accessible by rail, boat, or trail. Consequently the area described herein, which at that time was not served by road, received only scant attention.

[1]E. S. Moore, *Batchawana Area, District of Algoma,* Ont. Dept. Mines, Vol. XXXV, 1926, pt. 2, pp. 53–85.

Topography

The area has been described by Moore as one of the most rugged in Ontario. In this author's opinion it is also one of the most beautiful. The scenery as viewed from many points of prominence and at lake level along the rocky shore cannot be adequately described and remains fresh and unspoiled.

Some of the hills rise to an elevation of about 1,400 feet; since Lake Superior is 600 feet above sea level, the total relief is about 800 feet. The hills are composed mainly of granitic rocks, whereas the depressions are occupied by diabase dikes as well as fault zones and glacial and glacial-lake deposits. Not uncommonly, certain diabase dikes are more resistant to weathering than nearby granite and form prominent ridges. Where shearing has occurred along granite-diabase contacts, the boundaries are deeply eroded and covered with heavy overburden.



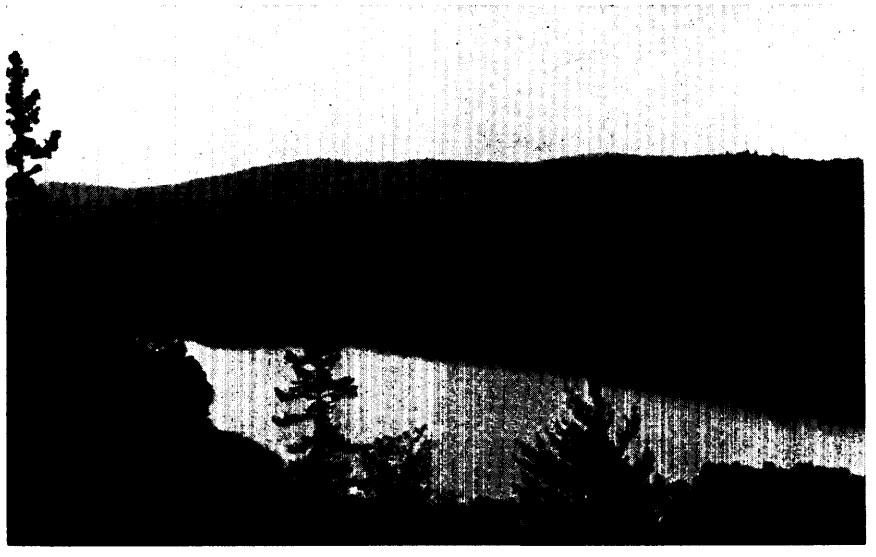
Crevice formed by the erosion of a diabase dike on the south side of Theano Point.

Typically, the north slopes of the larger hills are less steep and rugged and have fewer outcrops than the south slopes, which are frequently precipitous, rocky escarpments several hundred feet high. On the south side of Theano Point, for example, practically sheer rock faces rise for 400 feet out of the lake. Here, as elsewhere inland, climbing the southern flanks of the hills is extremely hazardous if not impossible for the amateur.

The shore line of Lake Superior in this region is marked by alternating

bays composed of boulder beaches and granitic points that are free of vegetation for several hundred feet back from the shore line owing to ice and wave action. Steep-walled gorges, which mark the site of former diabase dikes or fault zones, run inland for several hundred feet from some of the points. The fury and force of the Lake Superior storms is evident on Theano Point where driftwood has been driven inland along these coves for hundreds of feet and securely lodged in crevices 50–100 feet above lake level. Navigation by small boats is hazardous in rough weather.

Comparatively few lakes and streams occur in the region. The thick deposits of Pleistocene sand and gravel along abandoned beach lines and in depressions evidently permit free underground drainage. It is often difficult to map accurately the course of smaller streams near Lake Superior, since the stream may disappear and run underground for some distance along its route. The activities of beaver in the southern and eastern parts of the area have resulted in many swampy and flooded areas. This is the case in the water system



Lake Islay, in a heavily wooded valley.

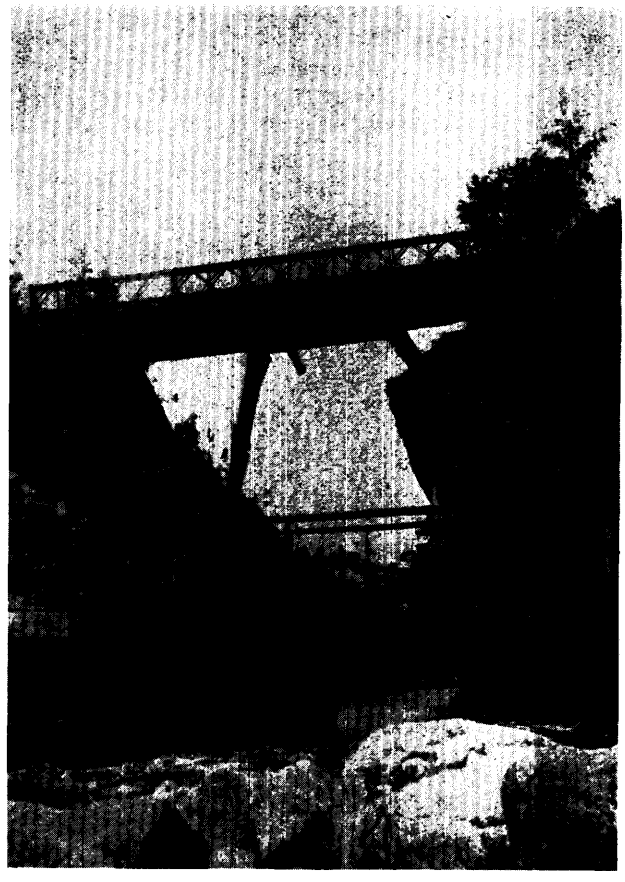
that drains lakes Alpha and Islay into the south end of Alona Bay and is especially true of the drainage pattern connecting the land immediately northwest of Queminico Lake with Alona Bay.

The largest stream in the area is the Montreal River, which crosses the northeast corner of township 29, range XIV, and empties into Lake Superior about a mile north of this township. It averages 150 feet in width. The stream is consequent, developed mainly on glacial deposits; but where it has cut through these deposits to bedrock, its course is, in part, determined by the rock structure. Below the lower dam it follows a narrow eroded diabase dike until it empties into the harbour and presents an impressive sight when the floodgates are open. Rapids or falls have formed in several places where diabase dikes cross the river bed.

The Great Lakes Power Corporation, Limited, operates two dams with hydro-electric plants on the Montreal River, one near its mouth at the highway crossing, and the other about 12 miles upstream where the Algoma Central and Hudson Bay railway crosses the river. These two sites have a total developed

capacity of 44,000 horsepower and aid in supplying electrical power to the city of Sault Ste. Marie as well as to mining and industrial companies in the district of Algoma.

A harbour suitable for small boats has been enlarged by dredging at the mouth of the Montreal River. This is the site of several permanent homes for employees of the Great Lakes Power Corporation, Limited, and of two small summer resorts, one on either side of the river, which cater to tourists interested in deep-water fishing for lake trout from power launches. It is reported that as many as 6,000 tourist cars have visited the area in a single season.



The Montreal River near its mouth flowing through a gorge formed by the erosion of a diabase dike.

The area is well wooded with deciduous trees, maple, birch, and poplar and, on rocky slopes, pine and spruce. Cedar is plentiful in low-lying, swampy areas. A lumber company that had the Rankin Location of the Quebec and Lake Superior Mining Association as a concession was taking out birch for the manufacture of veneer during 1949. Birch and pine measuring three feet in diameter are fairly common.

Moose and deer appear to be plentiful and are occasionally seen and accidentally killed by trucks along the highway. Evidence of beaver is plentiful; the trappers report that they are increasing in numbers. Inland fishing is not

particularly successful; the lakes and streams are relatively shallow, and the water is usually warm and not clear.

GENERAL GEOLOGY

The following is a table of the rock formations that have been recognized in the area, arranged according to age. It is based on the table given by Moore[1] in his report on the larger Batchawana area.

Table of Formations

CENOZOIC	
RECENT:	Gravel and sand.
PLEISTOCENE:	Drift, stratified gravel, sand, varved clay.
	Great Unconformity
PRECAMBRIAN	
KEWEENAWAN:	Upper Keweenawan—conglomerate, sandstone, shale. Middle Keweenawan—basalt, amygdaloidal basalt, diabasic flows. Lower Keweenawan—diabase dikes.
ALGOMAN(?):	Granite, granite gneiss, pegmatite, syenite.
PRE-ALGOMAN:	Paragneiss, amphibolite.

The majority of these rock types were recognized in this area and are described below.

Pre-Algoman

The oldest rocks in the area occur only as inclusions in the later granites. Occasionally boundaries of the fragments are difficult to trace, indicating some assimilation by granite. In general the inclusions are scattered and without orientation, but on the southwestern sides of both Pointe aux Mines and Theano Point, these rocks constitute the major part of the outcropping, and their strikes and dips are consistent for some distance. Metamorphism has largely destroyed the original rock characteristics and produced biotite gneisses and schists and amphibolites.

These inclusions probably represent the metamorphosed remnants of the Basement series mapped by R. G. McConnell in the Sault Ste. Marie area.[2] This series consists of hornblende and chlorite schists, lavas, conglomerates, greywackes, and quartzites near Sault Ste. Marie. McConnell found evidence of a clastic origin for the schists in thin-section studies. A granite, which he tentatively described as Algoman, and which is similar in character to the granite mapped in this area, was observed by him to contain irregular-shaped inclusions of the Basement series, in particular, greenish hornblende schists.

Algoman (?)

Most of the area is underlain by granitic intrusive rocks consisting of granite, granite gneiss, and minor syenite, all cut by pegmatite dikes and quartz veins. The granite, which ranges in colour from white and grey to red, is mostly biotitic but grades into hornblende or pyroxene types. The pegmatites occur as ill-defined dikes and irregular masses. The character of these intrusives changes within short distances and it was found impossible on the scale of mapping used, to draw geological boundaries between the types. An attempt has been made, however, to indicate the dominant type in the rock outcrops.

[1] E. S. Moore, *op. cit.*, p. 59.

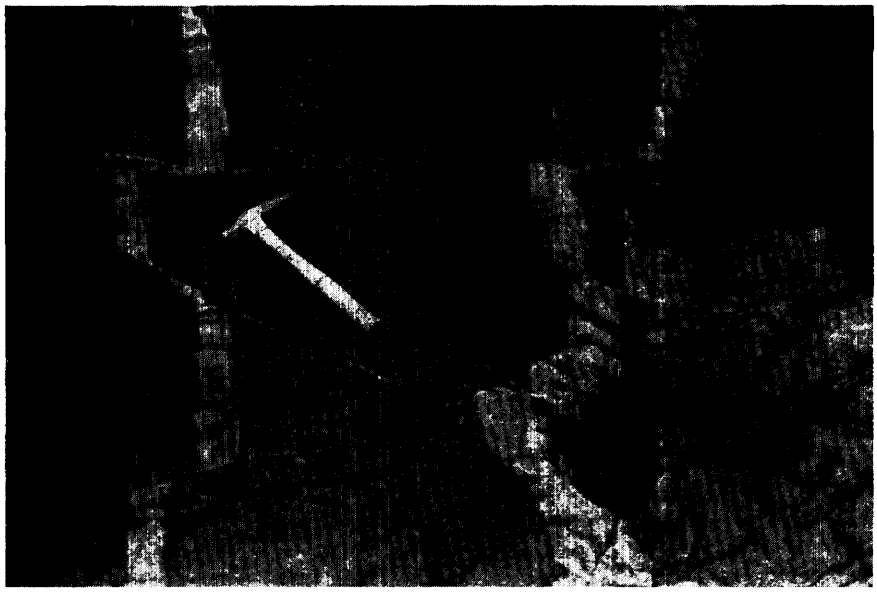
[2] R. G. McConnell, *Sault Ste. Marie Area, District of Algoma*, Ont. Dept Mines, Vol. XXXV, 1926, pt. 2, pp. 1–52.

Keweenawan

LOWER KEWEENAWAN

The Keweenawan system is represented almost entirely by a vast number of diabase dikes that were regarded by Moore[1] as Lower Keweenawan in age. They may constitute as much as 5 percent of the rock. They range in width from less than a foot to as much as 600 feet, but then frequently contain narrow "islands" of granite. Some of the closely spaced dikes had to be mapped as single, wide dikes. Little effect on the granitic country rock resulted from the intrusion of the diabase.

The dikes trend in three general directions. The most numerous and persistent dikes strike west to northwest and dip steeply north. Several of these dikes were traced for more than two miles. Much fewer in number and less persistent in length are the dikes that strike northeast and dip vertically or



Faulted aplite cutting diabase dike, north of Theano Point.

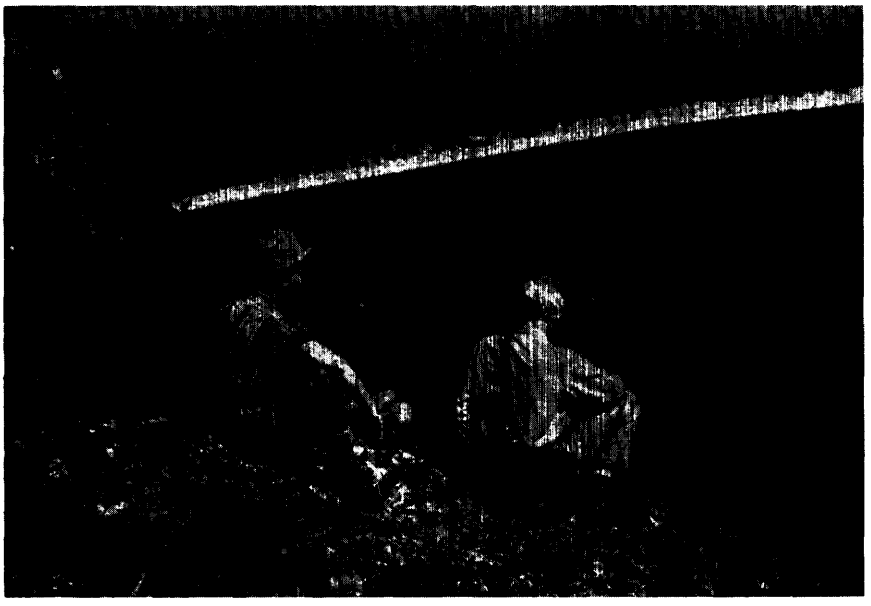
steeply, usually to the southeast. A few dikes strike nearly north. On the west side of Pointe aux Mines the three types can be seen intersecting each other, indicating that the northeast-striking dikes are the oldest, followed by the persistent northwest types. However, north of the mouth of the Montreal River, along the lake shore, these two types cut each other indiscriminantly.

In general the dikes have weathered more rapidly than the granite and in areas largely covered by overburden can now be traced as shallow valleys. Occasionally steep granite faces, to which traces of diabase cling, define the widths of eroded dikes. Sometimes one of the contacts appears to be less resistant than the other, perhaps owing to movement and consequent shattering, and then one contact is on a rock bluff, while the other occupies a valley. Characteristically the dikes branch and vary somewhat in both direction and width. Aplite stringers, measuring less than a foot in width, were seen cutting the

[1]E. S. Moore, *op. cit.*, p. 64.

diabase in certain places, especially at the coast where exposures are best. They are considered to be a differentiate of the diabase magma.

Examination of about a dozen thin sections of various diabase dikes from Theano Point indicates the almost invariable presence of quartz in various amounts. Much of this quartz may be secondary. Olivine is absent, or present in insignificant amounts. The author is indebted to R. S. Woolverton[1] for a detailed petrographic study of the diabase of the "discovery" dike on Theano Point. The mining activity in connection with the dike is described below under the section, "Economic Geology." Mr. Woolverton reports that in all except the very fine-grained types the diabase shows considerable alteration. The ophitic texture of fresh diabase is retained because labradorite, not completely altered to clinozoisite, is still recognizable as lath-shaped, and the interstitial chlorite is, to a large extent, pseudomorphous after the original pyroxene. Only a few crystals of pyroxene, identified as augite, were found; in



Alona Bay as seen from the promontory of Theano Point.

all other instances it is represented by various alteration products—tremolite-actinolite, antigorite, or quartz—but chiefly by chlorite, which in some sections comprises 50–60 percent of the rock. Quartz is not present in sufficient amounts, even if primary, to justify calling the rock a quartz diabase. Sphene, forming up to 5 percent of the rock in places, occurs typically as formless aggregates near crystals of ilmenite and hematite along with the alteration product, leucoxene. One slide showed a six-sided aggregate of serpentine, one millimetre in diameter, which was interpreted as the remains of an original olivine crystal.

MIDDLE KEWEENAWAN

The Middle Keweenawan is represented by a series of lava flows, which is exposed as a narrow rim around the southeastern shore of Alona Bay. The

[1]R. S. Woolverton, by permission from his thesis for Master of Science degree, McGill University, 1950.

series is here practically eroded to its granite base; patches of granite protrude near the outer edge of the lava rim. The bands of lava are made up of beds that grade upwards from diabasic flows to red-and-black-weathering fine-grained basalts and amygdaloidal tops with calcite fillings. The flows strike roughly north and dip 25°–50°W. Areas underlain by lavas are characteristically dotted by steep-sided hummocks or north-striking ridges of lightly covered rock. Considerable difficulty was encountered on Pointe aux Mines in distinguishing the diabasic flows from diabase dikes. The task was complicated by the presence of amphibolite gneisses as inclusions in the granite.

Moore[1] observed certain olivine diabase dikes later in age than the Middle Keweenawan lavas. Only one of the many diabase dikes mapped in the area was seen definitely cutting the lavas; it is a 100-foot, fine-grained, basalt-like dike striking N.20°W. This dike is exposed on the southeast shore of Alona Bay near the mouth of a creek shown on the coloured geological map (back pocket).

UPPER KEWEENAWAN

A few patches of sediments consisting of conglomerate and red and grey sandstones are exposed on Alona Bay and on the north side of Theano Point. These sediments were regarded as Upper Keweenawan, possibly Cambrian, by Moore. They lie unconformably on the Middle Keweenawan lavas and on weathered surfaces of granite. They strike roughly northeast and dip at shallow angles to the northwest.

The reader is referred to Moore's report on the Batchawana area for a more detailed description of the Keweenawan system, which is exposed over larger areas and in greater thicknesses to the south of this area.

Pleistocene and Recent

The topography shows the effects of the ice sheet, which advanced from the north. The glaciers rode up the north sides of the larger hills, leaving relatively gentle slopes, but plucked the south sides, forming craggy exposures.

Glacial till was deposited throughout the area by the ice sheet. It is exposed in the Alona Bay area where a small stream has cut through the overlying lake-bottom deposits.

During the recession of the ice, the Lake Superior basin was occupied by a succession of lakes. At one time, in the Lake Algonquin stage, the water reached an elevation of about 400 feet above the present lake level. Two abandoned sea caves, about 75 feet above lake level, were found on Theano Point and are evidently due to wave erosion along zones of weakness in the granite; one of these caves was found to have ice and snow in it in July. A series of beach terraces was formed at different levels that in some cases are still clearly marked. They extend inland for several miles from Lake Superior. Several of these terraces, near the lake and north of Theano Point, are composed of well-rounded boulders of granite, about 8 inches in diameter, and are covered with little or no vegetation. They are identified as beach deposits on the geological map. The glacial till that covered much of the area was removed and redeposited on the lake bottom, in depressions, as stratified clay, sand, and gravel. These areas are characterized by few rock outcrops as is evident on the map in the region extending inland from Alona Bay to Queminico Lake.

[1]E. S. Moore, *Batchawana Area, District of Algoma*, Ont. Dept. Mines, Vol. XXXV, 1926, pt. 2, p. 74.

They permit underground drainage; a well-marked stream north of highway No. 17 in township 29, range XV, disappears entirely on entering the extensive beach deposits north of the Montreal River harbour.

The effect of Lake Superior on the shore line is visible along the rocky points that jut out into the water. The rock surfaces that are within reach of wave and ice are kept scoured and free of vegetation. Steep-walled gorges running several hundred feet inland give evidence of the plucking force of the lake on the weaker diabase dikes and fault zones. These gorges are particularly pronounced on Theano Point. (See photo, page 4.)

ECONOMIC GEOLOGY

Copper

The first effort at mine development in the area dates back to about the middle of the last century and was focussed on an occurrence of copper mineralization at Pointe aux Mines.

The records[1] of this work state that at the base of the point a shaft was sunk by the Quebec Mining Association to a depth of 70 feet on a small east-west vein of native copper in calcite, quartz, and mica. The report also calls attention to two chalcocite-bearing veins situated about 500 feet north of the shaft and two other small veins, containing chalcocite and sphalerite in the vicinity. Some of these occurrences were examined during the present mapping and found to be related to minor structures in the granite. None appear to be of economic significance.

A report by T. MacFarlane[2] deals with the more extensive operations of the Quebec and Lake Superior Mining Company at a position about half a mile northeast of the locations described above. The activity took place near the south extremity of the Middle Keweenawan volcanic rocks that occur as a thin layer overlying the Algoman granites on the southeast shore of Alona Bay. An adit was driven in the volcanics at a bearing of S.10°W. for a distance of 220 feet where it was connected with the surface by a 40-foot shaft. The adit continued past the shaft in a direction S.50°W. for about 30 feet where it penetrated granite. The object of the workings was the exploration of a decomposed vein containing calcite, quartz, barite, hematite, chalcocite, bornite, and chalcopyrite. According to MacFarlane the vein was obviously of very small vertical extent because of the underlying granite, and its copper content was not promising.

The location of the workings is marked on the geological map by a circle and the notation "Old Copper Workings" and was identified in the field by several pits and a caved adit, all in overburden. Several pieces of machinery and the ruins of a stone building, used perhaps as a smelter and later as a fort, remain.

Traces of native copper were observed in the amygdaloidal basalts in a few places, but this area offers little hope for economic quantities of copper.

Uranium

At the present time all economic interest in the immediate vicinity is centred in occurrences of anomalous radioactivity following Robert Campbell's dis-

[1] Geological Survey of Canada, *Geology of Canada*, 1863, p. 702.
[2] Geological Survey of Canada, *Report of Progress from 1863 to 1866*, p. 144.

covery of pitchblende on Theano Point. The many showings that were examined during the field season may be conveniently grouped into two types on the basis of the mineral responsible for the radioactivity. In the first type the radioactivity is confined to granite or pegmatite, whereas in the second type radioactivity is localized in or near, and then structurally related to, diabase. The two types of showings are discussed below.

SHOWINGS IN GRANITE OR PEGMATITE

Showings in granite or pegmatite in this area often give exceedingly high readings on the geiger counter. Generally the anomalies cannot be related to any structural feature in the outcrop, the rock being perfectly massive, although at times the radioactivity appears to be concentrated in a tight fracture over a length of 1–3 feet. Sometimes a characteristic brick-red colour is present, forecasting unusual radioactivity. The brick-red colour may exist for several inches on either side of the fracture, and yellowish oxidation products of uranium may coat the fracture. Specimens removed from such a highly radioactive zone to a region of low-background count usually prove disappointing in that the geiger readings are now less than twice background count. Examination of the specimens in the laboratory often fails to reveal the cause of the radioactivity. This suggests a fairly uniform but meagre distribution of radioactive minerals as a primary constituent in the granite and indicates that the radioactive effect is a mass effect from a considerable volume of rock.

The author succeeded, after much effort, in isolating the radioactive mineral from one highly radioactive specimen of granite. An X-ray powder diffraction pattern identified the mineral as microlite-pyrochlore (ellsworthite). Minerals of the microlite-pyrochlore series have the ideal formula $(Na,Ca)_2(Cb,Ta)_2O_6(O,OH,F)$ and are, therefore, multiple oxides of sodium, calcium, columbium, and tantalum. Both uranium and thorium may substitute in the atomic structure for calcium and sodium, and therefore, a radioactive specimen of microlite must be tested chemically to ascertain the presence of uranium. Nine of the eighteen chemical analyses of microlite-pyrochlore recorded in Dana[1] show no UO_2 or UO_3; only three show more than 10 percent UO_2, UO_3, or both.

The microlite-pyrochlore series are but one of a group of chemically similar minerals that may yet be identified in the Montreal River area. This group includes fergusonite-formanite, euxenite-polycrase, eschynite-priorite, samarskite, and betafite. All, like microlite-pyrochlore, are multiple oxides of columbium and tantalum, which may contain uranium, thorium, or both. They occur typically as primary constituents of igneous granitic rocks. Several of the species are common in Ontario and Quebec. The analyses of specimens from various parts of the world as presented in Dana[2] show that euxenite-polycrase, samarskite, and betafite are most apt to have appreciable percentages of uranium.

At this time uranium is not being extracted commercially from Canadian deposits of such minerals, although a representative number of occurrences have been investigated in the Grenville rocks of eastern Ontario. Therefore it is not possible to estimate the percentage of recovery or the cost of separation. An occurrence of pyrochlore in the Lake Nipissing district of Ontario is now being studied with a view to extracting columbium-tantalum oxides with uranium as a possible by-product.

The occurrences in the Montreal River area are low-grade and at this time are of no economic value.

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[1] Dana's *System of Mineralogy*, Vol. 1, 1944, pp. 750–51.
[2] *Ibid.*

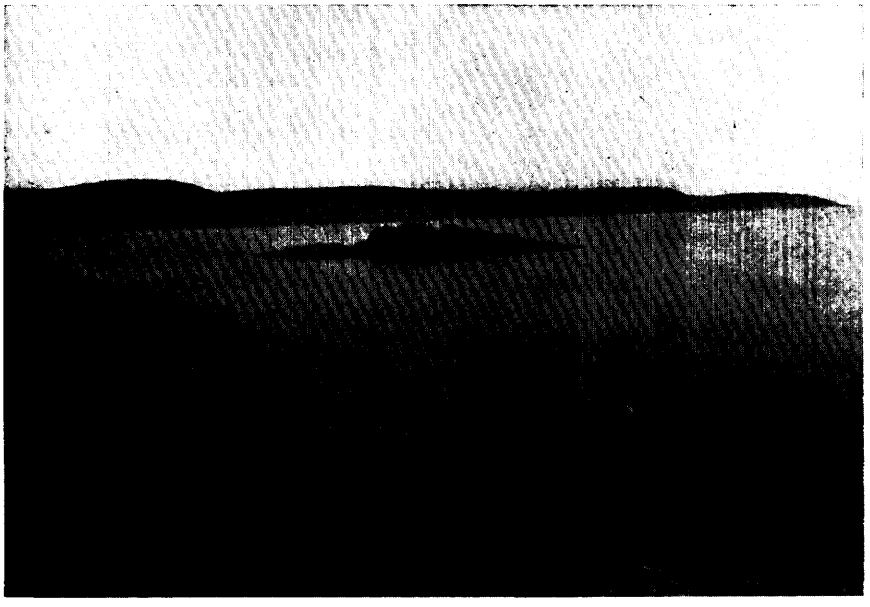
SHOWINGS IN OR NEAR AND RELATED TO DIABASE

The showings that are classed under this heading differ from those in granite in that the primary radioactive mineral is pitchblende. A number of typical showings are described below, and their characteristics are discussed in the following paragraphs.

Properties

Batachawana Uranium Mines, Limited
(See geological map, property No. 8)

The Batachawana group, which consists of 10 claims (15887–15892, 21560–21562, and 21610) in township 29, range XIV, is near the east boundary of that township, north of Queminico Lake, and south of the La Bine-McCarthy road. A pitchblende find was made near the south end of the property in 1950.



Ossifrage Island with Pointe aux Mines in the distance as seen from Theano Point.

A pit, measuring 4 by 3 by 2 feet, in a highly fractured diabase dike, exposed a vertical fracture striking north, which contains a pod of pitchblende measuring 15 by 10 by 1½ inches covered with yellow alterations. The same fracture contained a second, smaller pod. Vugs in the pit were largely filled with a soft muck of decomposed calcite and hematite. A second pit revealed considerable fresh calcite and hematite.

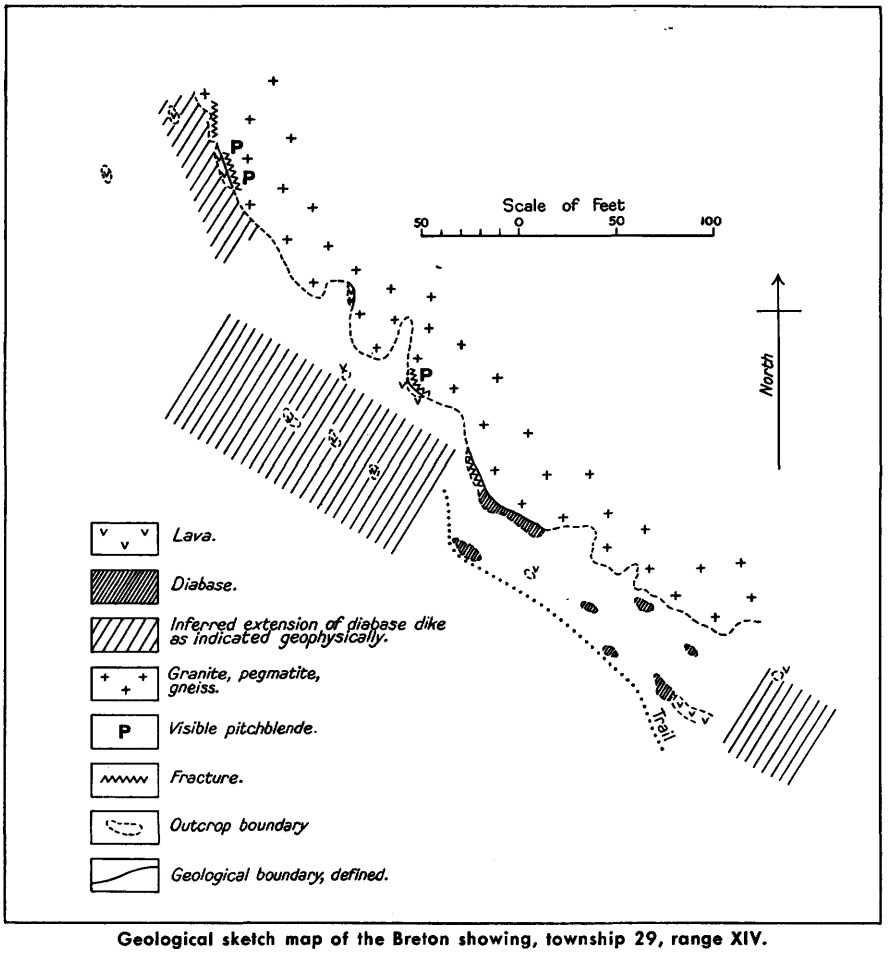
Bobcam Mines, Limited
(See geological map, property No. 10)

In 1949 Bobcam Mines, Limited, an affiliate of Camray Mines, Limited, carried on an extensive surface exploration program, including geological mapping, a magnetometer survey, and surface-trenching, on a group of 21 claims (16054–16074) in township 29, range XIV, immediately east of the Camray claims. Although several interesting radioactive showings were discovered, none appeared to warrant underground development. No work was undertaken in 1950.

Breton Showing
(See geological map, property No. 11)

The Breton showing, which is immediately west of highway No. 17 near the south boundary of township 29, range XIV, was discovered in the summer of 1950 by Karl Gunterman.

The geological relations are here somewhat difficult to decipher owing to the presence of both diabase and lava. The discovery is adjacent to a granite wall facing southwest and striking roughly northwest (see accompanying geological sketch map). Both diabase and lava cling to this wall and are exposed



Geological sketch map of the Breton showing, township 29, range XIV.

within 50 feet of it to the southwest. A magnetometer survey made by J. McCloskey and the author across the showing confirmed the presence of at least two diabase dikes, one probably branching from the other, below the granite wall. Dip determinations indicate that it is the hanging-wall granite for the two dikes, which strike roughly parallel to the wall. The lavas overlying the diabase have weathered almost entirely away, leaving only patches that outcrop in the depression above the dike and cling to the hanging-wall granite.

The north contact of the dikes, where exposed, is sheared and filled for a width of 1–2 inches with calcite, hematite. fine-grained diabase fragments,

and some radioactive material. In other places fractures, parallel to, or at slight angles to, and within 3 feet of the contact, may be seen in the granite. Two of these contained stringers of pitchblende up to ½ inch in width, calcite, and hematite. A test pit on an outcrop of diabase within 40 feet of the wall gave evidence of anomalous radioactivity; it was reported that pitchblende was seen in the pit.

The entire showing as seen in the fall of 1951 had a length of 250 feet. Not sufficient surface work had been done to indicate a continuity of radioactivity over this length.

Camray Mines, Limited
(See geological map, property No. 9)

The history of this deposit may well date back to the middle of the nineteenth century. It is the opinion of the author that this or the Franz showing (see page 20) is the site of the first recorded discovery of uranium in Canada. The original reference to this occurrence was made by J. L. Le Conte[1] in 1847 who referred as follows to a specimen that he studied:

> This mineral forms part of a collection made by Mr. B. A. Stanard on the north shore of Lake Superior . . . [It occurs] about seventy miles from Sault Ste. Marie, at the junction of trap and sienite; the vein in which it is found is about two inches in width; but on account of its position (on the face of an almost perpendicular cliff) only a few specimens were obtained and those with great difficulty.

Le Conte observed that the mineral closely resembled pitchblende but differed slightly in its physical and chemical properties from typical Joachimsthal pitchblende. For this reason he considered it a new mineral distinct from pitchblende to which he gave the name coracite from the Greek word for a raven, in allusion to its colour and lustre.[2]

J. D. Whitney[3] in 1849 obtained a specific gravity of 4.38 and gave the following chemical data for the mineral:

	Percent
Silica	4.35
Alumina	0.90
Oxide of iron	2.24
Oxide of uranium	59.30
Oxide of lead	5.36
Lime	14.44
Carbonic acid	7.47
Water	4.64
Magnesia, manganese	trace
Total	98.70

He noted that it was more readily soluble in acids than typical pitchblende and thus assumed a different state of valence for the uranium. It appears likely that the specimen was highly oxidized; research by the author and his students at the University of Toronto has shown that the solubility of pitchblende increases with increasing UO_3 content.

F. A. Genth[4] also mentioned the mineral in 1857:

> Dr. John L. Le Conte kindly presented me with a specimen of the mineral from about 90 miles above Sault Ste. Marie on the north shore of Lake Superior, which he had described as Coracite. Its great resemblance to pitchblende favoured the opinion that it was really nothing

[1]John L. Le Conte, "On Coracite, a New Ore of Uranium," *American Journal of Science*, 2nd ser., Vol. 3, 1847, pp. 173–75.
[2]Dana's, *System of Mineralogy*, Vol. 1, 1944, p. 617.
[3]J. D. Whitney, "A chemical examination of some minerals," *American Journal of Science*, 2nd ser., Vol. 7, 1849, p. 434.
[4]F. A. Genth, "Contributions to Mineralogy," *American Journal of Science*, 2nd ser., Vol. 23, 1857, p. 421.

else . . . though it is interesting that it is so readily soluble in chlorhydric acid, this fact alone is not sufficient to separate it from pitchblende.

It is noteworthy that this description introduced a discrepancy regarding the location of the occurrence.

Further reports of the occurrence appeared in various publications of the Geological Survey of Canada, but efforts to relocate the deposit by the officers of both the Ontario Department of Mines and the Geological Survey of Canada were unsuccessful. Further confusion regarding the locality was created by W. E. Logan[1] who stated: "An ore of this rare metal is said to occur at Mamainse." In the same report (page 700), Logan stated that the promontory of Mamainse was midway between Sand Bay and Mica Bay, thus placing the locality about eleven miles south of Theano Point.

Robert Campbell was one of a number of prospectors who prepared to search again for the Lake Superior occurrence of uranium as a result of the sudden interest in the element following its use in the preparation of the atomic bomb. Mr. Campbell examined the original references to the mineral in Toronto libraries and, in the spring of 1948, equipped with a geiger counter, set out to prospect the shore of Lake Superior with two assistants. Later in the season, he was forced to continue alone. Finally, on September 8, after his boat had been wrecked by a storm, he entered a cove on the west side of Theano Point. Near the water's edge his counter gave indications of unusually high radioactivity, which he ascertained to be due to short veins of a black mineral, some with uranium stain, that occurred in the granite face forming the south wall of the cove. Other veins soon became evident farther back from the water. Mr. Campbell thereupon staked a number of claims and recorded them on October 16. The news of the discovery was released several weeks later and precipitated a staking rush.

The discovery was examined by J. Satterly and D. F. Hewitt[2] for the Ontario Department of Mines on November 7, 1948, and by A. H. Lang[3] for the Geological Survey of Canada on November 11. The published reports of these two visits give an excellent description of the occurrence at the time of its discovery. These descriptions are briefly reviewed below, and certain more recent data are included.

The discovery cove was formed at the expense of a diabase dike, which, like most dikes at the coast, eroded more rapidly, through the action of ice and water, than the granite country rock. Remnants of the diabase can be seen on the walls, and the dike itself is exposed underfoot.

Near the lake the dike strikes N.80°W. and dips at about 70°N. It averages 35–40 feet in width, here and there narrowing to less than 20 feet. Inland about a quarter of a mile, the dike narrows to 20 feet and turns sharply to the southeast. It was at first thought that this was the result of post-dike movement, but no shattering of the diabase is visible at the bend. The dike now strikes parallel to a prominent gully that is occupied by another diabase dike. Within a few hundred feet past the bend, the discovery dike passes into overburden, and its erosion gully is too indistinct to trace.

Along its known length the dike occupies a pronounced gully, locally called "the canyon." Its granite walls on the south are 50–100 feet high and nearly

[1]Geological Survey of Canada, *Geology of Canada*, 1863, p. 504.

[2]J. Satterly and D. F. Hewitt, *Report on a Pitchblende Occurrence at Theano Point, Lake Superior, Ontario*, Ont. Dept. Mines, Prelim. rept. No. P.R.1948–9, 1948.

[3]A. H. Lang, *The Camray Uranium Discovery*, Trans. Can. Inst. Min. Met., Vol. XLII, 1949, No. 444, pp. 42–46.

vertical. The north walls are not so pronounced but rise as much as 20 feet. Outcrops of diabase on the floor of the canyon are sparse, becoming fewer inland; remnants on the south walls are a help in tracing the dike.

Within 150 feet of the water's edge a fault, striking N.28°W. and dipping 45°E., traverses the dike and the granite on both sides; the displacement is only a few feet. Other even less prominent fractures are present, entering but dying within the diabase.

The south contact shows evidence of considerable shearing after emplacement of the dike. This contact, in its exposed length near the lake, is a brecciated zone, averaging 2–3 inches in width with a maximum of 1 foot, composed of lens-shaped fragments of fine-grained diabase, and granite, in a matrix of pink calcite, chlorite, hematite, and pitchblende. The broken edges of adjacent diabase fragments are identical, indicating that the movement along the contact was confined largely to a spreading of the adjacent formations. Under the microscope it is seen that the fine-grained diabase fragments are replaced, to



The eroded diabase dike and cove in which Robert Campbell made his discovery of pitchblende.

a varying degree, by hematite. The feldspar of the granite fragments is completely replaced by chlorite and hematite. The quartz grains are shattered and are traversed by stringers of hematite and fibrous calcite. Hematite staining pervades and imparts a reddish colour to the brecciated zone. The dike itself is here closely jointed. The joint blocks are 2–3 inches to the side and in many cases show slickensiding on all faces. The jointing and slickensiding extend to within a few feet of the north contact, which tends to be sharp and tight.

Pitchblende[1] occurs as stringers with calcite and hematite in fractures that are concentrated in the south granite wall immediately adjacent to the diabase; only two small stringers were seen on the north granite wall. The fractures are probably tension cracks; they vary in width, generally up to 2 inches, although one 6-inch patch of pitchblende was seen by Satterly and Hewitt (see

[1]Three samples submitted to the author by Satterly and Hewitt were identified as pitchblende by X-ray methods. On the assumption that this is the locality visited by Stanard, it follows that coracite is pitchblende, and that the name coracite should be discarded.

accompanying surface plan). In general they have a vertical and horizontal extent of 3–4 feet, projecting into the granite from the contact. Although the fractures strike and dip at various angles, most of them intersect the granite-diabase contact at low angles, striking about N.65°E. and dipping steeply southeast. This suggests that the movement of the footwall granite relative to the hanging wall was upwards and to the east. The pitchblende-bearing fractures occur in patches; there is a 250-foot mineralized zone, starting in the cove, separated by a 220-foot barren zone from another 130 feet of mineralized fractures to the east.

Three samples of pitchblende selected from different stringers (see surface plan) were submitted by Satterly and Hewitt to the Provincial Assay Office. The samples gave the following values for beta-ray activity in terms of uranium oxide equivalent: 61.6, 63.8, and 56.3 percent. Lang[1] reports a value of 8.72 percent U_3O_8 equivalent on a sample representative of a 6-inch stringer. The variation in results is probably due to a difference in purity of the samples selected for assaying. At the surface, the pitchblende is typically weathered with the formation of yellowish hydrous uranium alteration products. Later blasting showed that this alteration may extend to a depth of more than 3 feet below the surface.

The pitchblende here, as elsewhere in the area, is relatively free of associated minerals except for calcite and hematite. In the field, minor pyrite and galena may be seen in hand specimens. In two polished sections the author identified, by means of X-rays, clausthalite (PbSe) as a fine-grained, intimate intergrowth with an unknown mineral. This latter mineral is blue-grey in polished section and has a fiery orange anisotropism much like klockmannite (CuSe). First-rate X-ray-powder photographs of this mineral could not be obtained owing to the extremely small size of the grains, but those made were sufficiently good to show that the mineral is not klockmannite. It is perhaps worth mentioning here that this occurrence of clausthalite is the first positive identification of a selenide mineral in Canada. S. Kaiman of the Bureau of Mines, Ottawa, and S. C. Robinson of the Geological Survey of Canada informed the author that they had subsequently identified selenides associated with pitchblende from Great Bear Lake and from Goldfields in Saskatchewan. The association of selenium and uranium in hydrothermal veins may be significant.

Polished-section studies indicate that pitchblende, clausthalite, and the unknown mineral were deposited during the first stages of mineralization; pyrite and galena were formed later. Quartz and calcite were deposited during both stages of mineralization.

Bunk-houses, a cook-house, and an office were erected in the spring of 1949; and a road, suitable for passenger cars in dry weather, was built from highway No. 17 into the property. Some surface exploration was done by slashing down a portion of the south wall containing pitchblende stringers. The extension in depth of the stringers was probed by diamond-drilling. This latter program proved of small value since extremely close drilling would be necessary to intersect a representative number of the erratically situated stringers.

Finally a two-compartment shaft was located about 120 feet from the lake on the south diabase-granite contact. The shaft was sunk 150 feet at an inclination of 69° to remain on the contact. Starting at 138 feet, the company drifted east along the contact for about 330 feet and west for about 175 feet.

Immediately west of the shaft, the face samples averaged 0.24 percent

[1]A. H. Lang, *op. cit.*

U_3O_8 across 3.0 feet over a length of 52 feet. Over a length of 90 feet, beginning at the shaft, the muck samples averaged 0.044 percent U_3O_8, and the back samples 0.043 percent U_3O_8 across a width of 3.0 feet. The remainder of the west zone gave, at best, only a trace of uranium.

The best zone in the east drift began about 150 feet east of the shaft and extended for about 110 feet. Muck samples averaged 0.02 percent U_3O_8, back samples averaged 0.037 percent U_3O_8, and face samples averaged 0.034 percent U_3O_8 across 3.0 feet.

More than 20 holes were drilled underground, including some in vertical (both up and down) and horizontal directions.

A second occurrence just south of the Camray road and less than half a mile from highway No. 17 received considerable attention during the latter part of the season. This showing is similar to the one in the discovery dike in that the pitchblende is present, filling tension cracks in the footwall granite of a



Bunk-house and cookery of Camray Mines, Limited, on Theano Point.

northwest-striking, north-dipping diabase dike. The veins extend for 2–3 feet into the granite and have a vertical extent of 4–5 feet. The fractures here tend to be narrower, and the contact is less sheared than in the discovery dike. A good concentration of pitchblende-bearing fractures was located near the surface at the east end of the showing. This zone was explored by driving an adit westward for 230 feet along the contact, starting at a point below and to the east of the showing. For the most part the assays of samples from the adit gave no uranium, or only traces. A few samples gave good assays, but these were confined to short, scattered occurrences.

The results of the development work in both zones influenced the company to suspend operations. The work would suggest that the fractures carrying pitchblende are as erratic in vertical extent as they are horizontally, and that the concentration of pitchblende over a mining length and depth is not of economic importance. Following the field season, the headframe near the lake was smashed by a high sea. No further work was done in 1950.

Canagau Mines, Limited, and Dickenson Properties
(See geological map, properties Nos. 6 and 2)

The Dickenson claims (A.C.4731–4734, A.C.4739, and A.C.4775) and the Canagau Mines, Limited, claims (A.C.4735–4737, and A.C.4740–4745) in township 29, range XV, are crossed by a prominent dike known as the Canagau dike.

In 1949 stripping and trenching on this dike had exposed a fracture plane for 6 feet, striking N.75°W. and dipping 45°N. The surface of this plane was covered with hematite and, in places, calcite up to ¼ inch in thickness. In several places pitchblende accompanied by yellow alteration products could be seen. A second fracture, striking N.5°W. and dipping 55°E., intersected the first fracture and had been followed for 20 feet. This fracture also showed patches of pitchblende, one being 2 feet long by ¼ inch thick. It was reported that a single specimen of wire silver was taken from the muck of the workings.

At another place in the same dike and several hundred feet to the southeast, two fractures had been exposed by stripping. Higher radioactivity was evident at the intersection of the fractures, decreasing markedly within several feet of it.

Franz Property
(Not included on geological map)

The Franz property is located in township 29, range XVI. It consists of 12 claims (19082 and 19084–19094). The principal showing is on claims 19084 and 19086 on the shore of Lake Superior between Barrett and Sinclair Islands. Access is by boat from Montreal River Harbour, a distance of about 10 miles.

Anomalous radioactivity is connected with a nearly vertical diabase dike striking N.35°W. The dike is well exposed at the shore but passes into heavy overburden a short distance inland. It forms a part of the shore line, the west contact being underwater here, but the width of the dike was fairly reliably estimated at about 70 feet.

At the shore the east contact shows evidence of movement with the formation of tension cracks in granite that are both parallel to and at a slight angle to the contact. This contact is here deeply eroded, in places below lake level. The movement created openings that acted as channelways for aplite, quartz, carbonate, and a radioactive mineral, producing a zone in the contact of radioactive material 2–8 feet wide (wider where tension cracks occur), which is exposed for 125 feet. Radioactivity readings along this water-washed contact of 2–4 times background count were observed over much of the zone, with occasionally much higher activity; at one point a reading of 15 times background count was obtained.

About 100 feet southeast of this zone along the contact, anomalous radioactivity appears to be associated with a fault that has offset the contact 4 feet to the west. The contact south of this fault is filled with calcite-hematite veins to a total width of 3 feet and for a length of 30 feet where it enters overburden. Radioactivity of several times background count was noted here, and some uranium stain was seen. It was reliably reported that a specimen of pitchblende had been removed. The contact here is also deeply eroded and is below lake level where the fault crosses it. The small cove with its nearly vertical walls at this point suggested the possibility to the author that this, rather than the Camray discovery, is the original Stanard locality.

In 1950 the claim owners began trenching along the contact where it entered overburden southeast of the cove. At the time of the author's visit in September it had been cleared to a depth of 2–3 feet for about 100 feet. Fresh, hard material had not been reached, but anomalous radioactivity was evident.

Of more interest was the discovery of two fractures running into the diabase from the contact at strikes of about N.75°W., which gave much higher geiger readings. A fist-sized specimen of botryoidal pitchblende was obtained several feet below the surface in one of the fractures.

No work of any consequence was undertaken in 1951.

Jalore Mining Company, Limited
(Not included on geological map)

The Jalore company, a subsidiary of the Jones and Laughlin Steel Corporation, holds a group of 38 claims (16368–16386 and 15960–15978) straddling the Algoma Central and Hudson Bay railway. The discovery and main showing is in a railway cut in township 28, range XVI, just south of mileage 105. The discovery was made in the late fall of 1948 by E. T. Richards who prospected the railway cuts in the area with a geiger counter under the direction of L. P. Barrett, vice-president of Jones and Laughlin.

The showing is in a diabase dike, 90 feet wide, which strikes northeast and dips steeply southeast. In this respect it differs from most of the other showings described in this report, which occur in northwest-southeast dikes. Anomalous radioactivity is connected with a zone in the railway cut, 10–12 feet wide, consisting of subparallel, more or less persistent calcite-hematite stringers, which trend nearly at right angles to the dike and dip steeply northeast. Small calcite-hematite-filled fractures running away from the zone show anomalous radioactivity in places.

The northwest contact of the dike with granite is offset 5–6 feet across the tracks. This appears to have been a region of strong crushing and of faulting, which eroded more readily than the body of the dike. The old railway survey notes show that this site was chosen to cross the dike because a depression, filled largely with sand and gravel, existed here; relatively little blasting was necessary to form the present cut.

The zone is well marked in the diabase. Although it extends for about 15 feet into the granite on either side of the dike, it is here much less pronounced, and radioactivity is much lower except where openings favourable for uranium-bearing solutions were created around inclusions of paragneiss.

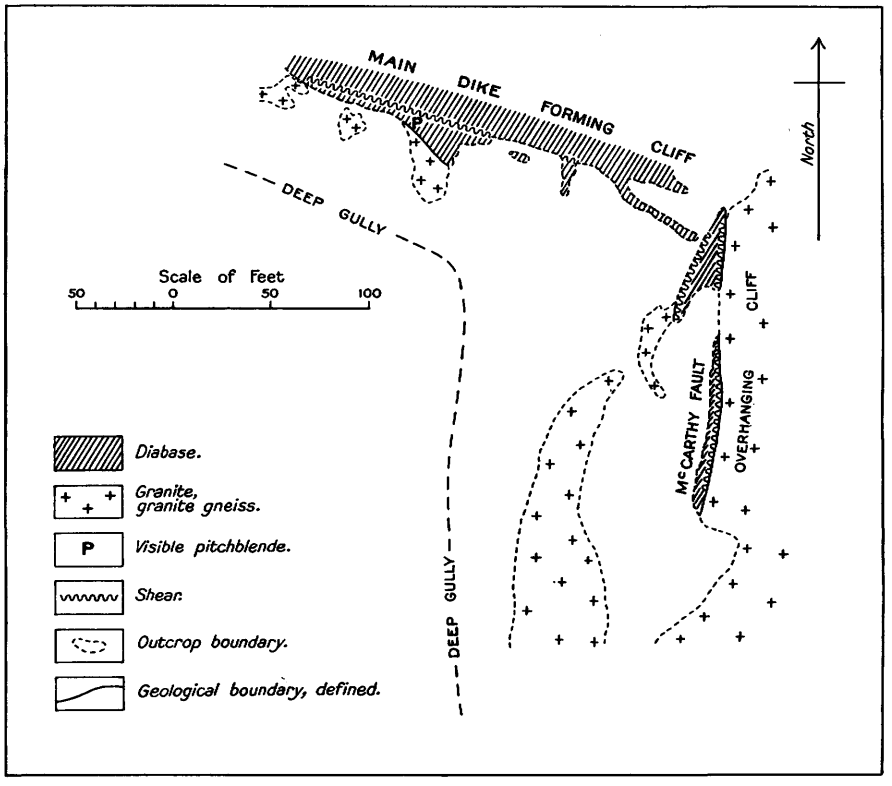
In the spring of 1949 the company erected bunk-houses and a cookery and undertook an extensive exploratory program on the claims, particularly the discovery. The showing was diamond-drilled, and by the fall of 1949, the calcite-hematite mineralization had been proved to a depth approaching 400 feet. The core was used to obtain U_3O_8-equivalent assays. The results of these assays showed a variability in the concentration of radioactive minerals and indicated that the grade of the deposit was too low to warrant further work at this time.

La Bine-McCarthy Uranium Mines, Limited
(See geological map, property No. 5)

The La Bine-McCarthy property is located in the northwest quarter of township 28, range XIV and overlaps into range XV. It includes the following patented claims: 16299–16310, 17224, 17225, 17227, 17228, 17230, 17231, 19281–19286, and 19914–19919. The camp can be reached by way of a company-built road 5–6 miles long from highway No. 17. During the period when the various companies were in operation, a raft attached to a cable spanning the Montreal River at the company transmission line provided access to the Ranwick camp.

The showing is in a diabase dike that may be the extension of the Canagau dike west of the Montreal River. On the geological map it is designated as the "McCarthy dike" after Roy McCarthy who discovered this pitchblende occurrence.

The main showing is near the south contact of the dike with granite near the top of a steep gully (see accompanying sketch map). Two hundred feet west of this, the dike is abruptly cut off by a north-south granite wall locally called the "McCarthy Fault." A second 20-foot dike occupies this "fault." The relationship between the two dikes is not clear. The author's experience in the surrounding area is that post-diabase faulting is not of major importance.



Geological sketch map of the La Bine-McCarthy showing, township 28, range XIV.

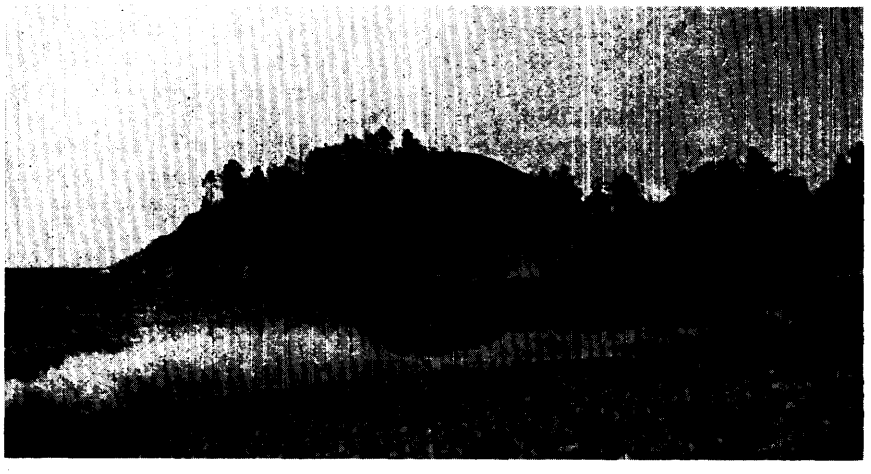
The main dike may have filled a fracture system in the granite that was terminated by a north-south fracture system previously filled by the 20-foot dike. Other east-west dikes have been located east of the "fault," but all are small, and none appear to be the extension of the McCarthy dike.

A feature of the showing is a brecciated zone 12–15 inches wide within the main dike, which runs roughly parallel to and is within several feet of the south contact. It is filled with hematite and white-to-pink coarse calcite. Narrower fractures, roughly parallel to and south of the brecciated zone, may be seen within the diabase. The zone passes into overburden 230 feet west of the "McCarthy Fault." Evidently this zone weathers easily for it is now at the base of a cliff formed by the main body of the diabase to the north.

Beginning at the point where it emerges from overburden, 230 feet west

of the "McCarthy Fault" (see accompanying sketch map), the zone is prominent, and geiger readings of 4–5 times background count were obtained over a length of 55 feet. The south contact here is not exposed. East of this, very high readings were obtained for 35 feet in the brecciated zone, but more particularly from fractures parallel to, and angling off, the shear, some of which contained excellent specimens of pitchblende. The contact swings southward here. Beyond this the shear is exposed for another 15 feet. It is composed of soft hematite; no calcite was seen, and the geiger readings dropped to twice background count. From here to the "fault" the shear is not exposed except at a midway point in a test pit, where it is much less pronounced. It is hematitic and soft, calcite is absent, and no anomalous radioactivity was noted.

The west contact of the 20-foot dike is exposed for 40 feet; it is filled for a width of 1–2 feet with hematitic material; geiger readings of 3–5 times background count were obtained. The east contact is exposed over most of a length of 155 feet. It is also sheared and filled with soft hematite. Low geiger readings were obtained.



A granite point forming the north shore of the Montreal River harbour.

Preliminary to underground exploration, the company constructed an electric transmission line in 1950 from the power plant at the mouth of the Montreal River to the property. A saw-mill was erected and lumber cut for the construction of bunk-houses, an office, and other buildings.

An adit was begun about 800 feet northwest of the surface showing in January, 1951. It was driven from the north contact across the dike in a southeasterly direction for 180 feet until it intersected the south contact. This contact was now followed for 1,080 feet to the "McCarthy Fault." The "fault" was followed for 318 feet to the south and 50 feet to the north. An inclined raise was driven 164 feet from the south contact of the main dike, where visible pitchblende occurred, into the centre of the surface showing. Ten short crosscuts, totalling 192 feet, were cut from the main drift, both north and south. Eleven hundred feet of underground drilling was done. The core was tested with a geiger counter and the holes probed for radioactivity.

The program was completed in 1951 without disclosing any appreciable volume of material of commercial grade.

Murmac Lake Athabaska Mines, Limited
(See geological map, property No. 7)

Murmac Lake Athabaska Mines, Limited, did considerable exploratory work in 1949 on a group of nine claims (15744–15752) in the north half of township 29, range XIV. Most of the work was performed on a northwest-trending diabase dike a few hundred yards east of highway No. 17. The most interesting feature of this showing is the south contact with granite, which had been exposed by stripping and trenching at intervals along a 400-foot length. The contact is sheared and highly chloritized across a 1-foot width along most of its exposed length. In places it is laced with a network of tiny hematite veinlets. Geiger readings of at least 2–3 times background count were obtained over most the length of the zone. At one point, for a length of several feet, geiger readings were very high. Here the chlorite is interbanded with 1-inch hematite veins. No pitchblende was seen by the author, but several specimens rich in uranium stains were removed.

Anomalous radioactivity was also found associated with fractures within the diabase. One of these fractures runs off the contact at a low angle. It is 1 inch wide over most of its 100-feet of exposed length, but twice within that distance it horsetails into numerous calcite-hematite bearing fractures with an accompanying rise in radioactivity. Other fractures, or more particularly the intersections of fractures within the dike, give high geiger readings, but any significant anomalous radioactivity is confined to a length of a few inches. Evidently the sheared south contact and certain fractures within the dike have acted as channelways for uranium-bearing solutions. Deposition is localized at the intersection of fractures and also appears to have favoured the tighter fractures.

The company undertook to diamond-drill the dike in the hope of obtaining intersections with fresher material below surface. Although calcite-hematite mineralization was encountered, the core gave no encouragement for further work, and the company ceased operations.

Patrick Uranium Mines, Limited
(See geological map, property No. 4)

Patrick Uranium Mines, Limited, has a group of eight surveyed claims. Seven (19288–19292 and 19409–19410) are wholly and another (20499) is partly in township 28, range XV. They lie between the La Bine-McCarthy property to the southeast and the Montreal River to the west. A company-built road branches from the La Bine-McCarthy road a few hundred feet west of the entrance to the adit.

It has been suggested that the diabase dike in which the showing occurs is an extension of the Ranson dike. If this is the case, then this portion of the dike has been offset to the north about 900 feet by a fault along which the Montreal River now flows. There is some reason to believe that a fault zone does exist here but of much less magnitude. The evidence favours the view that the Patrick dike is a distinct one.

The Patrick dike, where it has been cleared, is 30–40 feet wide. By late 1950, development work had accomplished the clearing of promising patches of the dike and blasting into radioactive fractures, revealing pitchblende. Anomalous radioactivity was apparent in both contacts with granite, although not continuous, in fractures parallel to the contact, and in cross fractures at intervals over a length of about 1,100 feet.

Further work undertaken in 1951 included diamond-drilling. The holes were tested with a geiger counter fitted with a probe.

Following this work the company decided to discontinue further development work for the time being.

RANSON DIKE SHOWINGS

Falconbridge Nickel Mines, Limited
(See geological map, property No. 1)

The Falconbridge property (claims A.C. 4707–4727) lies to the northwest of the F. D. Roche claims in the same township and is astride the Ranson dike.

Pitchblende was visible in a fracture of the footwall granite immediately east of the road. Across the road, stripping by bulldozer and trenching late in 1950 had located two radioactive fractures. One of these, traced for only a few feet, is within the dike and roughly parallel to the contact. The other is along the south contact, which is here strongly sheared across a 2-foot width. The contact had been exposed for 30–40 feet and is strongly radioactive. No pitchblende was seen in either of the zones, but this is not surprising in view of the highly oxidized surface conditions.

The Ranson dike would appear, to date, to be the most favourable dike for uranium prospecting in the area. Strong radioactivity, accompanied in places by visible pitchblende, has been noted at intervals for a full mile from the creek showing near the Ranwick adit, northwest to the Falconbridge stripping.

Ranwick Uranium Mines, Limited[1]
(See geological map, property No. 3)

Ranwick Uranium Mines, Limited, holds a group of 23 patented claims (A.C.4728–4730 in township 29, range XV; 20451 in township 29, range XIV; 15936–15938, 18950–18953, 18958–18964, 18998, and 18999 in township 28, range XV; and 20596 in township 28, range XIV)[2] north of the Montreal River.

Pitchblende was discovered by R. R. Ranson in November of 1948 in a northwest-trending, north-dipping diabase dike that has since become known as the Ranson dike and is so named on the geological map. The claims staked by Mr. Ranson and those later staked by L. G. Kaulser and H. L. Barwick form the Ranwick property.

By midsummer of 1949, trenching across the dike at intervals along a 200-foot length had exposed three sets of closely spaced fractures 5–10 feet apart, parallel to and near the south contact, accompanied by minor connecting cross fractures. These fractures contain pitchblende veinlets up to 1 inch wide altered in part to yellow secondary products to a depth of 5 feet. Some galena and chalcocite was reported. The company reported the following assays across the three main fractures: 0.059 percent U_3O_8 across 5 feet; 3.6 percent U_3O_8 across 5 feet; and 5.95 percent U_3O_8 across 0.4 feet. These samples were not contiguous, and the intervening ground gave comparatively low assays. However, the company felt that the samples had not been taken quite deep enough, and that resampling of fresher material would yield higher assays.

A new L-shaped trench, which was cut across the dike near the same location exposed nine radioactive fractures paralleling the contact over a 55-foot width. One fracture was followed along the dike for 80 feet. The company was sufficiently encouraged by tests of the new showing to begin underground exploration.

An adit was begun in January of 1950 about 900 feet southeast of the surface showing near a small creek where visible pitchblende had been discovered.

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[1]Now Consolidated Ranwick Uranium Mines, Limited.—*Ed.*

[2]The company reports that it has recently purchased claims A.C.4771–4774 and A.C.4900–4902 from F. D. Roche.

The adit was driven northwest along the footwall of the dike until a point, 1,049 feet from the portal, was reached. Two crosscuts were driven 70 feet across the dike, one of which was situated 120 feet below the surface showing. Five other crosscuts were turned off at intervals and driven for two or three rounds to permit sampling the dike at some future date.

Anomalous radioactivity was encountered at the very beginning of the adit, and after an advance of about 65 feet, visible pitchblende was observed associated with calcite-hematite veins and brecciation near the contact. Beyond this, pitchblende continued to occur, ranging from threads to seams of ½ inch, mainly in fracture planes either parallel to the dike contact or angling gradually towards it from the southeast. Narrow, rather tight calcite-hematite veins appeared to carry the higher radioactivity, whereas veins as wide as 4 inches were made up chiefly of calcite and hematite. Anomalous radioactivity was also noted in cross fractures, but as in the surface showing, these fractures were much less pronounced, and radioactivity much lower.

Assays along the total 1,049 feet of adit indicated that pitchblende occurs in ten "shoots" or zones with relatively barren intervening ground. The company reported the following results of bulk sampling from the backs in the ten zones from a total of 279.375 tons of rock broken:

Bulk sample	Width	Length	U_3O_8
No.	feet	feet	percent
1	3.0	22.5	0.0295
2	3.0	30.0	0.1025
3	2.5	24.5	0.0385
4	4.0	24.5	0.013
5	4.5	37.5	0.013
6	6.0	18.0	0.0195
7	5.0	40.0	0.012
8	3.0	24.0	0.0275
9	3.0	64.0	0.035
10[1]	3.0	17.0	0.050

[1]Bulk sample No. 10 was taken from below the surface showing.

Thus a combined length of 302 feet or roughly 30 percent of the total adit length assayed 0.0391 percent or 0.638 pounds U_3O_8.

In July, 1951, nine diamond-drill holes were put out from the end of the adit to further test the ore possibilities at this point. The drilling disclosed nothing of importance.

F. D. Roche Property
(Not located on geological map)

The F. D. Roche claims (A.C.4740, A.C.4741, A.C.4743–4745, A.C.4771–4774, and A.C.4899–4902)[1] in township 29, range XV, and northwest of the Ranwick property, are traversed by the Ranson dike. Stripping of overburden revealed anomalous radioactivity in fractures within the dike. Visible pitchblende was encountered here.

Summary

The radioactive constituents of granite in the Montreal River area have thus far not proved to be pitchblende; microlite-pyrochlore, a multiple oxide of columbium, tantalum, and titanium, was identified in one highly-radioactive

[1]Ranwick Uranium Mines, Limited, reports that it recently purchased claims 4771–4774 and 4900–4902 from F. D. Roche.

specimen. On the other hand, the radioactive mineral in the diabase-type showing is pitchblende accompanied at the surface by secondary uranium minerals, which are the result of surface or near-surface oxidation.

The multiple oxides are primary constituents of the granites and formed during the crystallization and solidification of the granite. The pitchblende was deposited from hydrothermal solutions along with calcite and hematite after the intrusion and fracturing of the diabase.

It is of some significance that pitchblende discoveries have so far not been reported from the large areas of Keweenawan lavas that overlie the older pitchblende-bearing diabase dikes to the south of township 29, range XIV. The explanation may be that the pitchblende was deposited prior to extrusion of the lavas, thus fixing the mineralization as pre-Middle Keweenawan in age. On the other hand, it is possible that the pitchblende is post-lava in age but is not found in the lavas because favourable openings for transportation and deposition of uranium were not provided in these rocks.

There is a structural relationship between pitchblende and diabase. All deposits of pitchblende in the area have, to date, been found in structural features that are in, or near and then related to, diabase.

These features are of two types:

1) Due to movement in a dike parallel to its contacts:
   a) Tension cracks running into granite from a diabase-granite contact (Camray and Franz properties).
   b) Granite-diabase contacts that are sheared (Murmac Lake Athabaska, Franz, Ranwick, and Breton properties).
   c) Fractures or shears within diabase that run off one of the contacts (Murmac Lake Athabaska and Franz properties).
   d) Fractures or shears within diabase that are roughly parallel to a contact (Ranwick and La Bine-McCarthy properties).
2) Due to movement in a dike which is not related to a contact:
   a) Fractures or shears that are inclined to a contact (Jalore property).

It is evident that shearing or fracturing along a contact, or within a dike, was a necessary preliminary to the intrusion of uranium-bearing solutions and deposition of pitchblende.

It is generally agreed that granitic igneous rocks are less favourable host rocks for the deposition of pitchblende from hydrothermal solutions than are rocks of basic composition. For example R. Murphy[1] states that in the No. 2 vein at the Eldorado mine, Great Bear Lake, ". . . while different types of sedimentary rocks as well as the early diabase are favourable to ore deposition, the porphyry is decidedly unfavourable." Christie[2] has observed that in the Goldfields area, "With few exceptions, the pitchblende deposits favour the dark-coloured mafic rocks or the altered carbonate rocks rather than the quartzites or granite-gneisses." One important exception is the Gunnar deposit where the host rock is a mylonitized granite. The pitchblende occurrences in the Montreal River area constitute still another example of the selective deposition of pitchblende in mafic rocks.

J. W. Gruner[3] performed a number of laboratory experiments to study the formation of pitchblende at temperatures ranging between 50°C. and 217°C.

[1]W. F. James, A. H. Lang, Richard Murphy, and S. N. Kesten, *Canadian Deposits of Uranium and Thorium*, Trans. Amer. Inst. Min. Met., Vol. 187, 1950, p. 247.

[2]A. M. Christie and S. N. Kesten, *Goldfields and Martin Lake Areas, Saskatchewan*, Geol. Surv. Can., Paper No. 49-17, 1949, p. 31.

[3]John W. Gruner, *New Data on Synthesis of Uranium Minerals*, U. S. Atomic Energy Comm., RMO-983, pt. 1, July 1, 1952.

He found that the UO_2^{++} ion in an uranyl sulphate solution could not be reduced to UO_2 (pitchblende) by H_2S alone. The addition of ferrous iron in the form of a ferrous sulphate solution, however, produced precipitation of UO_2. Subsequent tests showed that no ferric iron had been formed, indicating that the ferrous iron had acted merely as a catalytic agent. In another experiment H_2S was omitted. Again UO_2 was precipitated, but during the process, ferrous iron was oxidized to ferric iron suggesting that in this experiment ferrous iron had acted as the reducing agent. In other experiments, specimens of pyrrhotite and marcasite were immersed in the uranyl sulphate solution at 200°C. Appreciable pitchblende had formed after three days.

Iron-bearing minerals were frequently observed intimately associated with primary uranium minerals as the following examples chosen at random will illustrate. Pitchblende and brannerite occur with pyrite cementing the quartz pebbles of conglomerate beds in the Blind River area of Ontario. Uraninite is closely associated with aegirine-augite in syenite pegmatites near Bancroft; at Nunn Lake in the Lac La Ronge area of Saskatchewan, uraninite occurs in a biotitic zone in pegmatite. Pyrochlore in the Lake Nipissing district of Ontario is associated with pyrite in a calcite-apatite metamorphic rock. Autoradiographs of certain sandstones show that a radioactive mineral of unknown origin is confined to grains of magnetite. It appears certain, therefore, that the presence of ferrous iron is also significant in nature for the formation of primary uranium minerals, not only by deposition from solutions (pitchblende) but also during the crystallization of magmas (uraninite and the multiple oxides of columbium and tantalum), and it may be fairly assumed that this is the reason why mafic rocks are the favoured host rocks for the deposition of pitchblende.

It is generally thought that the hydrothermal solutions that deposit pitchblende have their origin in granitic magmas. This idea comes from the fact that the concentration of primary radioactive minerals, such as uraninite and the multiple oxides of columbium and tantalum, is usually higher in granites and granite pegmatites than it is in basic rocks of igneous origin. However, efforts to trace this relationship in the field in the two major uranium camps in Canada have been unsuccessful. Murphy[1] states that at Great Bear Lake, "the most general consideration, that the ore solutions have had a common origin with the granite, is open to several objections." Christie[2] suggests that it is improbable that the mineralizing solutions were genetically related to any intrusive now exposed in the Goldfields area. Similarly, in the Montreal River area, there is no evidence to relate the post-diabase pitchblende veins to the much older, radioactive granite.

Basic intrusives, on the other hand, have a much closer age relation to pitchblende in the two northern camps, although there are objections to a genetic linkage. Murphy is of the opinion that, "the later diabase at Great Bear Lake can be coupled to the ore deposits more closely than any other intrusive . . . but there are no general considerations supporting the proposed relation between pitchblende ores and diabase." Christie states that at Goldfields, "the diabase dykes . . . are a possible source because of the age limitation, but their distribution has no apparent connection with the deposits and their volume is small." In the Montreal River area too the diabase dikes are the intrusives most closely related in age to the pitchblende. Here the distribution of the dikes has a connection with that of the veins, and the volume of

[1]W. F. James, *et al.*, *op. cit.*
[2]A. M. Christie and S. N. Kesten, *op. cit.*

the dikes is considerable. The genetic relation between diabase and pitchblende in this area deserves serious consideration.

PROSPECTING AND DEVELOPMENT

The foregoing discussion indicates that diabase dikes are the best prospecting possibilities in the area. The possibility of occurrences in granite should, however, not be overlooked. In areas covered by overburden, the dikes can often be traced both on the ground and with the aid of air photographs, as shallow valleys, or by the persistence of prominent granite faces. Magnetometer surveys to locate dikes will prove useful except in areas of granite that contain large quantities of pre-Algoman inclusions. In some places anomalous results were obtained because of these inclusions.

The interpretation of results obtained from airborne geiger surveys should be approached with caution. A high anomaly over one dike in the Lake Superior region proved later to be due to an unusual concentration of radioactive minerals in the host granite. In addition to the geiger counter, the scintillometer was widely used to advantage. It proved especially useful in the detailed examination of radioactive anomalies in known discoveries. Its sensitivity is sufficiently great to permit, in most cases, the detection of the slight change in radioactivity in passing from diabase to granite. It may therefore be employed in mapping the contacts of dikes. The small geiger detector will probably continue to be the favourite instrument for prospecting at random.

Estimation of the grade of radioactive showings at the surface in the Montreal River area cannot be made with any degree of accuracy. Pitchblende characteristically weathers rapidly at surface, and veins are more or less filled with yellowish hydrous uranium alteration products to a depth of 3 feet or more. Diamond-drilling is useful in extending structural features in depth. However, only a small amount of information regarding grade can be obtained by the usual drilling methods. The erratic nature of pitchblende-bearing veins requires extremely close drilling. Furthermore, core recovery in soft, hematitic material leaves much to be desired. A geiger counter fitted with a probe for insertion in diamond-drill holes has been used in the Lake Superior region, but this instrument cannot be used to full advantage until data provided by it have been interpreted in terms of assays of typical rocks in this area.

The author is of the opinion that a systematic program of bulk-sampling from the surface should be a prelude to underground development. The first step should be to clear the surface of the dike of overburden to a practical degree with the aid of a bulldozer, pick and shovel, and water. A 1½-inch hose supplied with water pumped from Lake Superior was successfully used by John McCombe at the Franz showing to clear debris blasted from fractures. A considerable saving in manpower and time was effected. Next, closely spaced bulk samples should be taken across the whole or a portion of the dike or contact, depending on the particular circumstances, of fresh material obtained at least 5 feet below surface. In outlining the sampling program and interpreting its results it should be borne in mind that experience in the area indicates that continuity in depth of the pitchblende shoots can be expected to be at least as erratic as continuity horizontally on surface. Therefore, if a calculation of the tonnage and grade from proper surface sampling does not indicate that the prospect can be mined economically, it is not likely that underground development is warranted.

Finally, it may be of some value to point out that in the matter of building roads into properties situated some distance from existing transportation facilities, air photographs, obtainable from the Ontario Department of Lands and

Forests, should be examined with the aid of a stereoscope. The practice of pointing the bulldozer in the general direction of the property and by-passing or overcoming obstacles as they are encountered is extremely wasteful of time and money in an area as rugged as the east shore of Lake Superior. Invariably the resulting road follows a twisting and torturous course and is far from suitable for trucking. A study of air photographs will frequently reveal the presence of continuous valleys or flats that could be used to advantage.

FUTURE OF THE AREA

This area has an advantage over northern Saskatchewan and the Northwest Territories in its proximity to the refinery at Port Hope, Ontario. Concentrates could be trucked to Sault Ste. Marie, which has good harbour facilities, and sent by water to within a short distance of the refinery. Hydro-electric power is available. Therefore a lower grade of ore can be mined.

The results of bulk-sampling the favourable-appearing Ranson dike are disappointing. Showings of this grade would benefit from an increase in the price of uranium. The price of uranium in peacetime will depend upon the demand of industry, our reserves in western and northern Canada, and on future discoveries in other parts of the world.

INDEX, PART 3

A PAGE

Access 2, 3
Acknowledgments 2
Algoman (?) rocks 7
Algonquin, glacial lake 10
Alona Bay 1
  Copper mg 11
  Photo 9
  Rocks 9, 10
Alpha Lake 5
Amygdaloidal lava 10
  Copper in 11
Aplite, notes and photo 8

B

Barrett, L. P. 21
Barwick, H. L. 25
Basalt 10
  Copper in 11
Basement series 7
Batchawana Uranium Mines, Ltd. 13
Beach terraces 10
Berlangette, J. 2
Bobcam Mines, Ltd. 13
Breton property, report and sk. map .. 14, 15
Burgess, L. 2

C

Chalcite-hematite deposits 27, 28
Cambrian (?) sediments 10
Campbell, Robert 1, 16, 17
Camray Mines, Ltd.
  See also Bobcam Mines.
  Property, report, plan, and photo ... 15–19
    road to 3
Canagau Mines, Ltd. 20
"Canyon, The" 16, 17
Chalcocite 11, 25
Clausthalite 18
Clifton, F. T. 2,
Conglomerate 10
Consolidated Ranwick Uranium
    Mines, Ltd. 25
Cook, R. J. 2
Copper 11
Coracite 15–17

D

Development, mining 29, 30
Diabase dikes 4, 5
  Aplite in, photo 8
  Erosion of, notes and photos 4, 6, 8, 17
  Petrography 8, 9
  Pitchblende in 13–29
Diabasic lava 10
Dickenson property 20

E

Economic geology 11–30
Ellsworthite 12
Escarpments 4

F PAGE

Falconbridge Nickel Mines, Ltd. 25
Faults 22–24
Formations, table of 7
Franz property 20, 21

G

Galena 18, 25
Gemmell, R. 2
Geology, economic 11–30
Geology, general 7–11
Glacial deposits 10, 11
Gneiss 7
Goodfellow, G. 2
Granite 7
  Inclusions in 7, 10
  Radioactivity in 12, 21, 25–29
Gray, J. K. 2
Great Lakes Power Corp. 5, 6
Gunterman, Karl 14

H

Hematite-calcite deposits 27, 28
Hewitt, D. F. 16–18
Hotchkiss, H. 2
Hydro-electric power plants 5, 6

I

Iron. *See* Hematite.
Islay Lake 5

J

Jalore Mining Co., Ltd. 21
Jamieson, H. C. 2
Jones and Laughlin Steel Corp. 21

K

Kaiman, S. 18
Kaulser, L. G. 25
Keweenawan series 7–10
  See also Diabase dikes.

L

La Bine-McCarthy Uranium Mines,
    Ltd. 21–23
Lake Superior 1
  Shore line, notes and photo 3–5, 11
    rocks 8
    uranium claims 20
    see also Theano Point.
Lang, A. H. 16, 18
Lavas 9, 10
  Copper in 11
Le Conte, J. L. 15

M

McAndrew, J. 2
McCarthy, Roy 22
McCarthy fault 22, 23
McCloskey, J. 14

PAGE

McCombe, John 29
MacInnis, G. I. 2
Map, geological, coloured ..... *in pocket*
  Notes on 1, 2
Map, key 2
Maps, Sketch.
  Breton showing 14
  Camray showing ..... *facing* 18
  La Bine-McCarthy showing 22
Microlite-pyrochlore 12, 26
Miller, W. N. 2
Mining properties, descriptions of 13–26
Montreal River 5
  Fault 24
  Photo 6
Moore, E. S. 3, 7, 8, 10
Moore, M. 2
Murmac Lake Athabaska Mines, Ltd. . 24

N

Natural resources 6
Nethery, W. A. 2

O

Olivine diabase 10
Ossifrage Island, photo 13

P

Patrick Uranium Mines, Ltd. 24
Pegmatites 7
  Radioactive minerals in 12
Pitchblende.
  Deposition of 27, 28
  Discoveries 1, 16
  Occurrences and mining properties ... 13–28
  Weathering of 29
Plans. *See* Maps, sketch.
Pleistocene 5, 10, 11
Pointe aux Mines.
  Copper 11
  Rocks 7, 8, 10
Pre-Algoman rocks 7
Precambrian rocks 7–10
Prospecting, notes on 29
Pyrochlore.
  See Microlite-pyrochlore.

Q

Quebec and Lake Superior Mining Association 1, 3, 6, 11
Queminico Lake 5
  Pitchblende near 13

R

PAGE

Radioactive minerals 12, 26, 27
  See also Pitchblende.
Rankin location 3, 6, 11
Ranson, R. R. 25
Ranson dike 24–26, 30
Ranwick Uranium Mines, Ltd. 25, 26
Recent deposits 10
Richards, E. T. 21
Roads 3
  Building of, notes on 29
Robinson, S. C. 18
Roche, F. D., claims 26

S

Sand and gravel 5, 10
Sandstone 10
Satterly, J. 16–18
Schists 7
Sedimentary rocks 10
Selenium 18
Shaw, D. M. 2
Silver 20
Sphalerite 11
Stanard, B. A. 15
Syenite 7

T

Taylor, H. 2
Terraces, beach 10
Theano Point 3, 4
  Photo 1
  Pitchblende discovery 1, 16, 17
    see also Camray Mines.
  Rocks 7, 10
    diabase dikes, notes and photos . . 4, 9, 17
Topography, notes and photos 4–6
Township 28 1
  Mining properties in 21–25
Township 29 1
  Mining properties in 13–20, 24–29

U

Uranium.
  Discoveries 1, 15–17
  Occurrences and mining properties 11–26

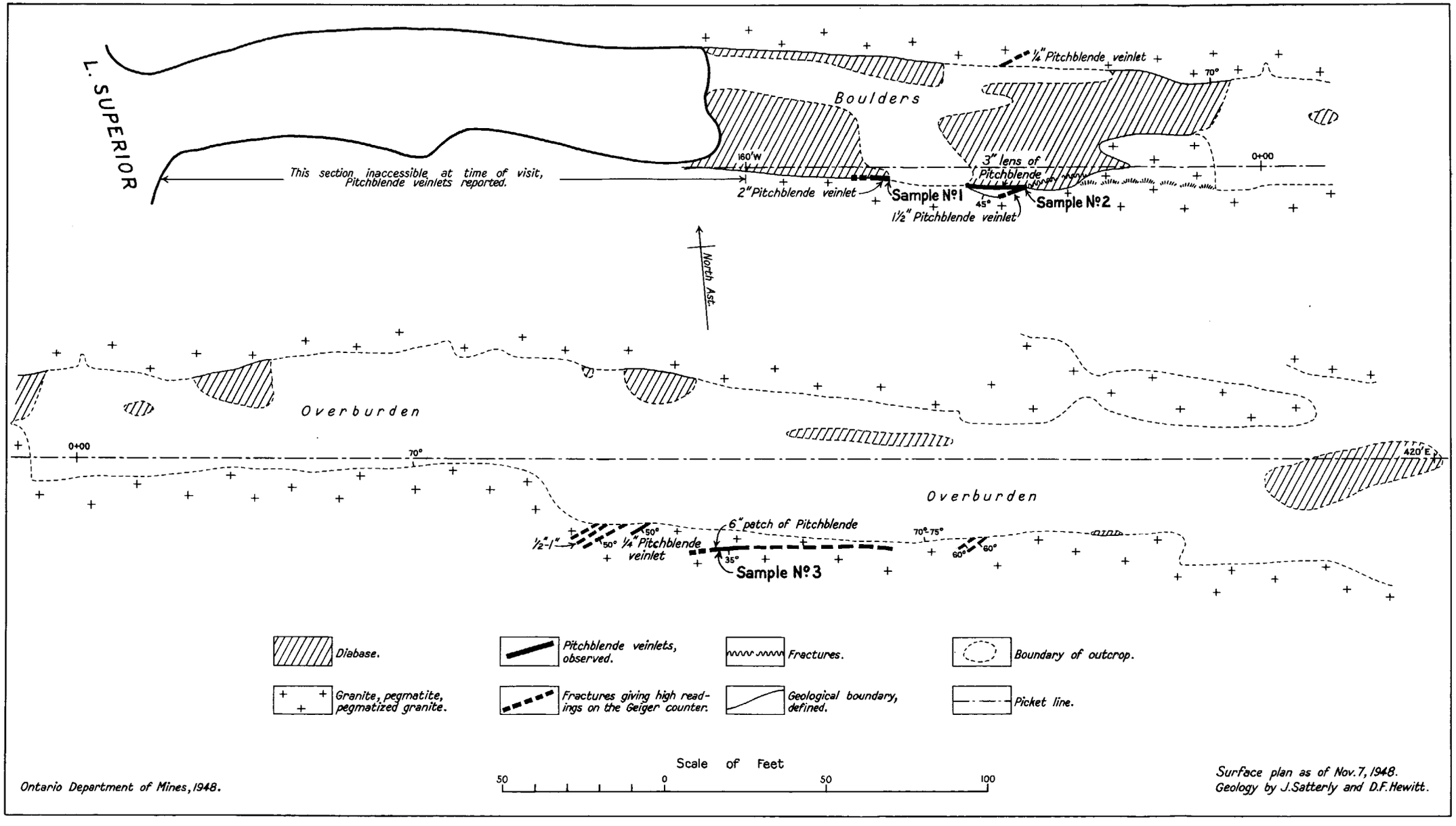
V

Volcanic rocks 9
  Copper in 11

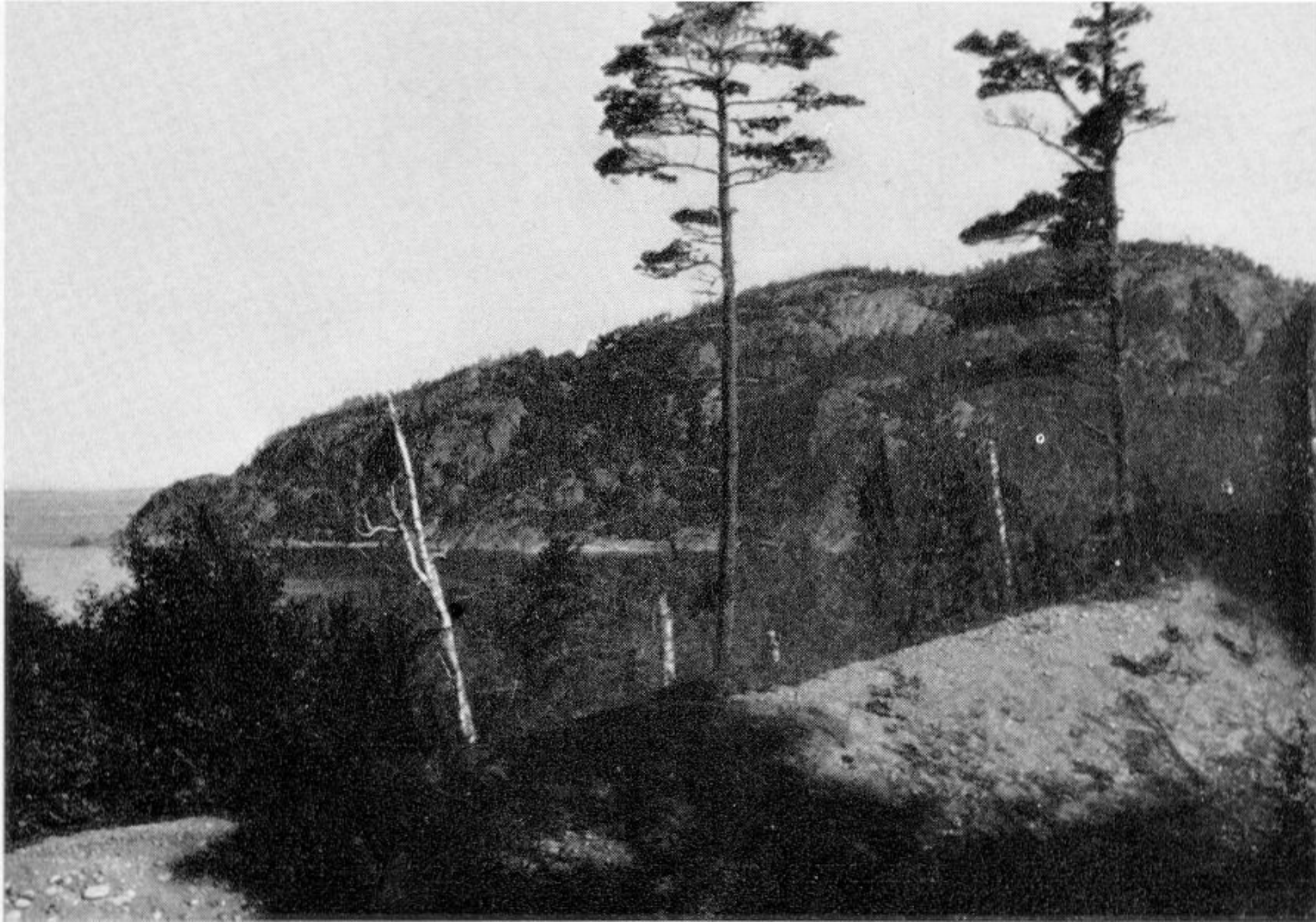
W

Woolverton, R. S. 2, 9

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Camray Prospecting Syndicate, Theano Point, Lake Superior, Tp. 29, R. XIV, District of Algoma



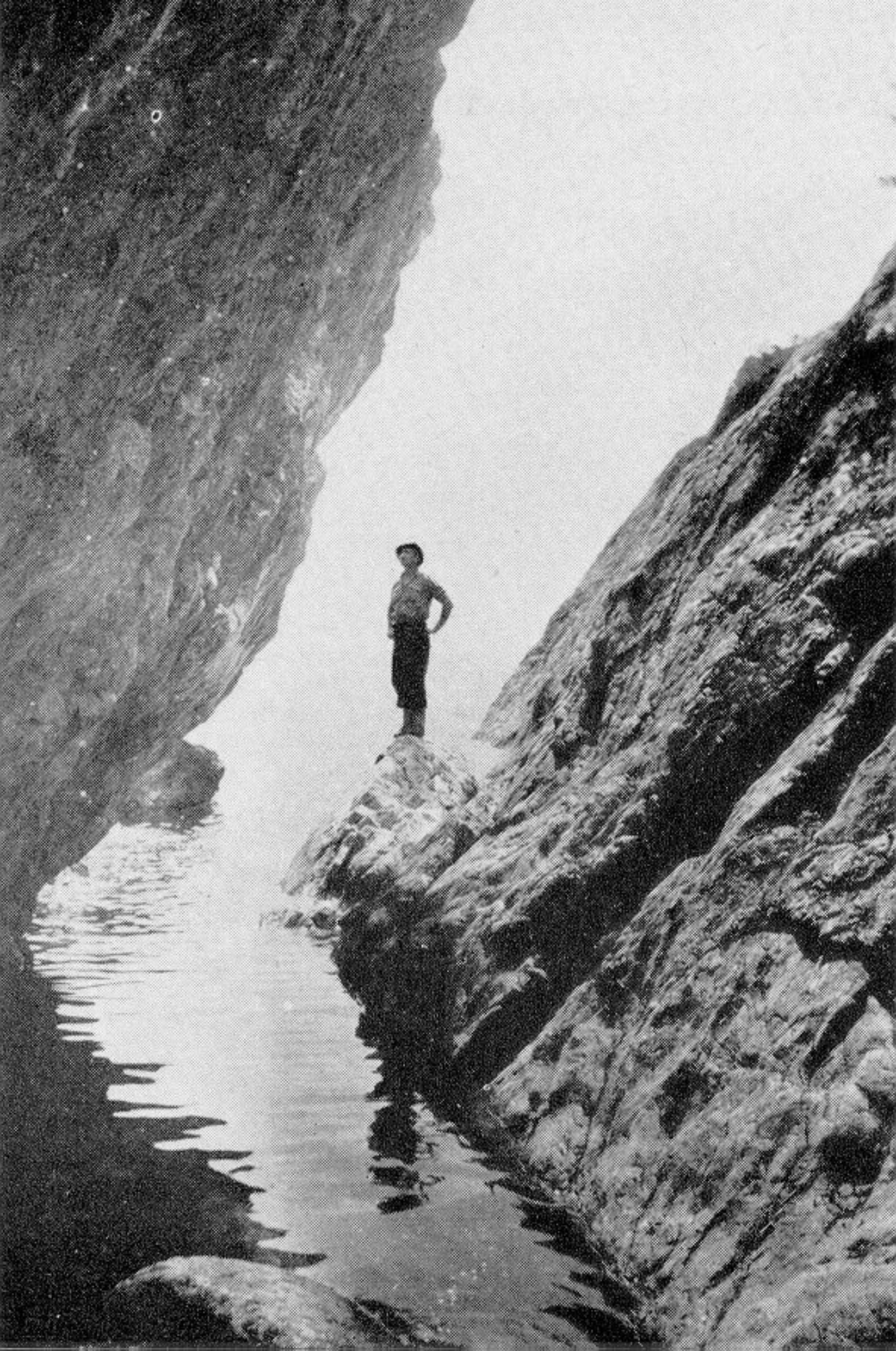




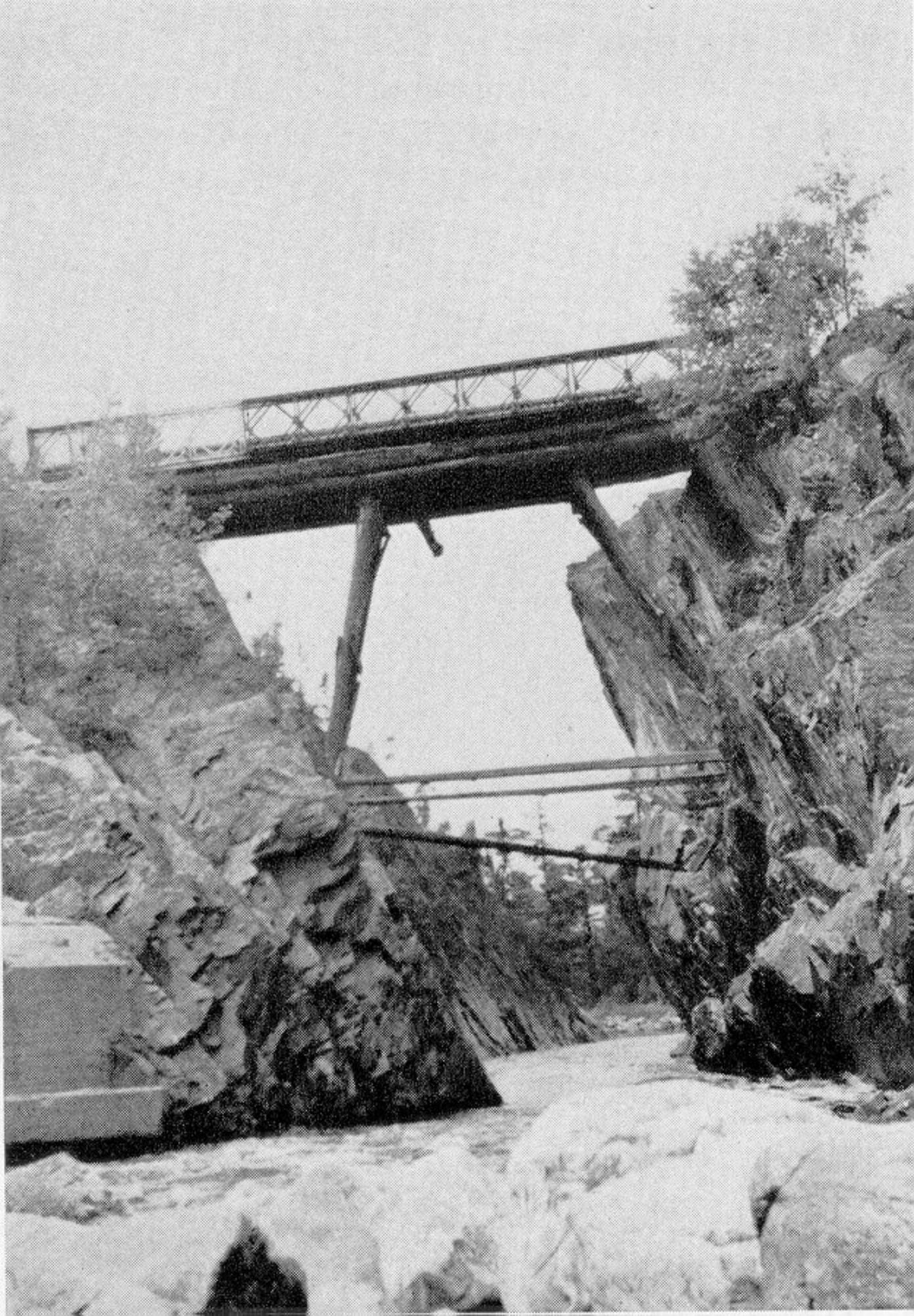














PROVINCE OF ONTARIO
DEPARTMENT OF MINES

HON. PHILIP T. KELLY, *Minister of Mines* H. C. RICKABY, *Deputy Minister*
M. E. HURST, *Provincial Geologist*

SIXTY-FOURTH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. LXIV, PART 4, 1955

Geology of the O'Sullivan Lake Area

By
W. W. MOORHOUSE

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO
Printed and Published by Baptist Johnston, Printer to the Queen's Most Excellent Majesty
1956

TABLE OF CONTENTS

Vol. LXIV, Part 4

	PAGE
Introduction	1
Acknowledgments	1
Means of Access	2
Previous Geological Work and Development	3
Topography	3
Natural Resources	4
Forest	4
Fish and Game	4
Water Power	4
Inhabitants	4
General Geology	4
Table of Formations	4
Keewatin	5
Metadiabase	5
Rhyolite	7
Tuff and Agglomerate	8
Iron Formation	10
Sediments	10
Pre-Algoman Intrusives	11
Algoman	12
Granites	12
Porphyries	13
Lamprophyre and Metadiabase Dikes	15
Keweenawan	15
Pleistocene	15
Structural Geology	15
Folding	15
Stuctural geology—*Continued*	
Shearing	16
Faulting	16
Economic Geology	19
Description of Properties	20
American Potash	20
Camdeck Gold Mines, Limited	20
Chimo Gold Mines, Limited	20
J. Conlon	21
Conwest Exploration Company Limited	21
Cryderman Claim	21
Harvey G. Green	21
M. H. Harlow	21
W. R. Hogan and J. Newman	21
Hurd-Demetrieff Group	22
Jarmack Mining Company, Limited	23
Lake-Osu Mines, Limited	23
Geology	23
Main Mineralized Zone	23
Megan Find	26
Ovansull Property	26
Rodney Gold Mines, Limited	28
Trans-American Mining Corporation, Limited	28
Other Occurrences of Mineralization	28
Recommendations to Prospectors	29
Index	30

ILLUSTRATIONS

	PAGE
The shaft, Lake-Osu mine, 1950	1
Amphibolitic agglomerate east of Prop Lake	8
Thinly bedded hornblendic tuff from the south side of the Supberb Lake arm	9
Knotted biotite schist from a reef in Superb Lake	10
An esker, Pelangio Point	14
Fault linears from the vicinity of Bigfault Lake	17
Fault linears from the vicinity of Hurd Lake	18
Mineralized quartz, Lake-Osu Mines, Limited	25

MAPS AND PLANS

	PAGE
Key map showing the location of the O'Sullivan Lake area	2
Sketch map of silver-bearing veins on Farley Island, Hurd-Demetrieff group	22
Geological sketch map of the main showing, Lake-Osu Mines, Limited	24
Geological plan of the 150-foot level, Lake-Osu Mines, Limited	*facing* 24
Geological sketch map of the west prophyry showing, Ovansull property	27

COLOURED GEOLOGICAL MAP

(In pocket at back of report)

Map No. 1955-2—O'Sullivan Lake Area, District of Thunder Bay, Ontario.
Scale, 1 inch to 1,000 feet.

Geology of the O'Sullivan Lake Area

By W. W. Moorhouse

INTRODUCTION

The O'Sullivan Lake area is located in the district of Thunder Bay 20 miles northwest of Nakina, a divisional point of the north transcontinental line of the Canadian National railway. It lies 50 miles east of Lake Nipigon and embraces an area of about 60 square miles. It includes all O'Sullivan Lake and the southwest part of Superb Lake.



The shaft, Lake-Osu mine, 1950.

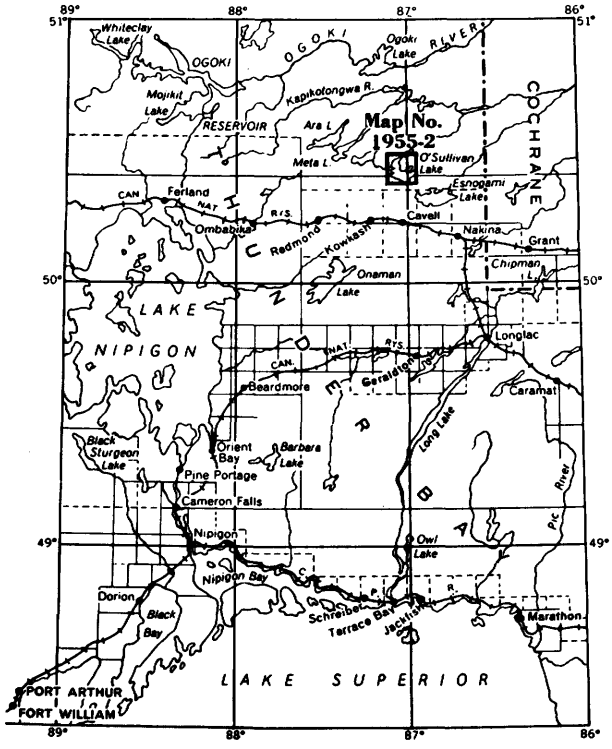
The present survey was carried out in the summers of 1947 and 1948, at a time when there was considerable interest in gold occurrences in the area. The mapping was done on the scale of 1 inch to 1,000 feet. Outcrops and contacts were located by pace-and-compass traverses, which were tied in to claim surveys, shore-line features, and recognizable points on air photographs. In areas where rock outcrops are abundant, traverses were spaced at intervals of six chains. Large areas of swamp or thick drift were not traversed in detail.

Acknowledgments

The author was ably assisted in the summer of 1947 by M. H. Hriskevich, D. W. Asbury, and R. J. Farley; and in the summer of 1948 by H. W. Pfeffer,

Peter Todd, and K. A. Morgan. These men carried out their duties efficiently; a good deal of the mapping was done by Messrs. Hriskevich and Pfeffer.

The field work was much facilitated by the friendly co-operation of the officers and employees of Osulake (later Lake-Osu) Mines, Limited, particularly Don Hurd, George Demetrieff, M. M. Ludgate, G. C. McCartney, W. A. Carter, and J. R. MacDougall. Prospectors in the area who assisted in various ways include Harvey Green, M. Harlow, Bill Shepherd, Joe O'Brien, W. R. Hogan, and Jack Conlon.



Key map showing the location of the O'Sullivan Lake area, district of Thunder Bay. Scale, 1 inch to 50 miles.

Means of Access

The area is most readily accessible by air from Nakina. It may also be conveniently reached by canoe from mileage 22½ on the Canadian National railway west of Nakina, via Johnson Creek, the Kawashkagama (Kowkash) River, and Abamasagi Lake. This route involves only a few short portages. A long-portage route used to connect O'Sullivan Lake with the Kawashkagama River by way of Hanover Lake, and a third route used to connect O'Sullivan Lake directly with Nakina, via Esnagami Lake. It is doubtful if the last two routes are still usable. While underground exploration was being carried out at the Lake-Osu mine, a tractor road was opened from the mine to Cavell, a siding on the Canadian National railway, by which heavy equipment and supplies were brought into the mine. All parts of the area are readily accessible from the lake.

Previous Geological Work and Development

The first geological observations were made in the O'Sullivan Lake area by W. J. Wilson and W. H. Collins[1] in 1904 for the Geological Survey of Canada, and in 1916 P. E. Hopkins[2] mapped the extreme western part of the area for the Ontario Department of Mines. The most recent mapping, prior to the present survey, was done in 1929 and 1930 by L. F. Kindle[3] for the Ontario Department of Mines.

The first known discovery of mineralization in the area was made many years ago by Russell Cryderman. The discovery was a gold occurrence in sheared and carbonated porphyry on the south side of the Cryderman Peninsula. Subsequently, in the late 1920's, lean copper mineralization was discovered a little over a mile east of Pelangio Point. Surface exploration was done on this showing by Northern Aerial Mining and Exploration Company. About 1935 the surface showing of the Lake-Osu property was discovered and staked by Jack Miller of Swastika. The showing was optioned and drilled by McIntyre Porcupine Mines, Limited, after which the claims were allowed to lapse. They were subsequently restaked by Miller and in 1945 were acquired by Osulake Mines, Limited. After this development, a large number of claims were staked in the area, and considerable exploration was done by a number of companies and individuals. Activity was considerably reduced by 1947, when the present mapping program was begun, and with the closing down of the Osulake operations, virtually all prospecting in the area ended.

Topography

The O'Sullivan Lake area lies north of the continental divide and forms part of the Little Current River system, which drains into Hudson Bay. Outcrops are for the most part relatively abundant for this part of Ontario, particularly on the peninsulas, which divide up the lake into a number of narrow arms and channels. Southwest of the lake, all rock is buried in a high hill of drift, which is visible from many parts of the lake. A broad belt of rock is also buried by a large esker, which extends northeast from Pelangio Point almost to Bigfault Lake. There are large areas of swamp, particularly north and south of the mouth of the Kawashkagama River, and on the mainland opposite Osulake Peninsula.

O'Sullivan Lake itself is a lake of great beauty, dotted with numerous well-wooded, rocky islands, and divided into many long and irregular arms, bays, and channels. Other lakes within the area, with the exception of Superb Lake, are all of small size, and are tributary to the main lake.

Apart from the hill of drift noted above, there are no elevations of any height in the area. Where outcrop is abundant, there are many cliffs and steep slopes, but few of them reach a height of more than 100 feet above the lake.

---

[1]W. J. Wilson, *The Little Current and Drowning Rivers, Branches of the Albany, East of Lake Nipigon*, Geol. Surv. Can., Vol. XVI. 1904, pp. 164A–73A.

[2]P. E. Hopkins, *The Kowkash Gold Area (Second Report)*, Ont. Bur. Mines, Vol. XXVI, 1917, pp. 190–226.

[3]L. F. Kindle, *Kowkash-Ogoki Gold Area, District of Thunder Bay*, Ont. Dept. Mines, Vol. XL, 1931, pt. 4, pp. 55–104.

Natural Resources

Forest

Much of the area consists of second-growth spruce, jackpine, balsam, poplar, and birch. A fine stand of original timber remains on the east end of Osulake Peninsula.

Fish and Game

O'Sullivan lake provides good fishing for lake trout and pickerel, and pike are abundant. Brook trout fishing on the Kawashkagama River and the Little Current River flowing northeast from Superb Lake is said to be good. Game is not especially abundant, but the Indians occasionally shoot moose, and one or two were seen by members of the party. Deer seem to be relatively scarce. Traces of bear were frequently seen.

Water Power

A number of small falls and rapids occur on the Kawashkagama and Little Current rivers, but none appear to offer important sources of power.

Inhabitants

A few Indian families live more or less permanently on the lake, but otherwise there are no permanent inhabitants.

GENERAL GEOLOGY

The consolidated rocks of the area are all Precambrian in age. The oldest rocks are a series of basic lavas, with which are associated basic, intermediate, and acid tuffs, the last being relatively rare. A series of metamorphosed sediments along the north boundary of the area mapped is considered here to be younger than the volcanics, but available evidence regarding its stratigraphic position is scanty and somewhat contradictory. These rocks have been intruded by gabbro, granites of various types, abundant dikes and irregular bodies of porphyry, and diabase dikes. The bed rock is overlain by Pleistocene glacial and glacial-fluvial deposits, and Recent swamp deposits.

Table of Formations

CENOZOIC	
RECENT:	Peat; river and beach deposits.
PLEISTOCENE:	Boulder clay, sand and gravel.
	Great Unconformity
PRECAMBRIAN	
KEWEENAWAN (?):	Diabase dikes.
POST-ALGOMAN (?):	Lamprophyre; diorite and metadiabase dikes.
	Intrusive Contact
ALGOMAN (?):	Quartz porphyry, feldspar porphyry, quartz-feldspar porphyry, aplite, dioritic aplite. Alaskite, hybrid granite. Granodiorite, quartz diorite.
	Intrusive Contact
PRE-ALGOMAN (?):	Gabbro, feldspathic gabbro, pyroxenite, peridotite; sheared gabbro.
	Intrusive Contact
SEDIMENTS:	Thin-bedded mica schists.
KEEWATIN (?):	Pillow lavas, metadiabase, amphibolite; rhyolite and quartz porphyry; tuff and agglomerate; iron formation.

Keewatin

The rocks classified here as Keewatin are predominantly of volcanic origin. Most abundant and most typical are the pillow lavas, which are found throughout the area except along the north edge of the Keewatin belt and in the southeastern part of the area, between the Northeast Arm and Wander Arm.

The pillow lavas appear, for the most part, to be basic or basaltic lavas, and in structure and microscopic features they resemble the Keewatin lavas throughout other parts of northern Ontario. The pillow structure is very well exposed on the shores of islands in the lake and on outcrops that have been recently burned over. Unfortunately, these lavas are not reliable for structural interpretation because, as a result of the intense compression that has been so general throughout the area, the pillow forms are invariably somewhat deformed. As far as can be determined they rarely appear to be elongated in the direction of strike of the flows as a result of this shearing. Consequently, top determinations that have been made and are recorded on the accompanying geological map (in back pocket) are unreliable and few in number.

On one or two islands and points exposed to strong wave action, pillows have, in places, become weathered out from the outcrop and can be lifted out bodily as football-shaped masses. In one or two outcrops at the east end of the Cryderman Peninsula very dense, flinty-looking material is found associated with pillows. In thin section it appears to be tuffaceous in character.

In addition to the pillow lavas, massive and structureless lavas also occur. Variolitic and vesicular flows seem to be relatively rare. Some slightly porphyritic flows are exposed in various parts of the area.

In the belt of metamorphosed, sheared amphibolitic Keewatin rocks between Merle Lake and Superb Lake, all primary structures of the original lavas have been completely destroyed. The same is true of the finer-grained schists in the granite-metadiabase complex of the peninsula south of Northeast Arm.

In the vicinity of porphyry dikes and certain quartz veins as in claim K.K.3357 and in the vicinity of the mineralized shear zone in claim K.K.3334 on the Lake-Osu Mines, Limited, property, the greenstone has been considerably altered. It becomes pale, greenish-white in colour on the weathered surface and develops a chalky texture. The altered rock, in thin section, proves to be made up of chlorite, carbonate, white mica, epidote and clinozoisite, albite, and quartz in place of the typical hornblende, chlorite, epidote, and albite of the normal greenstone. From the field occurrence and microscopic evidence it is not always certain that some of these altered phases are not tuffaceous in origin. The alteration evidently involves chloritization, albitization, carbonatization, and possibly silicification.

Metadiabase[1]

A very characteristic rock type in the Keewatin sequence is metadiabase. These coarse-grained, generally massive and structureless rocks are encountered in many areas of Keewatin lavas and are popularly known as "diorites." They form prominent outcrops some of which are over ¼ mile in width. The relation of the metadiabase to the lavas is generally obscure. In one or two places it has been possible to recognize a gradation in texture from the coarse-grained

[1]The heavy, broken black lines shown on the geological map (back pocket) to be near the Hogan-Newman property, south of Northeast Arm, represent inclusions of metadiabase and not iron formation as might be inferred from the map legend.

metadiabase to the fine-grained lava, as in an outcrop on the north side of Osulake Peninsula. Nowhere have definite intrusive contacts been observed between the two rock types, although in one or two places inclusions of finer-grained lava were observed in the metadiabase. Drill cores from the Lake-Osu mine indicated that the metadiabase and lava are usually intimately mixed. In most cases, it is probable that these massive rocks represent simply the coarser parts of flows; their structureless, resistant character results in their standing up as prominent outcrops.

The petrography and relationships of the metadiabases have been fully described by H. W. Pfeffer.[1] Throughout most of the area the metadiabase preserves perfectly the original ophitic or diabasic texture of the rock, although in most cases the pyroxene and calcic plagioclase initially present have been altered to fibrous uralitic hornblende and albite, often impregnated with saussurite. Only one or two samples were found that showed a little original pyroxene or plagioclase. This, in itself, is evidence to show that these rocks should not properly be called diorites. Chemical analyses of the metadiabase indicate its similarity to typical diabases and basalts and to the greenstones with which it is associated.

ANALYSES OF METADIABASES AND RELATED ROCKS

	1[2]	2[2]	3[2]	4	5	6
SiO_2	48.49	48.32	49.39	48.19	49.43	48.80
Al_2O_3	15.04	13.70	13.59	17.05	16.68	13.98
Fe_2O_3	3.41	4.45	3.78	4.06	3.24	3.59
FeO	8.36	8.52	8.97	9.29	10.23	9.78
MnO	0.11	0.16	0.21	.....	.....	0.17
MgO	8.06	7.82	7.03	3.64	4.54	6.70
CaO	9.72	11.09	10.12	8.99	8.49	9.38
Na_2O	1.59	1.00	1.78	2.24	2.56	2.59
K_2O	0.58	0.70	0.28	0.87	0.72	0.69
TiO_2	0.75	0.70	1.04	.....	.....	2.19
P_2O_5	0.12	0.12	0.26	.....	.....	0.33
H_2O	3.52	3.68	3.91	2.78	2.23	1.80
CO_2				2.43	1.24	.....
	99.75	100.26	100.36	99.55	99.36	100.00

1. Pillow lava (specimen No.K-59), Osulake Peninsula. Specific gravity, 2.95.
2. Medium-grained metadiabase (specimen No.K-62), Osulake Peninsula, taken about 20 feet from No.1 above; the two rock types grade into each other. Specific gravity, 3.04.
3. Coarse-grained metadiabase. Specific gravity, 2.98.
4. The average of 9 analyses of Keewatin basalts according to J. Satterly.[3]
5. The average of 7 analyses of pillowed Keewatin basalts according to J. Satterly.[4]
6. The average of 43 analyses of Plateau basalts according to R. A. Daly.[5]

The metadiabase occurs in an unusual manner on the peninsula north of Wander Arm. Here it is found in narrow bands from a few feet up to 400 feet wide, the bands being separated by granite that is more or less sheared. The origin of this very complex mixture of metadiabase and granite is obscure. The

[1]H. W. Pfeffer, by permission from his thesis for Doctor of Philosophy degree, *Petrogenesis of the Dioritic Rocks (Metadiabases) of the O'Sullivan Lake Area, Ontario*, University of Toronto, 1951.

[2]Analyses by D. A. Moddle, Provincial Assayer, Ontario Department of Mines.

[3]J. Satterly, "Pillow Lavas from the Dryden-Wabigoon Area, Kenora District, Ontario," University of Toronto Studies, Geol. Ser., No. 46, *Contributions to Canadian Mineralogy*, 1941, p. 133.

[4]*Ibid.*, p. 134.

[5]R. A. Daly, *Igneous Rocks and the Depths of the Earth*, McGraw-Hill Book Co., Inc., New York, 1933.

metadiabase appears to be normal in texture and mineralogy. It is possible that the finer-grained phases of the greenstone sequence have developed into shear zones along which the granite was intruded. The injection of granite is fairly consistently parallel to the northeast strike in this area. South and east of the area, especially on the islands and the southeast shore of Wander Arm, the distribution of granite, recrystallized metadiabase, and greenstone is much more irregular. The Keewatin occurs as roughly angular blocks enclosed in granite. The metadiabase and greenstone in this area are metamorphosed to a somewhat higher degree than in the belt to the north. A number of metadiabase outcrops are characterized by the presence of metacrysts of plagioclase, some attaining a diameter of several inches. Some of these are highly altered and are therefore probably phenocrysts, although similar textures have not been observed in other parts of the O'Sullivan Lake area. Some of the finer-grained amphibolitic greenstones, particularly along the south shore of Wander Arm, show irregular streaks and patches of coarser-grained feldspathic material, indicative of increasing injection and granitization.

In addition to the metadiabase and related rocks, which appear to be older than the granites, a number of dikes up to 80 feet wide, which appear to cut granite and pre-granite rocks, have been mapped. Texturally and mineralogically they resemble the metadiabase, except for the occurrence, in one dike, of patches of micropegmatite up to a couple of feet long. They have not been found in contact with the Keweenawan diabase, so their relative age is not definitely known; but their high degree of alteration, in areas where the later diabase is relatively fresh, has led to the conclusion that they are of an early period of diabase intrusion. Whether they are younger than all the granites in the O'Sullivan Lake area is not known since they have not been recognized beyond the southeast corner of the map area.

In the northern part of the map area, south of the arm leading to Superb Lake and along the northwest shore of O'Sullivan Lake, the metadiabases have been metamorphosed to an even higher degree. They have apparently been sheared and recrystallized intensely, because all trace of the original texture has been destroyed, and no pillow structures or other primary features are recognizable. The amphibolites derived from lavas are relatively fine-grained, but those developed from the metadiabase have become very coarse. Some amphibolites, as on the island and point immediately west of Pfeffer Point, contain an intensely blue (alkaline) amphibole, but this is not a general characteristic of the amphibolites described.

Amphibolites of obscure origin occupy a small irregular area at the contact of granite and sediments north of Odman Lake. Considerable outcrops of amphibolite and recrystallized greenstone also occur west and southwest of Elka Lake and in the vicinity of Prop Lake. Strongly banded or sheared amphibolites in the Elka Lake–Odman Lake area and on Peter Island and adjoining islands are of doubtful origin and are described more fully below, in the section on tuff and agglomerate.

Rhyolite

There are few rhyolites and related acid rocks in the O'Sullivan Lake area. A number of narrow bands of rhyolite and quartz porphyry outcrop on Cryderman Peninsula, Springpole Island, Harlow Island, and east of Conlon Bay. A few other minor occurrences are indicated on the map. In thin section these rocks appear to be very siliceous, sericitized, and otherwise altered. They are usually highly sheared but otherwise structureless.

Tuff and Agglomerate

Tuff and agglomerate are relatively subordinate except along the north edge of the area, in a belt extending from south of Superb Lake to Prop Lake. Elsewhere they occur as relatively narrow bands of 30-300 feet interbedded with lavas. The largest of these is on the north side of Cryderman Peninsula. This band is composed mostly of intermediate to basic agglomeratic rocks, with which are associated two narrow bands of rhyolitic tuff or arkose. The intermediate agglomerates continue eastward to outcrop on Farley Island. The distribution and strong shearing of this band indicates that it is rather complexly folded, particularly towards the east.



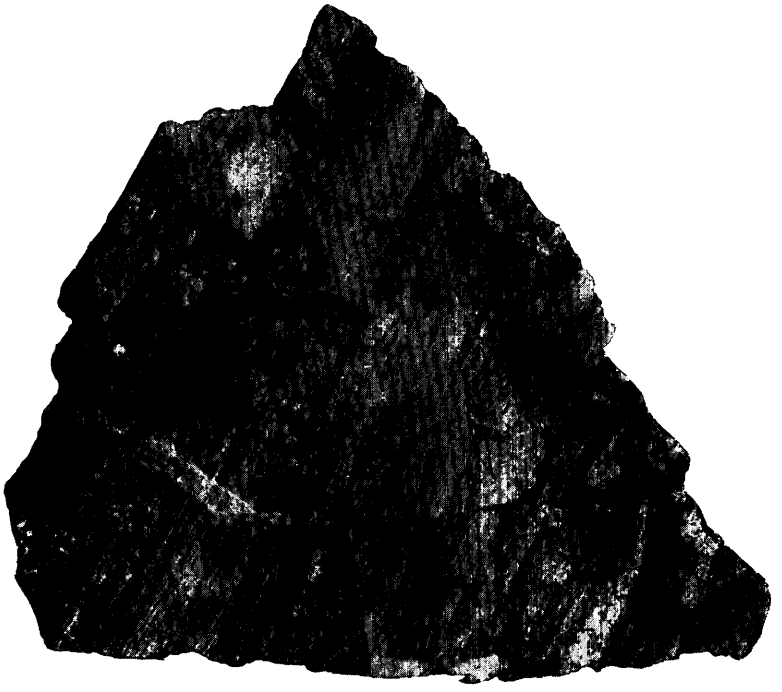
Amphibolitic agglomerate east of Prop Lake. The specimen is 7 inches long.

Two narrow bands of thinly bedded tuff are exposed on Osulake Peninsula. The south band is mineralized in places, as on the east shore of the bay in claim K.K.3334, and has been traced a few hundred feet west of the bay by trenching. It may possibly represent the zone in which the Lake-Osu mineralized zone has been developed. A similar narrow mineralized zone of tuff has been trenched on the island southeast of Pfeffer Point in the northeast corner of the Lake-Osu group of claims. Another tuff belt, possibly a continuation of the preceding one, has been exposed by workings on the Trans-American Mining Corporation, Limited, group on the east shore of the lake.

A rather extensive area of similar intermediate tuffs and agglomerates lies south and east of Conlon Bay. Owing to considerable shearing and faulting

in this area, the distribution of the fragmentals is not too clear, but a rather complicated fold structure seems apparent.

The belt of tuffs in the northern part of the map area is rather varied and, to the west, highly metamorphosed, so that identification of the original nature of the rocks is not always easy. Two main types are presented, one is a series of white to brown-weathering tuffs and agglomerates, particularly characteristic of the eastern part of the belt; the other is in the western part of the area, north of Kowkash Bay, a series of amphibolites and gneissic-appearing, banded garnetiferous amphibole-feldspar rocks. Many of the latter appear to be definitely tuffaceous and agglomeratic, but others may represent interbedded lavas, metadiabase, or possibly metamorphosed phases of the gabbro complex that



Thinly bedded hornblendic tuff from the south side of the Superb Lake arm. The specimen is 8 inches long.

lies west and south of the belt. All these rocks have been grouped together in the tuffaceous series, but it is probable that further detailed field and microscopic investigations would reveal a much more intricate mixture of several rock types. A thin section from the contact between an amphibolite and an agglomerate on a small island half a mile east of Peter Island shows essentially the same mineralogy in both rocks, except that the deep blue (alkaline) amphibole is much more abundant in the amphibolite than in its neighbour. A questionable "amphibolite" from an outcrop just west of the southwest end of Elka Lake proved, in thin section, to be a peculiar association of chlorite, epidote, and garnet. The sheared fragmental volcanics outcropping south of the gabbro-peridotite intrusive at the west boundary of the area are probably a part of this series.

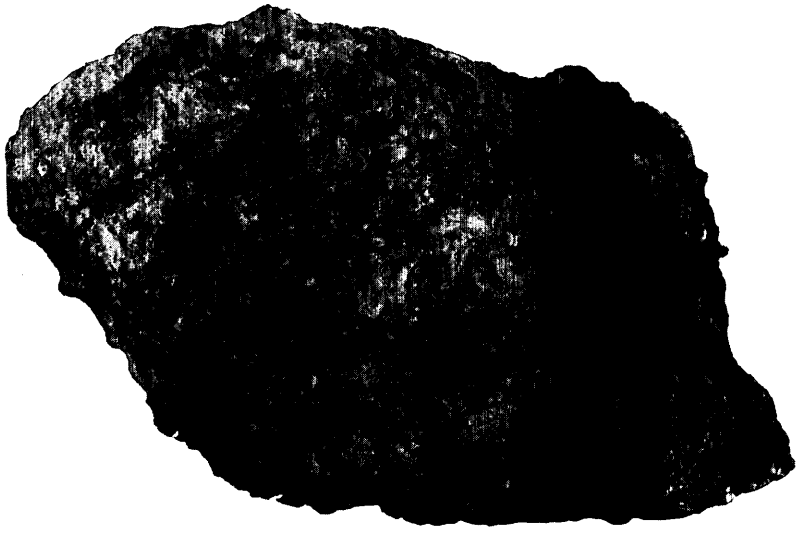
South of Elka Lake, near the south boundary of this predominantly fragmental belt, a number of outcrops of quartz porphyry and rhyolite, some of which may be tuffaceous, have been mapped.

Iron Formation[1]

A little magnetic iron formation was encountered in the area southeast of Conlon Bay. It is exposed on the side of an outcrop, so that its size is not determinable; but it does not seem to be of any consequence.

Sediments

A belt of sediments, ½-¾ mile wide, lies along the north edge of the area, separating the tuff-amphibolite zone from pegmatitic granite to the north. These sediments are for the most part light-grey to brown-weathering, sandy-



Knotted biotite schist from a reef in Superb Lake. The specimen is 9 inches long.

looking biotite schists and gneisses, in some cases with nodules of metamorphic minerals that tend to stand out on the weathered surface. The sediments appear to be otherwise structureless, except for one or two occurrences of grain-gradation. They show very little variation in grain, and neither conglomeratic nor slaty beds are recognizable as such. In some places tuffs appear to be interbedded with the more normal sediments.

In thin section, the sedimentary schists appear to be made up of quartz, biotite, and plagioclase; in places, andalusite, staurolite, and garnet occur. The occurrence of the andalusite and staurolite suggests that these schists were originally more argillaceous than they now appear.

The relation of the sediments to the Keewatin is obscure. Kindle,[2] following Hopkins,[3] has grouped these rocks with the Marshall Lake series, which he

[1]See footnote re Metadiabase on page 5.

[2]L. F. Kindle, *Kowkash-Ogoki Gold Area, District of Thunder Bay*, Ont. Dept. Mines, Vol. XL, 1931, pt. 4.

[3]P. E. Hopkins, *The Kowkash Gold Area (Second Report)*, Ont. Bur. Mines, Vol. XXVI, 1917, p. 207.

considers pre-Keewatin in age. Very meagre evidence from top determinations would seem to support this interpretation, but other evidence points to the younger age of the sediments:

1) A differentiated gabbro sill (described below) in the western part of the area, which has been intruded into the Keewatin and appears to have been folded with it, faces north, that is, towards the sediments.

2) The greenstones are separated from the sediments by the tuff and agglomerate zone described above. Since in most areas thick accumulations of fragmental rocks appear to overlie the main mass of basic pillow lavas, this relationship suggests a younger age for the sediments.

3) The distribution of metadiabase bodies in the Keewatin complex suggests a rather complicated fold pattern, but the sediments do not appear to be involved in this folding; this suggests that the volcanics were folded and eroded before deposition of the sediments.

It is recognized that the above evidence is not conclusive. If it is accepted, it also implies that the gabbro sill is older than the sediments, and it should therefore be placed below them in the table of formations. The sill and the sediments are nowhere known to be in contact, so direct evidence of their relationship is not available.

Pre-Algoman Intrusives

The pre-Algoman intrusives are best exposed on the north side of the Kawashkagama River, just west of Kowkash Bay. They are here exposed continuously from the river to the south side of Prop Lake, the maximum width being about half a mile. The gabbro, which is characteristic of these intrusives, is highly altered, and differentiated with the development of peridotitic and pyroxenite facies. The most persistent and easily recognized phase of the sill is the peridotite. This forms a continuous belt, 300 to nearly 1,000 feet wide, along the south side of the intrusive. It is invariably altered, but in thin section, the serpentine, of which it is mainly composed, clearly indicates by its structure that it has been derived from primary olivine. Associated with the serpentine is a small amount of carbonate, in places talc, and scattered grains of magnetite. No chromite has been noted in any of the sections examined. A pyroxenite from within the serpentine zone was found to contain serpentine and remnants of a colourless hypersthene. Hopkins[1] gives an analysis of this serpentine in which only a trace of chromium is recorded. In a few outcrops the serpentine is seamed with small, irregular cracks containing asbestos. No fibres longer than 1/10 inch were encountered in mapping the serpentine.

To the north of the serpentine, the gabbro sill consists largely of medium to coarse-grained gabbro, with some isolated occurrences of pyroxenite. The gabbro is much altered in that no pyroxene is preserved, its place being taken by almost colourless, fibrous amphibole. Surprisingly enough, the plagioclase is very little altered, consisting for the most part of labradorite. Sphene is usually present. Thin sections of altered pyroxenite from within the gabbro phase are in every case composed of the same minerals as the gabbro, except that the amphibole is in larger amounts.

The north contact of the gabbro mass is not well defined. It is in contact with a series of coarse amphibolites, and appears, itself, to have been metamorphosed to coarse hornblendic rocks along this contact.

[1] P. E. Hopkins, *op. cit.*, p. 206.

To the west, the gabbro extends beyond the limits of the area mapped. To the east it terminates against a fault trending roughly north. As noted previously, it is possible that it continues east of this fault, in the amphibolite-fragmental complex between Elka and Odman lakes. If this is the case, it must have changed considerably in character.

The original form of the gabbro intrusive is not definitely known, but it is believed to be a sill in view of the type of differentiation that it has undergone. Actually, the intrusive appears to cut across the strike of the Keewatin at a small angle, since fragmentals occur south of it at the west end of the area, but are only known north of the gabbro to the east. Thus the intrusive might better be described as a sheet than a sill.

Gabbro also occurs in the eastern part of the area, two or three distinct bands, 100–700 feet wide, lying just south of Superb Lake. This gabbro is throughout intensely sheared, and most outcrops are characterized by a marked fluxion structure. Thin-section examination of this rock confirms the profound shearing it has suffered. The plagioclase, though still labradorite in composition, is completely granulated and no longer retains its original crystal form. The sphene and amphibole of the rock are also strongly streaked out parallel to the direction of shearing. Since this gabbro appears to be parallel in strike to the volcanics with which it is associated, it is believed to be sill-like in form.

Algoman

A great variety of siliceous intrusives are included in the Algoman described here. There is some evidence that among these rocks there are granites and related rocks of more than one age, but in the absence of well-defined intrusive relationships it has been considered advisable to discuss them as a group.

Granites

The oldest granites in the area appear to be those that are associated with the metadiabases on the peninsula north of Wander Arm and on the islands and south shore of Wander Arm. This "granite" is properly a quartz diorite, being composed exclusively of quartz and plagioclase, generally andesine-oligoclase in composition, together with biotite or chlorite and abundant alteration products such as sericite and saussurite. Microcline or orthoclase are either completely absent or present in accessory amounts only. The "granite" is fairly massive and not deformed in the southern part of the area, but on the peninsula itself it is generally sheared. Along the shear zone that bounds the metadiabase-granite complex on the north, the "granite" has been intensely deformed, so that it is now a chlorite schist with large quartz eyes.

The quartz diorite is distinguished from later granitic intrusives by its being cut not only by Keweenawan diabase dikes but also by dikes of felsitic porphyry, pegmatite, and metadiabase (see page 6). These features are the basis for believing that it is somewhat older than other granites in the area. There is no doubt that it is intrusive into the metadiabases and associated volcanics, so that it is certainly post-Keewatin. Whether it represents an early period of granite intrusion (Laurentian) or is simply an early phase of Algoman vulcanism is not known, but the latter is considered more likely by the author.

In the broad area of Keewatin between the Northeast Arm and Superb Lake, there are a number of stocks, a sill-like intrusion, and a variety of smaller, irregular bodies of a light-coloured, generally rather siliceous granite, which,

in some cases at least, has fine-grained, porphyritic border facies. In view of the latter characteristic, this granite is considered to be very closely related to the porphyries that occur widely throughout the O'Sullivan Lake area, but are particularly abundant in the section in which the stocks and bodies of granite occur. In a few places, as in the small stock about a mile northeast of Hurd Lake, syenitic and dioritic hybrid facies have been developed. The large stock northeast of Pelangio Point is noteworthy for the contact effects associated with it. The lavas in contact with it appear hornfelsic and recrystallized. In places, rather broad zones of carbonatization have been observed in the greenstones. Around the stock the greenstones have been rather generally impregnated with scattered pockets and grains of iron sulphide and, rarely, chalcopyrite.

In thin section, these granites, like the quartz diorite just described, are characteristic plagioclase granites, in which the principal feldspar is albite. A little microcline was noted in one or two places, and it may be more abundant in the sill-like intrusion south of Superb Lake. However, the intimate association found between this granite and the porphyries confirms the general prevalence of albite mentioned, since all the porphyries are themselves sodic.

The third type of granite is exposed along the north boundary of the map area, where it occurs almost invariably in contact with the sediments. It is a distinctly pegmatitic granite, in which the principal constituents are almost equal quantities of microcline and albite, quartz, a little biotite and muscovite, and, in places, garnet. In one case the microcline was found to be replaced by secondary albite. North of Odman Lake the pegmatitic granite is separated in places from the sedimentary schists by an irregular mass of coarse amphibolite. In this area also, hybrid syenitic or dioritic rocks have been developed. Along the contact between the granite and the sediments, the sediments are much injected by dikes of pegmatite, so that the contact between the two rock types is difficult to determine.

The relations between the pegmatitic granite and the stocks and sills to the south of it in the greenstones, are not known, since the two types have not been observed in contact. The presence of pegmatites cutting the quartz diorite south of Wander Arm may indicate that the pegmatitic granite is the younger.

Porphyries

The porphyries constitute one of the most interesting rock types studied in the area. They are very widespread, and range in size from narrow dikes, a few inches wide, to large dikes and irregular bodies up to 300 feet wide. They vary somewhat in composition, including quartz porphyries, which are probably most common, quartz-feldspar porphyries, feldspar porphyry, aplite, and dioritic aplite. The porphyries vary somewhat in their structure. Some, such as the porphyry in the Lake-Osu mineralized zone and on the old Cryderman claim, are rather highly sheared. Others, which are more massive, may have chilled margins against the adjacent country rock. All the porphyries examined appear to be intrusive in character. Some of the dikes are cut by quartz and carbonate stringers and mineralized with pyrite. A little gold has been discovered in the quartz of some of these porphyries, as in the large dike on the Camdeck property, in the dike on the point three-quarters of a mile east of Pelangio Point, and in the dike on a small island southeast of the Lake-Osu mine. Most of the dikes and bodies of porphyry shown on the map, however, are unmineralized.

Most of the porphyries, in thin section, are found to contain abundant quartz and albite, both in phenocrysts and matrix, together with variable amounts of sericite, carbonate, chlorite, and occasionally hornblende. In the more

sheared and altered porphyries, little if any albite is recognizable, and sericite is correspondingly more abundant. In some apparently related dikes, quartz no longer appears as phenocrysts, the plagioclase is more calcic, and the ferromagnesian minerals are more abundant. This type of dike has been named "dioritic porphyry" on the map.

Reference has already been made to the interesting occurrence of quartz



An esker, Pelangio Point.

porphyry as a local border phase of granite stocks and sills in the east-central part of the area. With these intrusives there are associated more or less irregularly distributed swarms of dikes and bodies of porphyry. They are quite variable in strike. Dike swarms are found west and southwest of Bigfault Lake, south and west of Hurd Lake, north of Bayhead Island, and north of Conlon Bay. Two large sill-like bodies and quite a number of dikes occur east of Pfeffer Point.

Lamprophyre and Metadiabase Dikes

A few narrow lamprophyre dikes were mapped in various parts of the area. They are not, however, particularly abundant, and in most cases are hardly large enough to show on the map. The metadiabase dikes in the Wander Arm area have been described. As already noted, the age relationships of these dikes has not been definitely determined. They are younger than the quartz diorite, but their relation to other granites and the later diabases is unknown.

Keweenawan

Diabase dikes are abundant, particularly in the eastern part of the area. Several were examined in thin section, and all proved to be quartz diabases. In the southeast quarter of the area, diabase occurs in bodies up to 300 feet wide. The form of these bodies is not known. The dikes in general strike northwest, but two north-striking dikes also occur, and one northeast-striking dike was mapped south and east of Conlon Bay.

Pleistocene

Glacial till is distributed rather thinly over most of the area, except in the main valleys. However, southwest and west of the area, south of the Kawashkagama River, the bed rock is deeply covered with sand and gravel, which rises to a considerable height above the lake to form the prominent hill southwest of Discovery Bay. Another thick accumulation of drift is formed by the esker that extends northeast from Pelangio Point, where it terminates in the lake, almost to Bigfault Lake. This broad ridge of sand and gravel is dotted here and there with small pot-holes and pot-hole lakes. Southwest of Esker Lake, the esker is flanked on both sides by large areas of low, more or less open swamp, except in the vicinity of the large granite stock, which is fairly well exposed. Another extensive area of swamp and low sandy drift lies east and north of Prop Lake. North of Peter Island and the channel east of it, the mainland is flat and swampy, with very scanty outcrop. The north shore of Superb Lake is also buried in deep, sandy drift. The lake is crossed near the boundary of the map area by a shoal of fine sand and gravel, which is barely passable by canoe late in the summer.

Observations on glacial striae indicate a southwesterly movement of ice in this area. This direction is fairly general for the region, except where locally modified by structure.

STRUCTURAL GEOLOGY

Folding

All volcanic and sedimentary formations mapped in the area dip at steep angles, so that it can be concluded that these rocks have been strongly folded. Unfortunately there are no persistent flows or other recognizable horizons that can be traced for long distances. It is therefore impossible, on the basis of available information, to unravel the complexities of the fold structure. Various observations, such as the distribution of the metadiabase outcrops and the strike of some of the tuff horizons (in the area south of Conlon Bay, the point on Cryderman Peninsula west of Farley Island, and elsewhere) imply that folding is not simple. A peculiar feature, which appears to be very general, is the easterly to southeasterly strike of narrow tuff bands in the lavas. This suggests

that before being modified by shearing, the general trend of the fold structures was in this direction. The distribution of metadiabase outcrops around the Osulake Peninsula also suggests an easterly strike for the original fold axes.

Shearing

Most of the volcanics and sediments and some of the intrusives in the O'Sullivan Lake area have been sheared. The metadiabases, however, appear to have been sufficiently competent to escape all but the most concentrated shearing. In the west half of the area, the direction of shearing appears to be closely related to the character of the rock. Shearing in metadiabases strikes northeast, in lavas east-northeast, and in tuffs east or east-southeast. In the east half of the area no statistical studies have been made of the shear directions, but they seem here to be less dependent on the rock type. The shearing is generally northeast, but in certain places, as along the west trail from the Northeast Arm to Hurd Lake, and farther east, the strike of shearing is almost north.

Shearing in the lavas and sediments south of and on Superb Lake, and in the belt of tuffs and sediments extending west from there, has been intense. The rocks exposed on Harlow Island and to the east have also suffered heavy shearing, particularly near the break that separates these highly injected rocks from the more normal lavas to the north.

Innumerable shear zones were recognized in mapping, and a few of these appear to be important enough to deserve special mention. The mineralization at the Lake-Osu mine is located in highly sheared volcanics and quartz porphyry. A strong shear zone extends from the Camdeck showing east to Farley Island, along the north shore of Cryderman Peninsula. Both these sheared zones are probably tuffaceous in origin. The rocks on the south side of this peninsula are also intensely sheared. Other strongly sheared zones are located on the mainland north of Pelangio Point, on the point ¾ mile east of Pelangio Point, on the point opposite the east end of Bayhead Island, and in the area south of Conlon Bay. The rocks along the fault on the southwest shore of Northeast Arm have been intensely sheared. It is interesting to note that the Lake-Osu mine appears to be located at the intersection of a strong, wide belt of northeast shearing with the general east-west strike of Osulake Peninsula

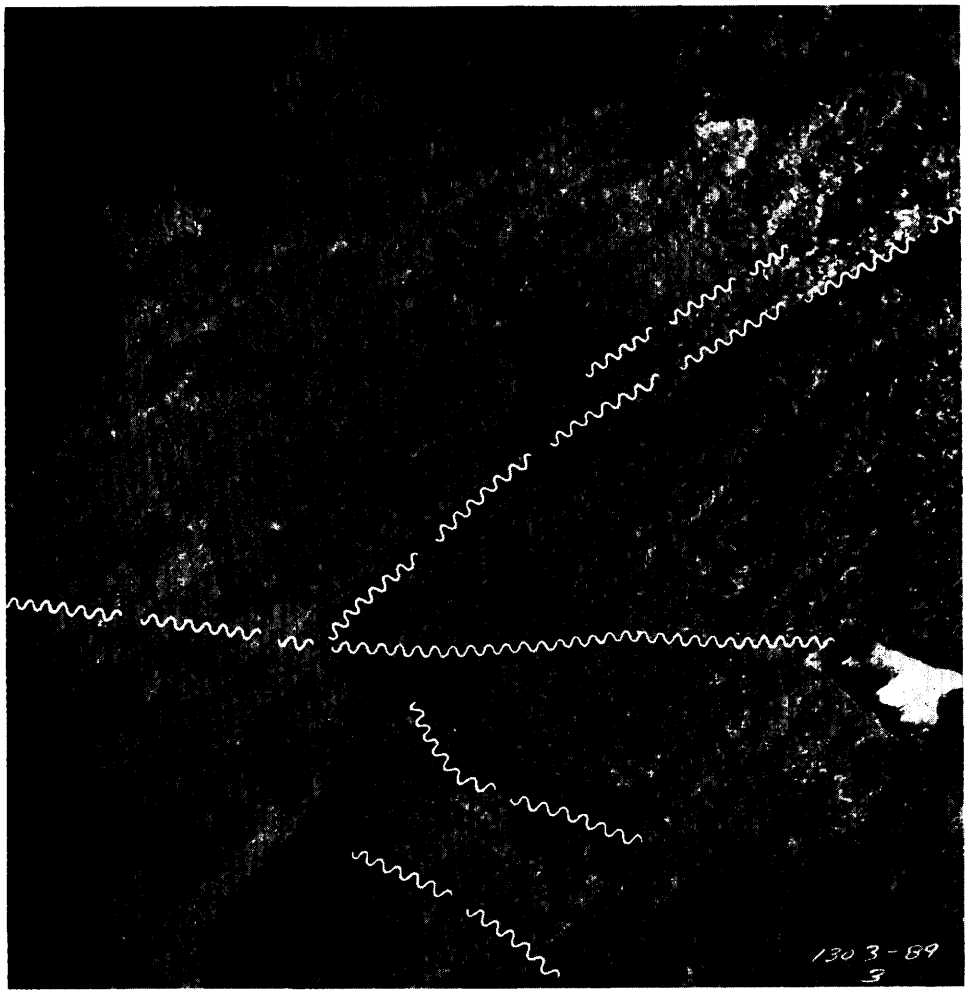
Faulting

Faulting is believed to have been very prevalent in the area. It is probable that only a small proportion of the existing faults have been recognized and represented on the map; owing to the absence of distinct marker horizons evidence of offsetting can often only be identified where diabase dikes have been cut by faults. Thus most of the faults recognized are of late development.

An early fault with one of the largest displacements so far recognized follows a course from Bigfault Lake west-by-north through the west end of Superb Lake. This fault has a strike-slip of roughly ¾ of a mile, the north side moving east. The distribution of porphyry along this fault, near Bigfault Lake, suggests that the movement was roughly contemporaneous with the period of porphyry intrusion. If so, this fault is one of the oldest recognized. A number of roughly parallel subsidiary faults have been inferred from topography southwest of Bigfault Lake. A similar fault has been inferred immediately north of Peter Island to account for a displacement of over a mile southeast of the granite-sediment contact. Apparently minor faults, which may be related to

these, are suspected in the narrows at the entrance to Superb Lake, striking northeast, and south of the western entrance to the lake, striking southeast.

Another major structure, presumably also an early one, is the shear zone which has been traced along the south shore of the Northeast Arm from Harlow Island to the east boundary of the map area. This break finds expression in intense shearing of greenstone, metadiabase, and granite, and has been min-

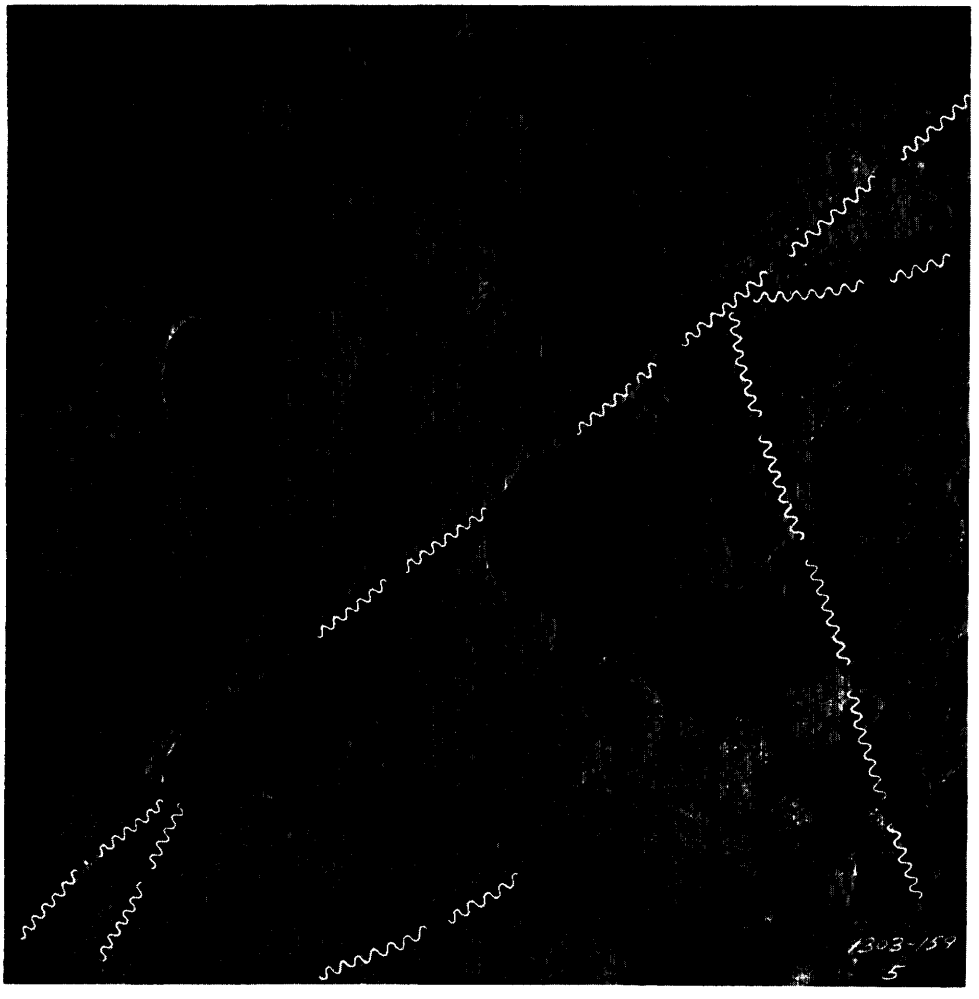


Fault linears in the vicinity of Bigfault Lake.

eralized in places, as noted on succeeding pages. The marked contrast between the rocks on the two sides of the break suggests that this is a major fault. Many other shear zones have been encountered in mapping, but in the absence of distinct evidence of displacement, it has been thought unwise to show them as faults.

A number of faults based on inferred displacements of diabase dikes are shown. In some cases these displacements are based on extrapolation of the

dikes across considerable areas of drift. In view of the irregularities that these dikes frequently show, such extrapolations are not altogether reliable. Most of these faults strike northeast and are frequently accompanied by marked gullies or other topographic features. The largest of these follows approximately the course of the Pelangio Point esker to Hurd Lake. Here the fault appears to split, the main branch swinging to a more easterly strike, the other continuing



Fault linears in the vicinity of Hurd Lake.

northeast. Strike slip on this fault appears to be between 800 and 1,000 feet. The rather larger displacements of the granite contacts cut by the fault suggest that vertical movement on this fault may also have been considerable, but available evidence does not permit any estimate of the amount.

Between Esker Lake and Northeast Arm, and north of Conlon Bay, a number of less persistent faults have apparently segmented diabase dikes and, in one case, a granite stock. These faults strike between northeast and east.

North and west of Esker Lake, particularly near the Chimo Gold Mines, Limited, property, similar northeast-striking faults have been inferred. Post-diabase faulting is also suspected in the area south of Conlon Bay. In general the displacement along these faults has moved the northwest side southwest, but movement in the opposite direction is also evident from the map.

Another series of faults is inferred largely from topographical evidence, although in places some displacement is implied by offsetting of contacts. These faults strike roughly north. One of these is thought to lie along the shore line north from Pelangio Point. About ¾ and 2½ miles north of Pelangio Point highly sheared greenstones tend to confirm the existence of this fault. A parallel fault is thought to separate Harlow Island from the west end of a large peninsula, although evidence of displacement along this supposed structure is not convincing. A little over ½ mile to the east, another parallel fault appears to have displaced the shear zone that forms the south shore of Northeast Arm; it is also indicated by topographic evidence. A fourth fault of this type, striking a little west of north, extends from north of Bayhead Island to 1,000 feet east of Hurd Lake. This fault appears to have displaced the granite-greenstone contact near Hurd Lake; its existence is also supported by evidence of nearly north-striking shearing along the trail to Hurd Lake. Additional support for the existence of these faults is the recognition of a north-striking fault on the point ¾ mile east of Pelangio Point, and a north-northeast-trending fault on the mainland east of Osulake Peninsula. A number of northwest-striking faults, as indicated by apparent displacements and well-marked valleys, are believed to cut the differentiated gabbro sill at the west boundary of the map area. The most important of these faults appears to be the one which cuts off the gabbro at the east end of its outcrop. The faults to the west of this major structure have relatively minor inferred displacements, and the direction of displacement appears to vary, as in some cases the east side appears to have moved north, in others south. The timing of this north-south faulting as compared with the post-diabase faulting is not known.

ECONOMIC GEOLOGY

In the past, the principal interest in the area has been in the gold occurrences, of which a number are known. One copper showing has also been investigated, and occurrences of base metals and iron sulphides have been prospected in Rodin, Kupfer, Queenston, and Muriel lakes east of the area. An occurrence of silver mineralization was discovered on Farley Island during the summer of 1947. No tin mineralization was recognized during mapping, but the pegmatitic granite along Superb Lake is somewhat similar in appearance to the granite with which tin is associated at Linklater Lake, 50 miles west of the map area, and may form part of the same general belt of granite and schist.

The area has also possibilities for non-metallic deposits. The altered peridotite at the base of the differentiated gabbro sill is favourable to the occurrence of asbestos, although the only fibres observed were very short (1/10 inch). A large part of this peridotite is, however, covered with drift, swamp, and the river bed. It should also be pointed out that only the eastern end of this body has been mapped, and nothing is known of its extension to the southwest. Unfortunately, in this direction it is probable that drift cover will obscure it even more effectively. The occurrence of andalusite in the sediments along Superb Lake is also of interest as a possible source of refractory material. It is probable that the andalusite-rich bands are relatively narrow, but only one or two thin

sections of this material were studied, so that generalizations regarding the distribution of andalusite are not possible.

DESCRIPTION OF PROPERTIES

The approximate location of the properties described is indicated on the geological map that accompanies this report. Since the field work on which this report is based was done in the summers of 1947 and 1948 it is probable that many of these claims have lapsed. In some cases these groups may have been staked by other prospectors. The author has paid only one brief visit to the area since that time, hence the following descriptions only apply to the properties as they were at the time of the survey.

American Potash

A group of 12 claims in the vicinity of Esker Lake was optioned to American Potash, and some diamond-drilling and geophysical work was done in 1946. The claims are underlain by greenstone and cut by a few small porphyry dikes and a diabase dike. As far as the author knows, no significant results were obtained.

Camdeck Gold Mines, Limited

The property of Camdeck Gold Mines, Limited, comprises a group of about 21 claims in the southwestern part of the area, just south of the Lake-Osu property. Rocks exposed on the claims are chiefly pillow lavas and meta-diabases, which are cut by a series of porphyry dikes up to 30 feet wide. A band of agglomerates and tuff lies south and east of the porphyry bodies and extends east along the north shore of Cryderman Peninsula.

Prospecting on the group was largely confined to one porphyry dike, which appears to be a succession of thick lenses of porphyry rather than a continuous dike. The porphyries are sheared and crossed by irregular fractures filled with quartz. A little gold was found by J. O'Brien, a prospector, in a vug in one of these quartz veins. Considerable pyrite is present in the porphyries. Development work was largely confined to stripping and some trenching.

Chimo Gold Mines, Limited

The property of Chimo Gold Mines, Limited, consists of seven claims in the north-central part of the map area, immediately northeast of the Lake-Osu property. Some trenches have been opened on a sheared tuffaceous zone about 13 feet wide that strikes N.80°W. According to Speers[1] the shear zone is mineralized with pyrite, arsenopyrite, pyrrhotite, chalcopyrite, sphalerite, galena, and a little supergene chalcocite. Gangue minerals include quartz, albite, sphene, white mica, carbonate, chlorite, biotite, and tourmaline. Gold is reported to have been obtained from this showing. A few diamond-drill holes were put down on the showing, which strikes into the northeast corner of the Lake-Osu property. Some stripping was also done on porphyries on the mainland to the northeast of the main showing, which is on the island southeast of Pfeffer Point.

[1]E. C. Speers, by permission from his unpublished thesis for Master of Science degree, *Mineralization of the O'Sullivan Lake Area*, University of Toronto, 1950.

J. Conlon

In 1947, J. Conlon held a block of 20 claims covering the east end of Northeast Arm and Melly Lake. The contact of granite and greenstone was stripped in places south of Conlon Bay, and some diamond-drilling was done on the contact between greenstone and porphyry north of the end of Northeast Arm. On the island in Melly Lake the author discovered a mineralized zone apparently hitherto unnoticed. This zone is silicified, porphyritized, sheared greenstone and is about 3 feet wide and exposed for a length of 180 feet, with a strike of N.35°–40°E. The zone is cut by quartz stringers, some of which are dragfolded, and is mineralized, rather sparsely, with pyrite, chalcopyrite, sphalerite, and galena. The zone is bounded on the north by sheared greenstone and on the south by quartz-bearing tuff or sheared diorite.

Conwest Exploration Company, Limited

Some stripping and trenching were done by this company on a group of claims on Northeast Arm in the summer of 1946. Most of the work was done on porphyry dikes, which are numerous in this area. Rocks exposed on the group include granite, greenstone, and diabase. Nothing of significance was found.

Cryderman Claim

The first discovery of gold on O'Sullivan Lake was made by Russell Cryderman. Under regulations existing at the time of the discovery, he was granted a patent on the claim on which the discovery was made (T.B.2730). The mineralization occurs in quartz stringers in sheared porphyry, with which is associated extensive carbonatization of the adjacent lavas. The showing has been described by Kindle.[1]

Harvey G. Green

During the summer of 1947, surface prospecting was done by Harvey G. Green on a number of sulphide showings on Rodin Lake, east of the map area, and on a group of claims on the north side of Kowkash Bay. Some stripping was done on disseminated iron sulphides in amphibolite on Peter Island. No results of importance were reported.

M. H. Harlow

The showings on this property are located on Harlow Island. The principal work appears to have been done on narrow quartz stringers in granite, which carry small amounts of galena. Carbonate-rich float, carrying visible gold, is said to have been discovered along the northwest shore of the island.

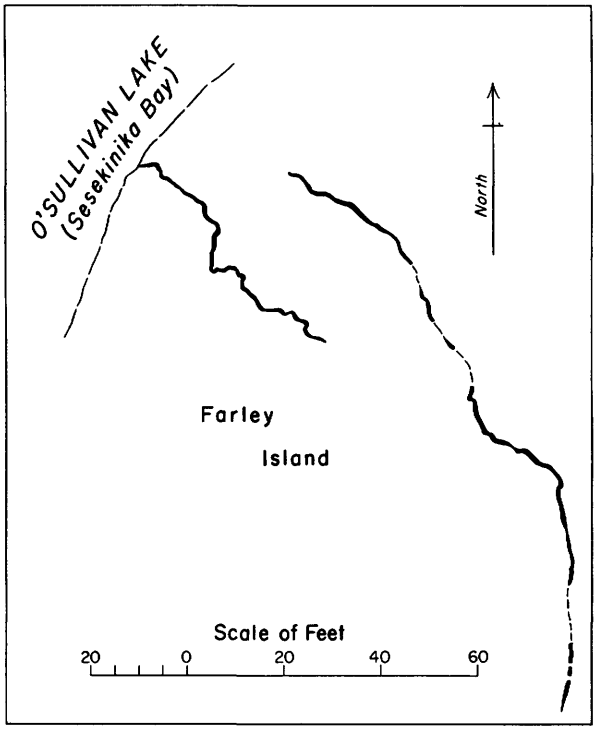
W. R. Hogan and J. Newman

During the summer of 1947 diamond-drilling was done on a property on Kupfer Lake, east of the map area, and on a porphyry dike on a point midway up Northeast Arm, on the north side. The latter work was done on a group of claims staked by Messrs. Hogan and Johnston. Late in the summer of 1947 a quartz vein mineralized with pyrite, galena, and sphalerite was discovered

[1]L. F. Kindle, *Kowkash-Ogoki Gold Area, District of Thunder Bay,* Ont. Dept. Mines Vol. XL, pt. 4, p. 99

by Mr. Hogan on the same group of claims, on the south side of Northeast Arm. The country rock here is an intensely sheared chlorite schist. The showing is on or adjacent to the strong shear zone or fault, which follows the south side of Northeast Arm.

Microscopic examination of the mineralization by Speers[1] revealed two ages of quartz, an early milky quartz and a late clear quartz, with which the sulphides were associated. Sulphides recognized in polished section include arsenopyrite (minor), pyrite, marcasite, sphalerite, chalcopyrite, galena, and a little tetrahedrite, ruby silver, and polybasite. Assays from this material are said to have yielded disappointing results.



Sketch map of silver-bearing veins on Farley Island, Hurd-Demetrieff group.

Hurd-Demetrieff Group

The Hurd-Demetrieff group of 13 claims is immediately east of the Lake-Osu and Camdeck properties. A considerable amount of stripping and trenching was done on porphyry dikes at the head of the bay west of Farley Island. Some gold values are reported from a northeast-striking dike on the north side of the bay. In the summer of 1947 mineralization was discovered in a narrow stringer on the west side of Farley Island. The vein ranges from 1 to 9 inches wide and has a most irregular course, as indicated in the accompanying sketch. A parallel vein was subsequently discovered a few feet to the north, which was mineralized with abundant arsenopyrite. The country rock in which the veins occur is sheared agglomerate and tuff. The showing is interesting in that picked samples yielded relatively high assays in silver, with some gold.

[1]E. C. Speers, *op. cit.*, p. 47.

on the other hand, according to maps of the mine engineers, the best mineralized sections were encountered in the tuffs.

The following sections of ore grade are reported by the management.[1]

Level	Length	Width	Grade	
			Uncut	Cut
	feet	feet	ounces per ton	ounces per ton
1st:				
No. 103 east drift	174	5.1	0.432	.....
No. 103 west drift	63	3.5	0.312	.....
2nd:				
No. 201 orebody	261.7	5.0	0.87	0.67
No. 203 orebody	122.5	5.4	0.36	0.29

The mineralogy and paragenesis have been described by Speers.[2] The earliest sulphides deposited were arsenopyrite, pyrite, and marcasite (seen in one speci-



Mineralized quartz, Lake-Osu Mines, Limited.

men only); followed by pyrrhotite; and finally chalcopyrite, sphalerite, native gold, and possibly a gold telluride. The principal gangue mineral is quartz, with tourmaline, carbonate, white mica, chlorite, and rutile. Carbonate, white mica, and chlorite are, at least in part, later than the sulphides.

Mineralization has been encountered in other parts of the property. The two tuff bands mentioned earlier (on page 23) have been mineralized to some extent. Gold is said to have been panned from a silicified zone in the south tuff band on the bay on claim K.K.3334. West of the bay, dragfolded quartz lenses were uncovered by stripping in the continuation of this zone. A little gold is also reported to have been obtained from a sheared and altered, north-striking porphyry on a small island south of the mine. On the point on claim K.K.3357, two mineralized zones have been stripped, and two drill holes have been sunk on the east zone. The east zone consists of a series of quartz lenses

[1]Fifth annual report of Lake-Osu Mines, Limited, 1950.
[2]E. C. Speers, *op. cit.*, p. 12

and veins, of which the largest is 6 feet wide and 12 feet long, located at the north-east side of an aplitic porphyry dike 15 feet wide that strikes N.40°W. The quartz is glassy and much fractured and contains patches of chlorite, white mica, and chalcopyrite, with occasional nests of pyrite. Secondary copper minerals have been produced by weathering. The quartz zone has a total exposed length of 80 feet. The mineralization to the west is in a highly sheared, altered, and silicified zone in greenstone. The quartz is rather watery in appearance, fine-grained, and contains inclusions of altered schist. It occurs in lenses and stringers, which have been locally dragfolded and have a maximum width of 10 inches. The maximum width of the silicified zone is 30 inches, but it pinches and swells rapidly. The zone strikes N.25°W. and has been traced at intervals from the south to the north side of the point. The silicified zone is well mineralized with pyrite and chalcopyrite where exposed at the south end. Similar northwest-striking veins, associated with porphyry dikes and mineralized with chalcopyrite were found by the author on the large island in claims K.K.3357 and K.K.3356.

Megan Find

Gold values are reported to have been obtained from a find made by Joe and Sam Megan, of Nakina, north of Conlon Bay. The zone is reported to be associated with a porphyry dike cutting the greenstones.

Ovansull Property

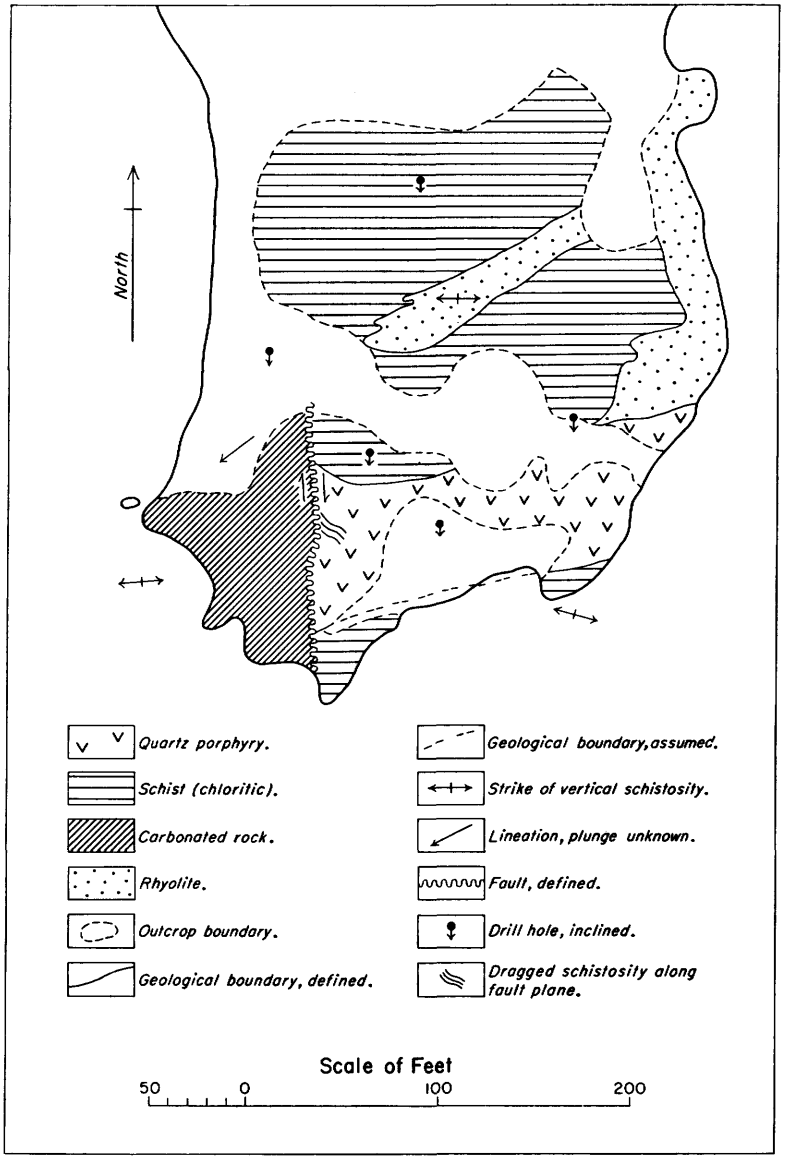
The Ovansull property is located on the north side of Northeast Arm, east of Pelangio Point. It was formerly controlled by Pelangio-Larder Mines, Limited. On this property are located workings over 20 years old on chalcopyrite-pyrite mineralization in the greenstones. Two gold showings were investigated during 1946 and 1947.

The work in 1946, including stripping, trenching, and diamond-drilling, was done on a sheared and altered quartz porphyry on the point ¾ mile east of Pelangio Point. A geological sketch map of the showing is given on page 27. The dike strikes roughly N.58°E. and is about 40 feet wide. It is exposed for a length of a little over 100 feet, terminating in the lake on the east and against a north-striking fault on the west. The porphyry cuts highly sheared and carbonated greenstone, with which is associated a narrow band of rhyolite. The sheared porphyry is cut by quartz stringers and lenses up to 4 inches wide. Some yellow-brown weathering carbonate is associated with the quartz. West of the fault, the country rock appears to be almost pure carbonate, cut by quartz stringers. A good deal of pyrite is present in the porphyry, and a little visible gold has been found associated with quartz and carbonate stringers.

In the summer of 1947 some drilling was done on a quartz porphyry dike, 20 to 30 feet wide and striking N.25°E. The dike is rather variable in texture; in some trenches it is aplitic and carbonated, in others it is a sheared quartz porphyry, in still others it is massive. Disseminated pyrite and quartz stringers occur in the porphyry.

The copper prospect, which was investigated many years ago by Northern Airways Mining and Exploration Company, is located in the northeast corner of the bay that lies to the east of the gold deposit first described. There are actually two sets of workings, one on the corner of the bay, the other about half way along the shore to the point to the east. The latter set includes some five pits and trenches located on an outcrop of fine-grained flinty lava, pillow

lava, and breccia. The rock is much cut by joints and fractures, and is mineralized with pods and seams of chalcopyrite, pyrrhotite, and pyrite. In the pillow lavas, the mineralization may follow the pillow selvages, or occupy the interstices between the pillows. Quartz and quartz-carbonate stringers and lenses are associated. In one trench arsenopyrite was observed.



Geological sketch map of the west porphyry showing, Ovansull property.

To the northwest of this outcrop, across a narrow belt of swamp, there is a fairly steep knob of diorite or metadiabase. Here and there on this knob are small pockets of pyrite, pyrrhotite, and chalcopyrite. The second set of trenches is located northwest of the diorite knob and is separated from it by swamp and bush. The country rock again is fine-grained, flinty lava and breccia,

cut by one or two porphyry dikes. Towards the north end of the workings the outcrop is cut by two breccia zones, which, however, do not appear to have been involved in much movement. As in the previous case, mineralization consists of pods of sulphides, with which are associated lensy, leached quartz veins. At least one drill hole has been put down on this zone.

Speers[1] found, in polished section, that the minerals present were pyrite, arsenopyrite, pyrrhotite, chalcopyrite, and sphalerite. Gangue minerals associated with the sulphides include quartz, albite, rutile, and white mica. Supergene chalcocite is also present.

Rodney Gold Mines, Limited

The property of Rodney Gold Mines, Limited, was located on the east end of Osulake Peninsula. Rocks exposed are chiefly greenstones and metadiabases, which are considerably altered in the southeastern part of the point. Considerable diamond-drilling was done on the property in 1946, but as far as is known nothing of interest was discovered.

Trans-American Mining Corporation, Limited

The property of Trans-American Mining Corporation, Limited, lies east of the Lake-Osu claims. The principal workings appear to have been opened on a band of sheared tuffs that strikes east-southeast and has been intruded by porphyry. Rhyolitic bands have also been exposed by trenching. Quartz lenses, usually of small size, and pyrite, pyrrhotite, and chalcopyrite are associated with the rhyolite and porphyry. Some diamond-drilling was done on this property in 1946.

Other Occurrences of Mineralization

Mineralization was noted at many places in the area. A mineralized shear zone was discovered by William Shepherd on the point east of Bayhead Island. It is not known whether this mineralization carried values or not. Rusty, mineralized greenstone, with some chalcopyrite, and rusty shear zones up to 6 feet wide have been prospected southwest of Hurd Lake where they occur associated with porphyries. These showings are presumed to have been on the Tooms property. Mention has already been made of the occurrence of disseminated pockets, chiefly of iron sulphide, in lavas around the contact with the granite stock just northeast of Pelangio Point. At the northeast end of Harlow Island a highly carbonated shear, about 20 feet wide, mineralized with pyrite, chalcopyrite and sphalerite, was seen. This is presumably the same shear on which the Hogan find (see page 21) was made.

In the northwestern part of the area, several areas mineralized with disseminated pyrrhotite and pyrite were found in the amphibolites and tuffs; a large area of mineralization was found on Peter Island. It is not known whether mineralization of this type carries values, but it is certain that none of these had been prospected previous to the present mapping.

Massive sulphides (pyrrhotite and pyrite) are also reported to have been intersected over a width of many feet in diamond-drilling on the Sulak group, just south of the Kawashkagama River and just west of the area. Negligible values were reported from this occurrence.

---

[1]E. C. Speers, *op. cit.*, p. 59.

Many occurrences of mineralized porphyry dikes, carbonatized zones and shear zones were encountered in various parts of the area. Many of these seen appear never to have been examined by prospectors.

Recommendations to Prospectors

Evidences of mineralization are widely distributed in the area. Not only does the area have promise as a possible gold producer, but also many indications were found of copper; and, in two cases, silver mineralization has been found. It is suggested that the best chance for finding more promising occurrences of base and precious metals lies in the investigation of the major shear zones, such as the shear zone along the south side of the Northeast Arm, the shear zones along the north side of Cryderman Peninsula, and those south of Conlon Bay. It is also suggested that the vicinity of the granite stocks in the east-central part of the area is favourable prospecting ground. It is probable that magnetic or electromagnetic surveys might be a useful aid in prospecting some of the areas that are heavily covered with drift and swamp or lie beneath the lake.

INDEX, PART 4

A PAGE

Access 2
Acknowledgments 1, 2
Agglomerate 22
  Notes and photo 8, 9
Algoman intrusives 12–15
  See also Porphyries.
American Potash claims 20
Amphibolites 7, 9
  Sulphides in 21, 28
Analyses, rock 6
Andalusite 10, 19
Aplite 13, 26
Arkose 8
Arsenopyrite 20, 22, 25, 28
Asbestos 11, 19
Asbury, D. W. 1

B

Basalt, notes and analyses 5, 6
  See also Greenstone.
Bayhead Island 14, 19, 28
Bigfault Lake 14
  Esker near 3, 15
  Faults, notes and photo 16, 17
Biotite schist, notes and photo 10

C

Camdeck Gold Mines, Ltd. 20
Carbonate rock, gold in 21, 26
Carter, W. A. 2
Chalcopyrite 20–22, 25–28
Chimo Gold Mines, Ltd. 20
Chlorite schist 12, 22
Conlon, J. 2, 21
Conlon Bay.
  Faults near 18, 19, 29
  Mineralization near 21, 25
  Rocks near 7–10, 14, 15
  Shear zone near 16
Conwest Exploration Co., Ltd. 21
Copper 1, 19, 26, 29
Cryderman, Russell 3, 21
Cryderman Peninsula.
  Rocks 5, 7, 8, 20
    structure 15, 16, 29

D

Demetrieff, G. 2
Demetrieff claims 22
Diabase 7, 15
  Dikes, faulted 17, 18
Diorite.
  See Metadiabase; Quartz diorite.
Dioritic porphyry 13, 14
Discovery Bay 15

E PAGE

Economic geology 19
  Mining properties, reports on 20–28
Elka Lake 7, 9, 12
Esker, notes and photo 3, 14, 15
Esker Lake 18–20

F

Farley, R. J. 1
Earley Island 8
  Silver 19, 22
Faulting, notes and photos 16–19
Feldspar porphyry 13
Folding 15, 16
Formations, table of 4

G

Gabbro 11, 12
Galena 20–22
Garnetiferous rocks 9, 10, 13
Geology, economic 19–28
Geology, general 4–15
Geology, structural 15–19
Glacial deposits 3, 14, 15
Gold 1, 13, 25
  Mining properties 20–28
Granite 12, 13, 29
  In metadiabase 6, 7
  Quartz veins in 21, 28
  Shearing in 17
Green, Harvey G. 2, 21
Greenstone 5, 7
  Carbonatized 13
  Mineralized 21, 26–28

H

Harlow, M. H. 2, 21
Harlow Island.
  Gold 21
  Rocks 7, 17, 19
  Shear zone 16, 28
Hogan, W. R. 2, 21
Hriskevich, M. H. 1, 2
Hurd, D. 2, 21
Hurd-Demetrieff gold claims, notes and sketch map 22
Hurd Lake 13
  Faults, notes and photo 18, 19
  Porphyry near 14
    mineralized 28

I

Intrusive rocks 4, 11–15
Iron formation 10

J PAGE

Jarmack Mining Co., Ltd. 23

K

Kawashkagama River 2–4
Rocks 11
Keewatin rocks 5–10, 15
See also Greenstone; Tuffs.
Keweenawan rocks 15
"Knotted" schist, photo 10
Kowkash Bay 21
Kupfer Lake 19, 21

L

Lake-Osu Mines, Ltd.
Property, photo 1
report, plan, and sketch map 23–26
Lamprophyre 15
Little Current River 4
Ludgate, M. M. 2

M

MacDougall, J. R. 2
McCartney, G. C. 2
McIntyre Porcupine Mines, Ltd. 3, 21
Map, geological, coloured *in pocket*
Map, key 2
Maps, sketch.
Lake-Osu showing 24
Ovansull showing 27
Silver veins, Farley Island 22
Marcasite 22, 25
Marshall Lake series 10
Megan, J. and S. 26
Melly Lake 21
Merle Lake 5
Metadiabase 15
Notes and analyses 5–7
Structure 16, 17
Sulphides in 27
Miller, J. 3, 23
Mineralization 22, 25, 28
Mining properties, reports on 20–28
Morgan, K. A. 2
Muriel Lake 19

N

Natural resources 4
Newman, J. 21
Northeast Arm 5
Gold claims 21, 22, 26
Prospecting advised 21
Rocks, structure 16, 17, 19
Northern Aerial Mining and Exploration Co. 3, 26

O

O'Brien, J. 2, 20
Odman Lake 7, 12, 13
Osulake Mines, Ltd. 1
See also Lake-Osu Mines.
Osulake Peninsula 4
Mining claims 23, 28
Rocks 6, 8, 16
Ovansull property, report and sketch map 26–28

P PAGE

Pegmatite 13, 19
Pelangio-Larder Mines, Ltd. 26
Pelangio Point 3, 13
Esker, notes and photo 14, 15
Gold claims near 26
Shear zones near 16, 19
Peridotite 11, 19
Peter Island 15
Fault near 16
Rocks 7, 9
Sulphides 21, 28
Pfeffer, H. W. 1, 2, 6
Pfeffer Point 7, 8, 14
Gold claims 20
Pillow lavas.
Mineralized 27
Notes and analyses 5, 6
Plan, geological.
See also Maps, sketch.
Level, Lake-Osu mine *facing* 24
Polybasite 22
Porphyries 13, 14
Mineralized veins in 21–23, 26, 28
Pre-Algoman intrusives 11, 12
See also Peridotite.
Precambrian rocks 4–15
Prop Lake 15
Rocks, notes and photo 7, 8, 11
Prospectors, notes for 29
Pyrite 20–22, 25–28
Pyroxenite 11
Pyrrhotite 20, 25, 28

Q

Quartz, mineralized.
Lake-Osu g.m., notes and photo 25, 26
Quartz diabase 15
Quartz diorite 12
Quartz porphyry 7, 10, 13, 14
Mineralized 23, 26
Queenston Lake 19

R

Rhyolite 7, 10
Sulphides in 28
Rodin Lake 19, 21
Rodney Gold Mines, Ltd. 28
Ruby silver 22

S

Sand and gravel 15
Schists 10, 12, 19
Sedimentary rocks.
Lithology and photo 10, 11
Structure 15, 16
Serpentine 11
Shear zones, mineralized 16, 19, 29
Shearing 12, 16, 17
Shepherd, W. 2, 28
Silver 19, 22, 29
Speers, E. C. 20, 23, 25, 28
Sphalerite 20–22, 25, 28
Springpole Island 7
Staurolite schist 10
Structural geology 15–19
Sulak claims 28
Sulphides 20, 22, 23, 25–28

PAGE
Superb Lake ... 3
Andalusite ... 19
Glacial deposits ... 15
Rocks ... 12, 16, 17
pegmatite ... 13, 19
photos ... 9, 10
Surveys, early ... 3

T

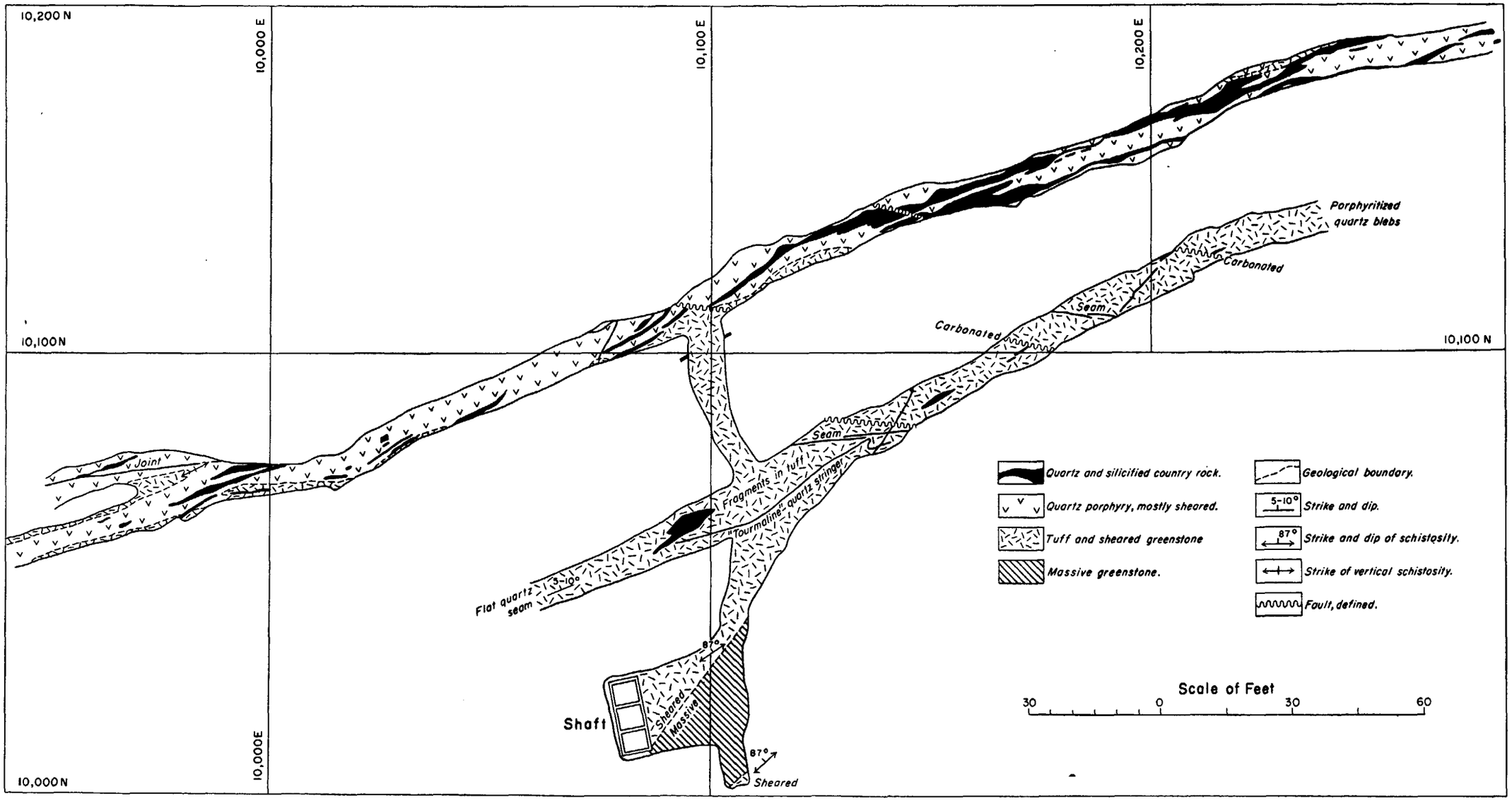
Telluride, gold ... 25
Timber ... 4
Tin ... 19
Todd, P. ... 2
Tooms property ... 28
Topography ... 3, 18
Trans-American Mining Corp., Ltd. ... 28
Tuffs.
Mineralization in ... 22, 23, 25, 28
Petrology and photo ... 8–10
Structure ... 15, 16

V

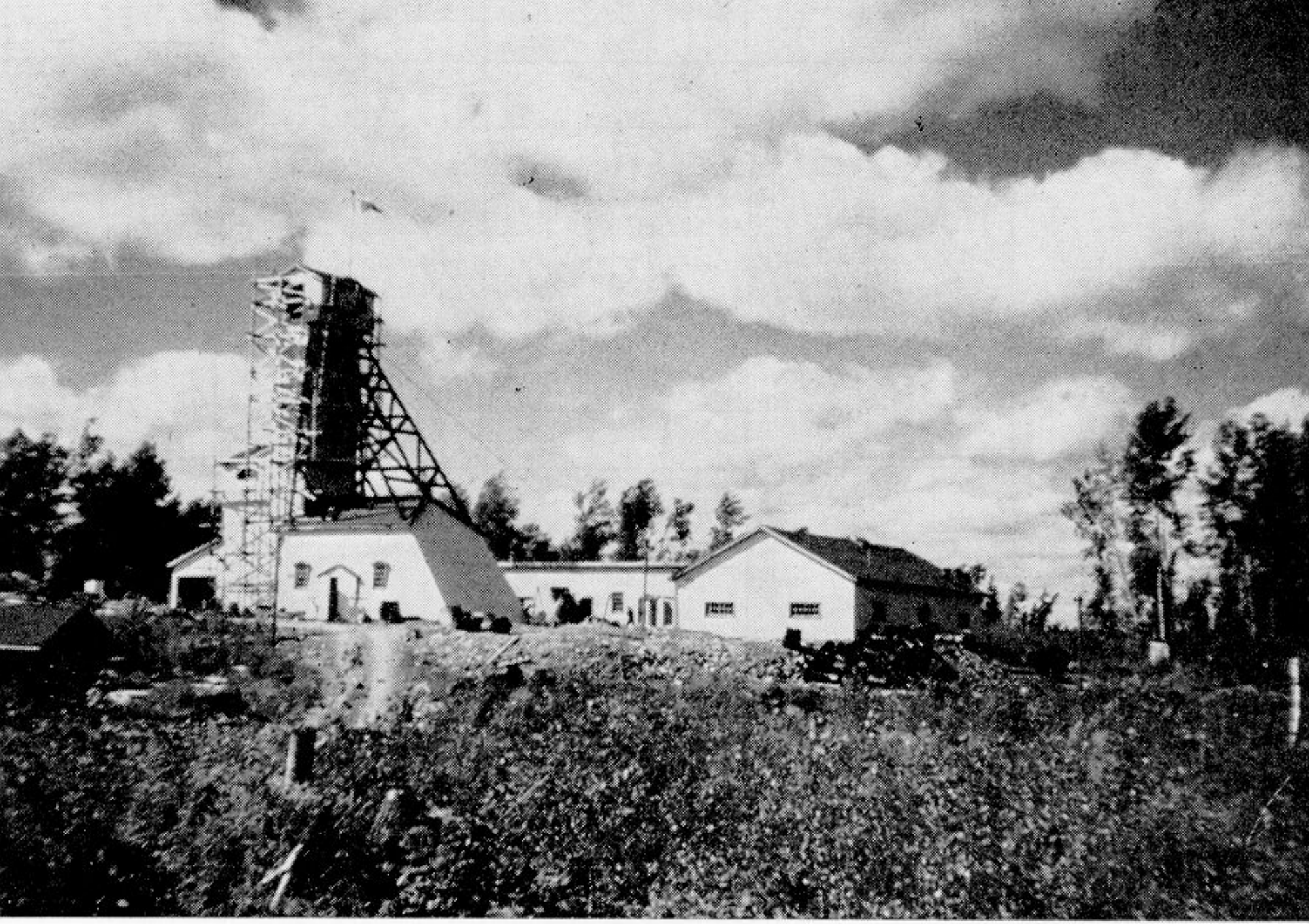
Volcanic rocks ... 5–10
Structure ... 15, 16
See also Greenstone.

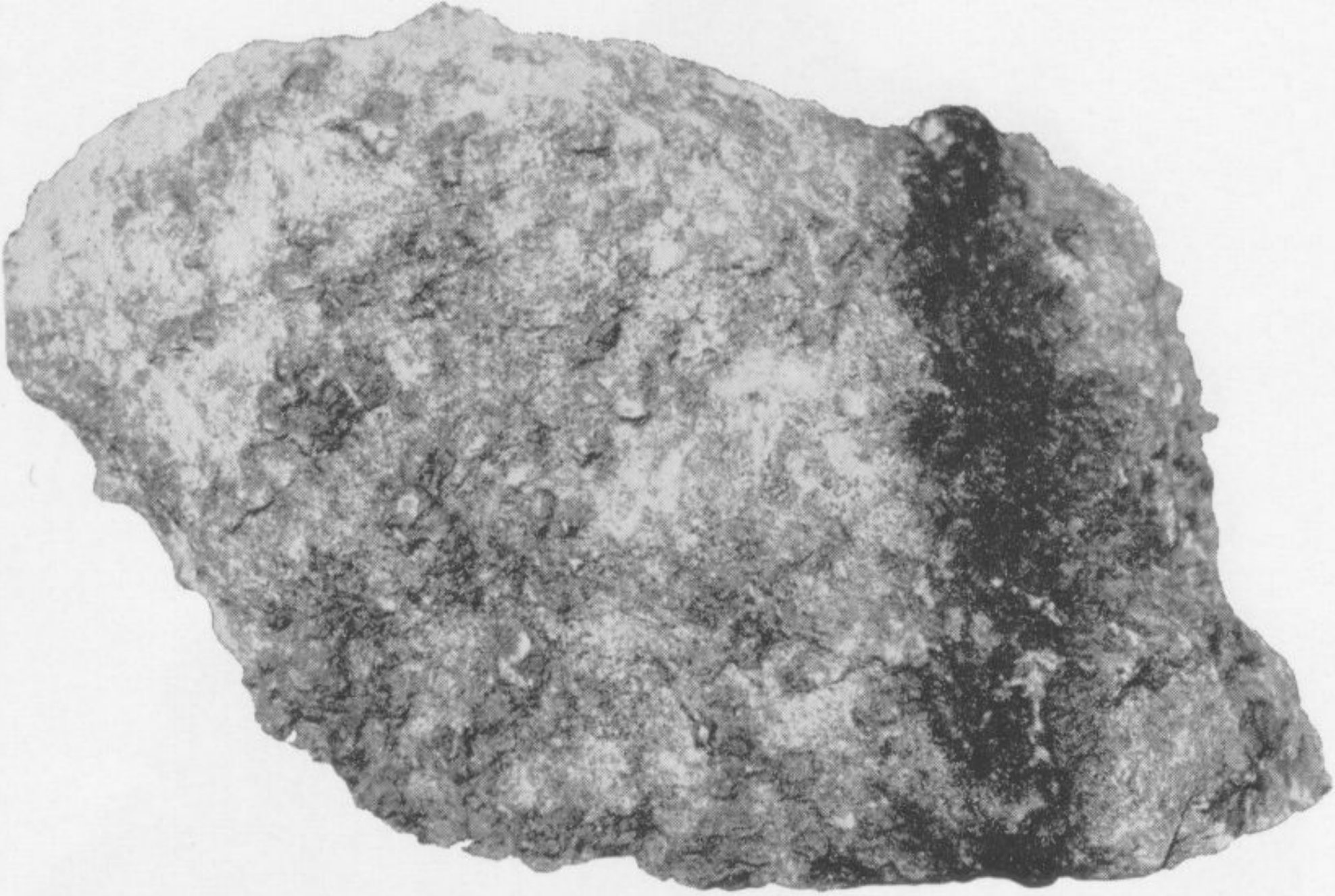
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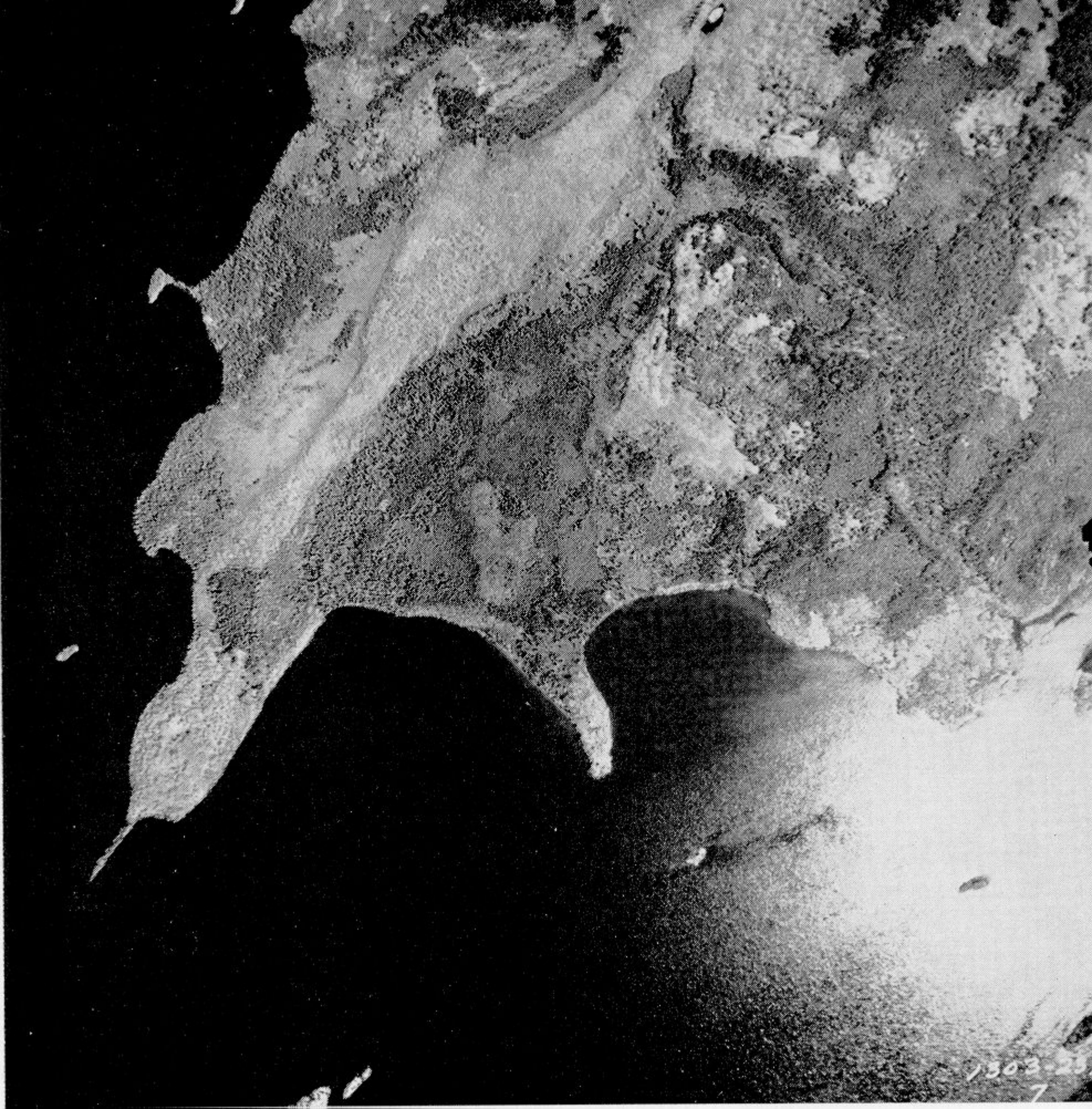
Wander Arm ... 7, 12

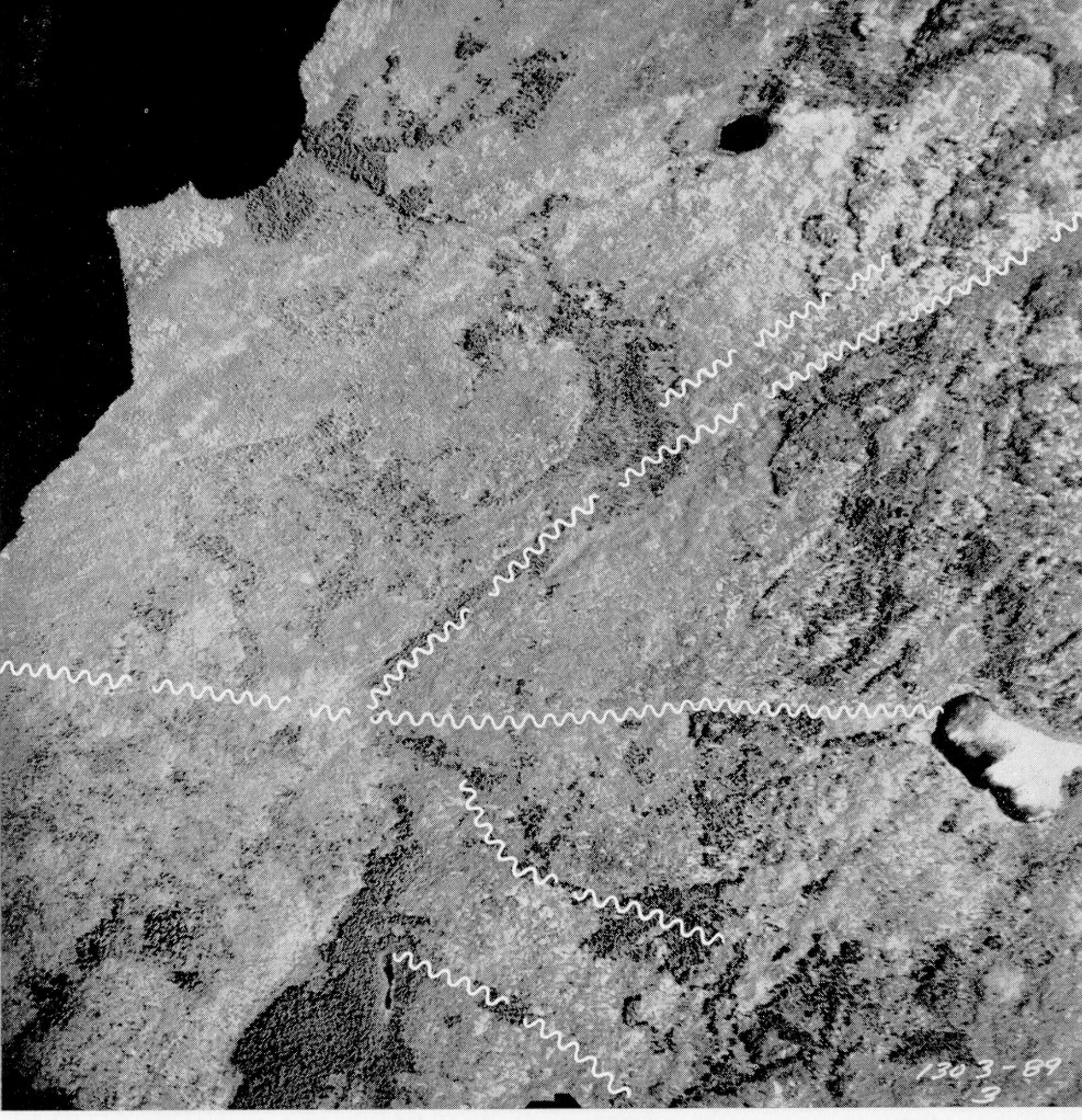


Geological plan of the 150-foot level, Lake-Osu Mines, Limited

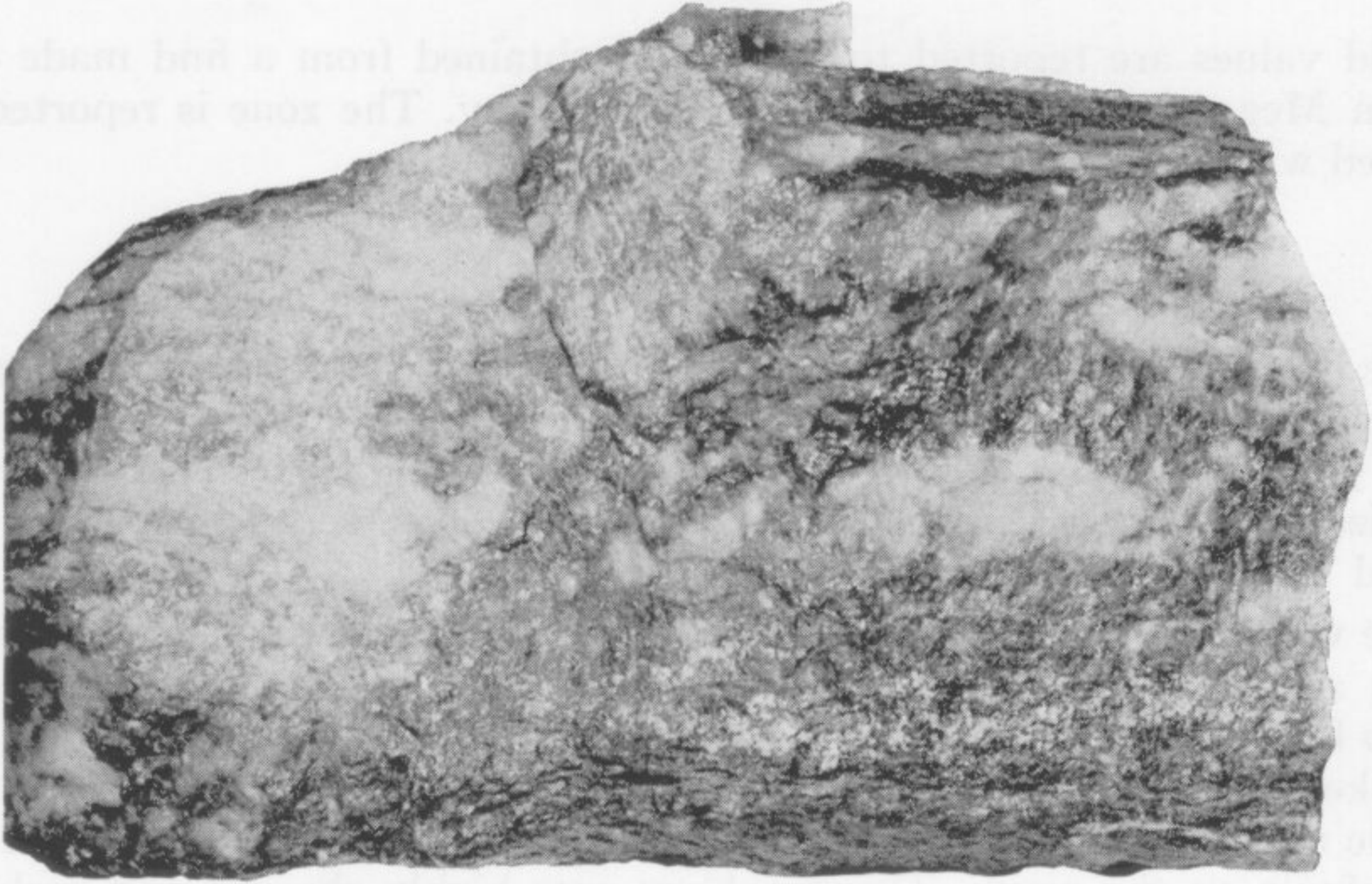




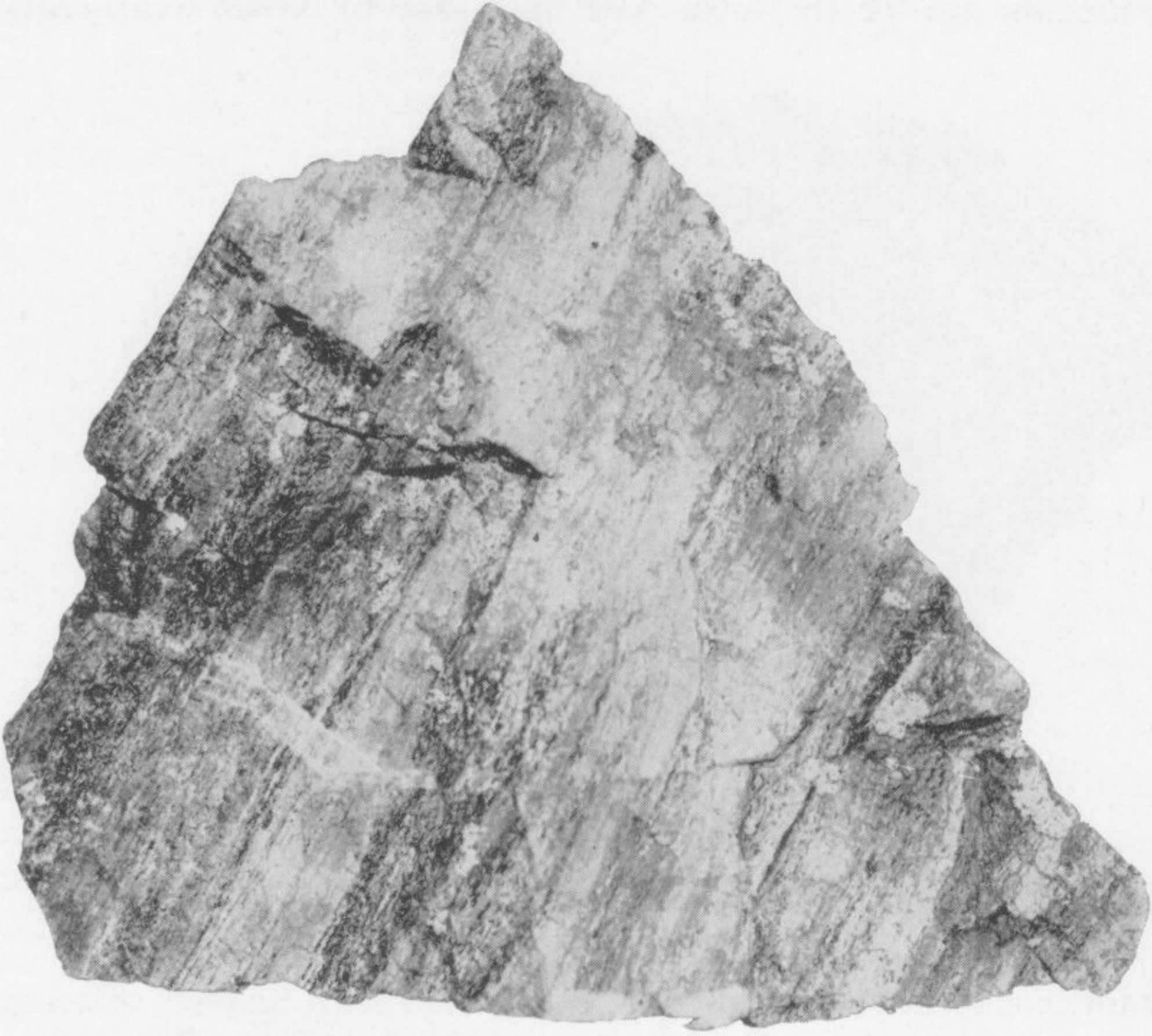



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M. E. HURST, *Provincial Geologist*

SIXTY-FOURTH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. LXIV, PART 5, 1955

Geology of the Miller Lake Portion of the Gowganda Silver Area

By
E. S. MOORE

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO
Printed and Published by Baptist Johnston, Printer to the Queen's Most Excellent Majesty
1956

TABLE OF CONTENTS

Vol. LXIV, Part 5

	PAGE
Introduction	1
History of the Gowganda Camp	2
Bibliography	4
Maps	4
Topography	5
General Geology	6
Table of Formations	6
Keewatin	6
Haileyburian	7
Algoman	7
Matachewan	8
Huronian	8
Gowganda Formation	8
Lorrain Formation	9
Keweenawan	10
Quartz Diabase Dikes	10
Olivine Diabase Dike	11
Pleistocene and Recent	12
The Nipissing Diabase Sill	12
Thickness of the Sill	12
Dip of the Sill	13
Contact Effects of the Sill	14
General Geology—*Continued*	
The Nipissing Diabase Sill—*Continued*	
Internal Structure of the Sill	14
Petrography of the Sill	16
Differentiation in the Sill	17
Structural Geology	21
Faulting	22
Economic Geology	24
The Form, Composition, and Origin of the Veins	24
Mineralogy	26
Origin of the Veins	27
Mining Operations	31
Castle-Trethewey Mines, Limited	31
Consolidated Morrison Explorations, Limited	35
Siscoe Metals of Ontario, Limited	35
Index	39

ILLUSTRATIONS

	PAGE
The Siscoe mine on Percy Lake	2
The Castle-Trethewey mine	3
The Morrison mine	5
Cobalt conglomerate southwest side of Percy Lake	9
Photomicrograph of thin section from quartz diabase dike in the Siscoe mine	11
Contact of Nipissing diabase with Cobalt conglomerate	14
Columnar jointing near base of Nipissing diabase sill	15
Concentric jointing in the upper part of the Nipissing diabase sill	15
Photomicrograph of granophyre from the south end of Lost Lake	18
A 6-inch calcite vein carrying silver, Siscoe mine	25
Capital shaft, Castle-Trethewey Mines, Limited	33
No. 2 mill, Siscoe Metals of Ontario, Limited	36

MAPS, SECTIONS, AND PLANS

	PAGE
Key map showing the location of the Gowganda silver area	1
Section across Nipissing diabase sill	16
Surface plan of the Miller Lake O'Brien mine	29
Section through the Capitol mine	30
Surface plan of the Capitol mine	32
Plan of the 1,275-foot level, Capitol mine	*facing* 32
Plan and longitudinal projection on east-west line, Miller Lake O'Brien mine	34
Plan of the 1,200-foot level, Miller Lake O'Brien mine	*facing* 34
Plan of the Morrison mine	*facing* 36

GEOLOGICAL MAPS

(In pocket at back of report)

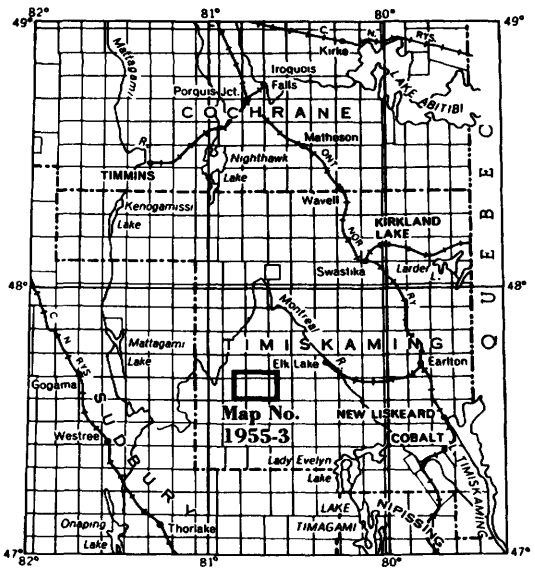
Map No. 1955–3—Gowganda Silver Area, District of Timiskaming, Ontario.
Scale, 1 inch to ½ mile. (Coloured.)
Miller Lake Portion, Gowganda Silver Area, showing silver-producing properties.

Geology of the Miller Lake Portion of the Gowganda Silver Area

By E. S. Moore

INTRODUCTION

Since World War II there has been a revival in mining in the old Gowganda silver field, district of Timiskaming. Most of the summer of 1954 was spent by the author in this area on a re-study of the geology and in investigating recent developments. Mining operations have been confined, in recent years, to the Miller Lake portion of the Gowganda area, and most of the field work was, there-



Key map showing the location of the Gowganda silver area, district of Timiskaming. Scale, 1 inch to 50 miles.

fore, done in this portion. Numerous checks, however, were made on geological features over a much larger area in order to see whether the author concurred in the findings of previous workers.

Three mines were operating in the Miller Lake basin. These were the Siscoe, Castle-Trethewey, and Morrison. The author expresses his sincere thanks to the officers and staff of these mines for all their help and hospitality to his party during the field season: to G. Shartner, manager, A. J. McKinnon, superintendent, and J. Londry, geologist of the Siscoe mine; N. E. A. Pearson, manager of the Morrison mine; and A. D. Campbell, manager, G. D. McLeod, assistant manager, and A. Omerod, engineer of the Castle-Trethewey mine. Robert Thom-

son, resident geologist, Ontario Department of Mines, at Cobalt, kindly loaned maps, air photographs, and instruments and examined thin sections for the identity of some rocks. P. A. Peach of the University of Toronto made the photomicrographs used in this report. J. L. Tindale rendered faithful service as a field assistant.

History of the Gowganda Camp

Spectacular discoveries of silver at Cobalt early in the century incited prospectors to range far to the west where many geological conditions appeared to be similar to those at Cobalt. Silver was soon discovered near Elk Lake, and in 1907, the first discovery of mineralization of the Cobalt type was made in the Gowganda area, near Bloom Lake, in Haultain township. Before the end of 1908 prospectors had swarmed over most of the area, and some spectacular discoveries of native silver had been made west of Gowganda Lake. The first



The Siscoe mine, formerly the Miller Lake O'Brien, on Percy Lake. The main shaft and No. 1 mill are shown just left of the centre of the picture.

shipment of ore came from the Bartlett claims in this part of the area, and by 1910 a number of properties there and in the Miller Lake portion were shipping small amounts of high-grade, hand-picked ore. A frontier village sprang up at the north end of large and beautiful Gowganda Lake.[1] There is still a village there with post office, forestry station, sawmill, tourist camps, meagre hotels, gas station, and stores. A narrow and winding, but otherwise good road runs from Elk Lake through the village and on to Shiningtree to connect with the Canadian National railway at Westree. Gowganda is 28 miles from Elk Lake and 71 miles from New Liskeard. The Ontario Northland Railway built a line from New Liskeard to Elk Lake and maintains a twice-weekly freight service so that concentrates and other freight can be shipped from Elk Lake. The O'Brien post office at the Siscoe mine serves the mining community with daily mail.

[1]This lake was named Lady Dufferin Lake by Robert Bell (see The Canadian Geological Survey's Report of Progress, 1875–76, p. 299), but later the Indian name, meaning "porcupine's home," was restored.

Burrows' last report on the Gowganda silver area,[1] gives statistics of production from 1910 to the end of 1925 as 8,420,509 ounces of silver and 219,392 pounds of cobalt. This came from fourteen properties, and over half of it from the Miller Lake O'Brien mine. The Castle-Trethewey mine, the second largest producer, did not come into production until 1920. The Millerett mine, situated on the north end of Percy Lake, had a phenomenal production of 611,822 ounces of silver and 5,000 pounds of cobalt from 667 tons of ore and concentrates. This property was acquired by the Miller Lake O'Brien Company in 1913, and a mill was used by this company for some years. Other properties with much smaller production were the Mann, Reeve-Dobie, Tonopah (Walsh and Morrison), Bartlett (Crews-McFarlan), Bonsall, Boyd-Gordon, Miller Lake and Everett, Kell, Welch, and Wigwam. The Mann, Reeve-Dobie, and Tonopah were the only ones that produced more than 45,000 ounces of silver, and many of them did not produce more than a ton or two of concentrates. They had nearly all ceased operation by 1925.



The Castle-Trethewey mine, showing the mill, office, and No. 3 shaft, not now operating.

The Miller Lake O'Brien mine continued to operate until September, 1939, when war broke out, and the mine was closed. Up to the time of closing, the mine had produced 17,555,646 ounces of silver and a considerable amount of cobalt, which has not been recorded. Lessees are reported to have taken out of this mine, between 1940 and 1944, an estimated 620,000 ounces of silver. In November, 1945, Siscoe Metals of Ontario, Limited, a subsidiary of Siscoe Gold Mines, Limited, purchased the property and proceeded to open the mine. Under an agreement made in August, 1953, New Morrison Mines, Limited, another subsidiary of Siscoe Gold Mines, Limited, operated the Morrison mine on a profit-sharing basis with Lost Lake Mines, Limited, until the autumn in 1954.

Castle-Trethewey Mines, Limited, operated a mine northwest of Miller Lake from 1920 to April, 1931, when the low price of silver and the apparent exhaustion of the ore in three shafts led to the closing of the mine Work was started in 1948 to rehabilitate the property by development of the Capitol shaft

[1]A. G. Burrows, *Gowganda Silver Area (Fourth Report, Revised)*, Ont. Dept. Mines, Vol. XXXV, 1926, pt. 3, p. 5.

situated about half a mile southeast of the mill, and in April, 1951, milling of ore was resumed. The company has produced, since beginning of milling in 1920 to the end of June, 1954, 9,014,470 ounces of silver and considerable cobalt.

Further data on the producing properties will be found later in this report.

Bibliography

The following publications contain data on that part of the Gowganda area with which this report is concerned.

NORMAN L. BOWEN, *Diabase and Granophyre of the Gowganda Lake District, Ontario*, Jour. Geol. Vol. XVIII, 1910, pt. VII, Oct.-Nov., pp. 658–74.

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W. H. COLLINS, *The Quartz Diabases of Nipissing District, Ontario*, Econ. Geol., Vol. V, 1910, pp. 538–50.

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E. S. MOORE, *Genetic Relations of Silver Deposits and Keweenawan Diabases in Ontario*, Economic Geol., Vol. XXIX, 1934, No. 8, Dec., pp. 725–56.

E. W. TODD, *Gowganda Vein Minerals*, Ont. Dept. Mines, Vol. XXXV, 1925, pt. 3, pp. 62–78.

Maps

A large geological map covering the Gowganda mining division on a scale of 1 inch to 1 mile was published with Collins' memoir No. 33. Burrows issued several maps with his reports, the most comprehensive being the one on the scale of 1 inch to 1 mile with his 1921 report. This map covers practically all the area in which interesting silver deposits had been found and also all the claims that had been staked and surveyed previous to 1921. It has proven an excellent areal geological map, and the author acknowledges his indebtedness to both Collins and Burrows for much of the data on the maps accompanying this report. No attempt was made to retraverse the area although the geology was reviewed at many points, and some changes and additions were made to the existing maps.

Since Burrows' maps are becoming scarce, new maps (in back pocket of this report) have been prepared, using as a base the map compiled by the Ontario Department of Lands and Forests from air photographs and land surveys. These are much more accurate maps of the topography than were formerly available as base maps for showing the geology. Air photographs were also used in compiling the maps and in working out structure. Changes in the shape, size, and position of some lakes have been made. A number of dikes have been added, and an important change made in one dike. Burrows considered the large dike cutting the sill between Dinny and Obushkong lakes as a segment of the long olivine diabase dike south of Miller Lake, and that this dike had been offset a mile to the north by the Gowganda Lake fault. Since this dike, from evidence supplied by a thin section, consists of quartz diabase, all evidence disappears that there

is a large horizontal displacement on the fault, and that it is later than the olivine diabase dike.

The boundaries of the operating properties, but not claim boundaries, are shown on the coloured geological map (No. 1955-3, in back pocket) of the whole area. On a larger-scale map (also in back pocket) showing only the Miller Lake portion of the area, however, claim boundaries of the operating properties have been marked. Considerable plane-tabling was done in preparing these maps; the upper contact of the diabase sill was mapped by this method from a point east of the Morrison mine to the Castle-Trethewey, since its position is very important owing to the close relation of the ore deposits to it. A number of dikes and the surface features around the mines were also mapped by this method.



The Morrison mine.

Topography

The Gowganda area is one of rugged topography with numerous hills, and many depressions occupied by fine, clear lakes. It covers part of a great peneplain eroded on Precambrian rocks and modified by glaciation. The relief is not great since few hills exceed 200 feet in elevation above the lakes at their bases. The highest hill of Cobalt conglomerate is Tower Hill just east of Gowganda on which the fire ranger's tower is located. It rises about 200 feet above Gowganda Lake. Large hills of sill diabase may be seen along the west side of Dinny Lake, the east side of Lost Lake, and near the south end of Miller Lake. Outcrops of rock are numerous, but there is much drift in the lower lands and some sand plain, especially in the southeastern part of the map-area.

The area is drained mainly northward by the East Branch of the Montreal River of which Gowganda Lake is an expansion. A dam built recently by lumbermen has created a large lake south of Gowganda Lake where there was formerly a low, swampy area through which the river meandered.

This area has fortunately escaped, for about forty years, large forest fires, and the whole country is clothed with a green forest of jackpine, spruce, balsam, birch, poplar, tamarack, and red pine. A wind of almost hurricane force, late in June, 1954, blew down a great quantity of timber, especially jackpine, making it almost impossible to run traverses through the woods.

GENERAL GEOLOGY

The rocks of this area, except for glacial deposits and a little alluvium, are entirely Precambrian in age, and many systems and series are represented in its stratigraphy. The structural geology is varied, and the economic geology important. The following classification has been adopted for the formations:

Table of Formations

CENOZOIC	
PLEISTOCENE AND RECENT:	Glacial drift and alluvium.
	Great Unconformity
PRECAMBRIAN	
KEWEENAWAN:	Olivine diabase dike. Quartz diabase dikes. *Intrusive Contact* Nipissing quartz diabase sill.
	Intrusive Contact
HURONIAN (COBALT SERIES):	
Lorrain Formation:	Conglomerate, arkose, and quartzite.
	Disconformity
Gowganda Formation:	Conglomerate (tillite), greywacke, and quartzite.
	Great Unconformity
MATACHEWAN:	Quartz diabase dikes, generally porphyritic.
	Intrusive Contact
ALGOMAN:	Granite, syenite, and gneiss.
	Intrusive Contact
HAILEYBURIAN:	Serpentine (lamprophyre and some basic rocks probably of this age but not differentiated from Keewatin).
	Intrusive Contact
KEEWATIN:	Quartz porphyry, rhyolite, felsite; minor banded siliceous iron formation. Basic and intermediate lavas and tuffs; minor pillow, amygdaloidal, and spherulitic lava; chlorite, mica, and hornblende schists derived from the volcanics.

Keewatin

The Keewatin in this area is considered as consisting of two series of formations, an older series of basic to intermediate lavas and pyroclastics and a younger acid one of lavas and intrusives. The younger series has not been proven Keewatin, but the character of the rocks and the relations between the acid and basic series are similar to those studied by the author in many other Keewatin areas. Burrows suggested that they might be Algoman, but he, like the author, favoured a Keewatin age for them.

The older series consists of the usual types of rocks, such as basalt, andesite, and dacite, found in the Keewatin in other parts of the Canadian Shield. There are some massive, coarse-grained, diabasic types among the lavas, which represent parts of thick flows or possibly intrusions such as sills. These rocks, in some places, have led to confusion because they have been mistaken for sill diabase or later quartz diabase dikes. They are prominent just north of the Morrison mine where they were included with the sill on at least one geological map. They may be seen near the west shore of Miller Lake at its north end, around the east bay, and in other places.

The lavas in this area, unlike those of most other Keewatin areas, have few ellipsoids and amygdules. Pillows were observed in only two places. One of these is on the road at the southwest end of the small lake west of Leroy Lake, and the other is on the trail from the Siscoe mine to Miller Lake, just south of the old Castle No. 1 shaft. Amygdaloidal lava was observed on the transmission line along the Nicol-Haultain boundary where it crosses a small creek flowing into Leroy Lake.

Mingled with the lavas are many bands of tuffs some of which are distinctly layered, indicating deposition in water. There are numerous dikes and dikelets of granite and felsite cutting the volcanics, and these are mainly Algoman in age. Some felsite dikes may be late Keewatin. The finer-grained lavas and the tuffs have been sheared to chlorite, hornblende, and mica schists, which have a general strike roughly parallel to the long axis of the Miller Lake basin, although there are many local deviations from this trend. The schists mostly dip steeply.

Although Keewatin rocks at one time covered the whole of the Gowganda area, they now occupy only a small part of it. The large patch of these rocks around Miller Lake lies on top of the diabase sill, whereas the other exposures are beneath it.

Exposures of the acid Keewatin rocks, comprising quartz porphyry, felsite, rhyolite, and a little banded siliceous iron formation are confined to a small area north and east of the village of Gowganda, except possibly for some felsite dikes in the older Keewatin. The only iron formation seen is east of Banker Bay on Gowganda Lake, on the Big Four claims, where it is highly impregnated with pyrite.

The Keewatin formations are generally regarded as unfavourable for ore, although a few small, high-grade veins have been found in them above and below the sill. The silver usually ends at the sill-Keewatin contact even where calcite veins cross it into the Keewatin. This situation is similar to that in much of the Cobalt field where the Keewatin rocks are unfavourable for silver, whereas base metals such as copper, lead, and zinc favour them.

Haileyburian

A few small areas of serpentine derived from ultrabasic and basic rocks have been considered Haileyburian since they seem to correspond to the Haileyburian of the Cobalt district. The largest mass is on the southeast bay of Dinny Lake, and there are a few smaller bodies scattered through the Keewatin. Some small bodies of lamprophyre have been reported, but these have not been separated from the Keewatin in mapping.

Algoman

Two varieties of granite occur in the Miller Lake area, hornblende and biotite. Most of the rock is pink and fresh in appearance, but there are grey gneissic sections, especially near areas of Keewatin rocks. Granite grades into syenite near Everett Lake, and in places, the rock is porphyritic.

There are two main masses and several small bodies of the granite exposed besides the numerous dikes and other intrusions in the Keewatin. These are around Everett Lake and in the central part of Nicol township, north of Wilson Lake. It is believed that these connect at depth beneath the Miller Lake basin, and an east-west trough exists in the Keewatin overlying the granite batholith. This trough affected the shape of the diabase sill when it was intruded, making

it thicker in the basin with rather rapid thinning to the north and south and less rapid thinning to the east and west.

With the exception of one small body of granite, which occurs on the east side of Martin Lake, in Lawson township, all the granite bodies of any size lie under the diabase sill. It is probable that there is much more of this rock under the sill than the quantity exposed in the area would suggest. A diamond-drill hole west from the bottom of the sill on the 730-foot level of the Miller Lake O'Brien mine ended in granite.

No gold or other metal deposits have been found with the granite in this area.

Matachewan

Numerous quartz diabase dikes in this area are similar to those classed as Matachewan in other areas. They cut the Algoman and Keewatin but not the Huronian sediments. They are thus readily distinguished from the later quartz diabase dikes in the vicinity of sediments. They have a remarkably uniform, north strike and in this they differ from the later dikes, which strike in various directions. This uniformity in strike of the Matachewan dikes indicates that the earth's crust during this epoch must have been under tensional east-west strain. These dikes are, in general, more altered than the later dikes, and they have a distinctive feature in that they are almost everywhere porphyritic. They contain large phenocrysts of plagioclase up to 2½ inches in diameter. These are greenish yellow to white and nearly spherical in shape or with crystal boundaries. The dikes are 25–75 feet wide where seen, but Bowen[1] mentions some over 200 feet wide in other parts of the Gowganda area. They fortunately do not affect mining operations to any great extent, since they do not cut the diabase sill. They had nothing to do with the occurrence of ore except in a few places where small veins occur in or along them owing entirely to structural conditions.

Huronian

The Huronian in this area is divided into two formations as it was in the Cobalt area. The lower, Gowganda formation, is believed to be separated from the upper, Lorrain formation, by a disconformity. The author did not find definite evidence in the Miller Lake portion of a hiatus between them, since some of the same types of rocks occur in both series with gradation from one to the other. Bowen and Collins,[2] however, found evidence in other parts of the Gowganda area of changes in the conditions of deposition.

The Huronian sediments cover large sections of the Gowganda area, and they lie over the older formations with a great unconformity resulting from deformation and extensive erosion of the older rocks. A few veins have been found in them, but they play a minor role here, compared with their great importance in the Cobalt area, in the occurrence of veins.

Gowganda Formation

This formation comprises conglomerate, greywacke, and quartzite, with the first of these the dominant rock. It is at least partly a tillite or consolidated glacial drift. It contains very angular boulders, up to 4 feet long (on the south-

[1]Norman L. Bowen, *Diabase and Granophyre of the Gowganda Lake District, Ontario*, Jour. Geol., Vol. XVIII, 1910, pt. VII, Oct.–Nov., p. 662.

[2]W. H. Collins, *The Geology of the Gowganda Mining Division*, Geol. Surv. Can., Mem. No. 33, 1913, p. 55.

west side of Percy Lake) and 15 inches wide, jumbled together with smaller rounded boulders. In some places large boulders lie in a fine-grained matrix. There are pebbles and boulders representing all the older rocks found in the area, but granite greatly exceeds all other rocks in quantity. In most places the conglomerate forms the basal rock of the formation, but greywacke occupies this position in a few. The beds have gentle dips of 15–25 degrees, except in a few places where the intrusion of the diabase sill disturbed them at the contact, or where apparent folding resulted from conditions of deposition. Around the Millerett mine the dip of the conglomerate, as shown by thin bands of quartzite scattered through it, changes within a short distance from 15 degrees to almost vertical. Just east of the Capitol shaft and near the Kilpatrick vein, the conglomerate is apparently folded, but these disturbances in this rock are not regarded as due to folding after consolidation, but to slumping of the material



Cobalt conglomerate (tillite) with boulders four feet in length, southwest side of Percy Lake.

while being deposited. The slumping may have been due to pushing of glacial ice or to deposition in a depression. It is known that a depression in the Keewatin surface has been filled with conglomerate at the Millerett mine. It is a matter of some interest that two prominent veins occurred near these disturbed areas.

It is difficult to fix the thickness of the Gowganda formation, since so much of it has been eroded. A section 340 feet thick was found southwest of Mud Lake, in Haultain township, where the conglomerate overlies granite and dips about 20 degrees under the diabase sill. This, however, does not represent the maximum thickness of the conglomerate, since some of the rock lies on the sill to the east and south of this area. Collins,[1] from experience in a much larger area, placed the thickness at about 500 feet, where it could be measured, with a possible maximum thickness of 1,000 feet.

Lorrain Formation

White-to-yellow, feldspathic quartzite and arkose form most of the Lorrain formation. Conglomerate is much less abundant than it is in the Gowganda formation, and it is different in many respects. The pebbles and boulders are mostly

[1]W. H. Collins, *op. cit.*, p. 45.

of quartz, and there is no sign of a glacial origin in it. Good exposures of quartzite may be seen along the road southwest of Lost Lake, where it has a gentle dip of 15°SW., and of quartzite and arkose around Gowganda Lake. Most of the formation has been removed by erosion, and no sections were found where a satisfactory measurement of thickness could be obtained. Collins[1] stated that in some parts of the Gowganda mining division the thickness was known to be as much as 600 feet, and that this figure was probably well below the maximum.

Keweenawan

The Keweenawan system is represented in the Gowganda area entirely by diabase intrusions, except for a small amount of granophyre and the silver-cobalt veins. The earliest rock in the system is the Nipissing quartz diabase sill, which is of paramount importance since it has been responsible for the only commercial mineral deposits of the whole area. The sill also shows more interesting petrographic features than any of the other intrusions. A detailed description of this important body is therefore postponed until the remainder of the stratigraphy has been discussed.

Quartz Diabase Dikes

Seven quartz diabase dikes have been found in the Miller Lake portion, and all but two are known to be post-sill in age. These are doubtless of similar age. They must be considerably younger than the sill because they show distinct chilled edges against it, showing that the sill was completely cooled before the dikes were intruded. The longest of these dikes has been traced N.60°E. for 4 miles. It maintains a very constant strike except for two minor deviations. Burrows' latest map[2] shows an offset in the dike, in claim R.S.C.83 (northwest of Percy Lake), and this has been taken to indicate a fault at this point, possibly an extension of the C fault in the Siscoe mine. It was found, however, that this offset does not exist as the dike makes a sharp turn north for a short distance and then resumes its regular course. This sudden change in direction may be due to a pre-sill fault. This dike is 20–60 feet wide.

The widest of these quartz diabase dikes runs through the Siscoe and Castle-Trethewey mines where it is, in places, almost 100 feet wide and a nuisance in mining operations. It has been formerly mapped as an olivine diabase, but it contains no olivine and instead an estimated 5 percent quartz and plagioclase in micrographic intergrowth. In the Castle-Trethewey mine it has columnar jointage with the columns lying horizontally, normal to the contacts. An idea got abroad that the chances of ore south of this dike were not as good as north of it, but the dike could have nothing to do with the occurrence of the ore, since it is definitely later in age. A very high-grade vein was recently found south of the dike in the Siscoe mine carrying several thousand ounces of silver to a ton of ore.

A diabase dike 85 feet wide cuts the sill and Lorrain quartzite between Dinny and Obushkong lakes. Burrows[3] mapped this as a segment of the long olivine dike south of Miller Lake, cut off and shifted a mile to the north by the Gowganda Lake fault. This proved to be quartz diabase with about 3 percent quartz and thus removes any evidence of a large horizontal displacement on this fault.

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[1]W. H. Collins *op. cit.*, p. 52.
[2]Map No. 35d—Gowganda Silver Area, Ont. Dept. Mines, Vol. XXXV, 1926, pt. 3.
[3]A. G. Burrows, *Gowganda Silver Area (Fourth Report, Revised)*, Ont. Dept. Mines, Vol. XXXV, 1926, pt. 3, map No. 35d.

The diabase in these dikes resembles that in the sill, but differs from it in several respects. It is usually finer-grained, especially near the borders of the dikes, and it has a less harsh surface. The sill diabase is mostly grey whereas that in the dikes, where weathered, often has a brown or orange tint. No granophyre occurs in the dikes, and they do not contain, so far as studied in thin section, any orthorhombic pyroxene, a very common constituent of the sill. Quartz is generally more abundant in the dikes, and the micrographic intergrowth of quartz and plagioclase may be as high as 10 percent, about double that of normal sill diabase. Magnetite, much of it titaniferous, is generally higher in the dikes than in the sill, and it shows much evidence of having crystallized later than the plagioclase and pyroxene. Some very fine examples of exsolution of ilmenite in magnetite, as illustrated in the accompanying photomicrograph, occur.



Photomicrograph of a thin section from the quartz diabase dike in the Siscoe mine. It shows exsolution of ilmenite in lighter bands in magnetite. (X 250.)

Olivine Diabase Dike

Only one olivine diabase dike occurs in the Miller Lake area. It has been traced for 5 miles with a nearly regular strike of N.65°W. across the southern part of the Miller Lake basin. Where seen, the dike has a width of about 45 feet, but Burrows[1] states that it has a maximum width of 100 feet. It weathers to a browner colour than the quartz diabase and spalls off in thin slabs.

A good exposure of this dike may be seen on the road about 600 feet west of the Morrison mine. Here the rock is porphyritic, in the author's experience, an unusual condition for Keweenawan olivine diabase. The phenocrysts of plagioclase are up to ¾ inch in diameter and greenish yellow in colour. They show crystal outlines or roughly spherical forms and in these respects resemble the phenocrysts of the Matachewan dikes, although they are less altered.

A thin section shows the rock to be remarkably fresh, and the feldspar is

[1]A. G. Burrows, *op. cit.*, p. 20.

almost glassy in appearance. Feldspar dominates pyroxene, and the monoclinic pyroxene is not twinned as it almost universally is in the quartz diabases. The crystals are shorter and more blocky in form. Olivine is scattered throughout the rock in small grains.

Pleistocene and Recent

This area has been thoroughly glaciated. Abundant drift, several eskers, and numerous striations attest to the action of the ice. The striations mostly strike S.15°E., but some strike S.10°E. and a few S.25°E. The nature of the topography caused local deviations. There are, in many places, two sets of striations about 10 degrees apart, but no definite evidence could be found for the relative ages of the sets taken over the whole area where they were measured. The striations may be used by prospectors to trace float to its source, since the source should lie about N.15°W. of the location of the float. Several good eskers occur in the area, and one of these, about 20 feet higher than the adjacent swamp, may be seen just west of Miller Creek, about half a mile south of the north boundary of Nicol township.

The Nipissing Diabase Sill

This great intrusion is a dominating feature of the Gowganda area. It has been suggested by Burrows,[1] Campbell,[2] and others[3] that this is part of a very large sill originating in the Cobalt area and extending through the Cobalt, Timagami, Elk Lake, and other areas. The author does not accept this hypothesis because it puts too great a strain on the mechanics involved in such a concept. Such a sill would have to traverse, in a distance of over 75 miles, a variety of structures and formations, and it is simpler to assume that there is more than one sill fed by local feeders, such as the numerous quartz diabase dikes considered of Nipissing age scattered across much of the Canadian Shield. It seems unlikely that the Gowganda sill, coming from a very distant source, would have dug beneath more than 1,600 feet of Keewatin rocks in the Miller Lake basin when it could have penetrated along the base of the sediments or along their strata. It is believed that feeders supplied diabase magma at several points, and that it rose to a level where its temperature and the pressure on it made it easier for it to spread out as a tabular body, lifting up the overlying rocks, than to penetrate these rocks in some other form of intrusion. It is probable that sills developing locally spread laterally to coalesce and form what appears to have been originally one great intrusion.

The Gowganda sill is regarded as originating from a feeder under the Miller Lake basin where it is thickest and from which it spread out in all directions. The basin is apparently a trough of Keewatin rocks in a granite batholith, and this controlled the form that the sill assumed.

Thickness of the Sill

The thickness of the sill has been determined in only two places in the vicinity of Miller Lake. Miller Lake O'Brien Mines, Limited, drove westward on the 730-foot level from No. 1 shaft to the bottom of the sill, and, according to the data secured, the sill is 955 feet thick in the Siscoe mine. A. D. Campbell[4] states

[1]A. G. Burrows, *op. cit.*, p. 14.
[2]Angus D. Campbell, *Gowganda Silver Area*, Trans. Can. Inst. Min. Met., Vol. XXXIII, 1930, p. 276.
[3]See bibliography, page 4.
[4]Mine manager.

that in the Castle-Trethewey mine a hole was drilled from the 850-foot level of No. 3 shaft to the bottom of the sill, and the thickness was determined as 900 feet.

Very few other actual measurements of thickness have been made, but there is much evidence that the sill thins rather rapidly to the north and south of the mines mentioned and to a lesser degree to the east and west. Collins reported a thickness of 50 feet for the sill on Davidson Lake, in the northwest part of Haultain township. Around Pettipher Lake, near the south border of Nicol township, there is what appears to be a remnant of the sill in a small basin in which Cobalt sediments overlie the diabase. Taking the width of outcrop of the sill and allowing a dip towards the centre of this basin sufficiently great to permit it to hold as great a thickness of Cobalt sediments as ever suggested for these beds the sill is less than 225 feet thick in places. Although there is no definite evidence available of the thickness of the sill around Gowganda Lake to the west and Lost Lake to the east of Miller Lake, the author believes that it is not over 500 feet thick in these places. Structure sections across the sill, (shown on map No. 1955-3, in back pocket) give the author's concept of its form. The sill's thickness is a matter of some interest to mine operators because the possible occurrence of ore beneath it or in its lower part is a matter of concern to them.

Dip of the Sill

The dip of the upper contact of the sill is fairly regular for considerable distances in some areas, but there are many local irregularities, with the dip changing for short distances from as low as 15 degrees to vertical. These rolls in the contact are generally favourable for the occurrence of veins because they play a part in fracturing the sill.

Burrows[1] recorded the dip of the upper contact of the sill in a number of small mines now abandoned and full of water. These are set out here because of their use in computing the probable depth of the sill and the thickness of the overlying Keewatin in the Miller Lake basin. The figures are as follows: Silver Bullion, at the east end of Leroy Lake, 20°NE.; Coleroy, on the west side of Leroy Lake, 30°NW.; Huronian Belt, south of the east bay of Miller Lake, 20°N.; Walsh, on the south side of Miller Lake, 18°NE.; and in the Castle No. 1 shaft, on the northwest bay of Miller Lake, nearly vertical from 90 to 130 feet and below that 15°–20°.

The dip of the bottom of the sill on the west drive on the 730-foot level of the Siscoe mine is 14°E. The dip in the upper contact appears steeper near the outcrop of the sill and flattens as the centre of the basin is approached. Burrows reports a dip of 30° in the Castle-Trethewey mine in its early days, whereas the average dip of the workings in the Capitol shaft is 16°E. and 19°NE. It is nearly flat in the most easterly workings, indicating that they are approaching the bottom of the basin.

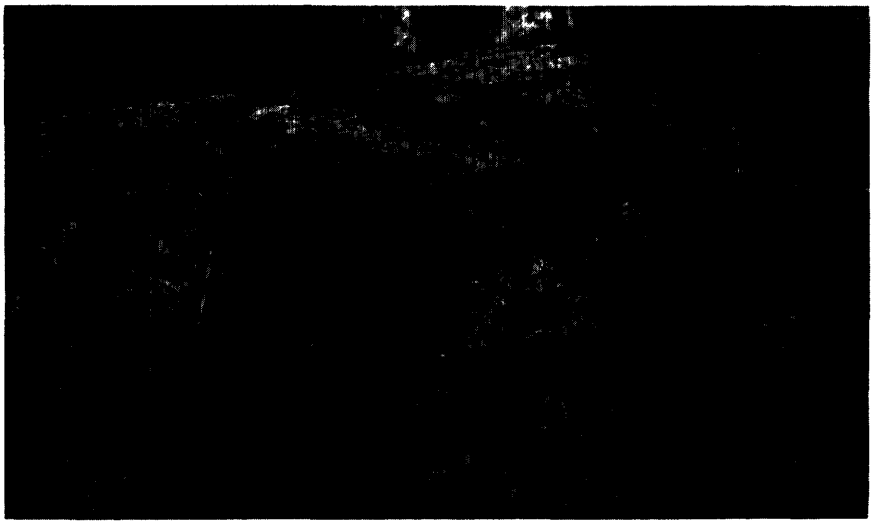
The deepest workings in the camp are at 1,425 feet in the Castle-Trethewey mine, and the next deepest in the Siscoe mine at 1,200 feet. From the figures for dip the author considers that the Keewatin rocks in the Miller Lake basin are about 1,600 feet thick. There was a report that in some drilling done about a year ago on the old Millcrest claims, on the east side of Miller Lake, the sill was reached at about 600 feet vertical depth. This report is so much at variance with other evidence of the depth of the sill in this locality that the author can not accept it as correct. The site of the drilling was visited, and no sill diabase was

[1]A. G. Burrows, *op. cit.*, pp. 41–47.

found in a lot of core left there. It is believed that some coarse, diabasic Keewatin greenstone such as may be seen in large outcrops on the opposite side of the east bay of Miller Lake, was mistaken for sill diabase, as it has been in other places.

Contact Effects of the Sill

Except where adinole and "red rock," described below, occur, the contact effects of the sill are slight, especially when its great volume is considered. This is, however, characteristic of these basic magmas in many areas. A sharp contact of the sill with overlying Cobalt conglomerate may be seen on the road from the Siscoe shaft to No. 2 mill. The conglomerate is practically unaltered, and a similar situation was found at other points along the upper contact.



A sharp contact of the Nipissing diabase sill with overlying Cobalt conglomerate along the road from the Siscoe shaft to the No. 2 mill.

A specimen was taken from the Keewatin at the lower contact on the 730-foot level in the Siscoe mine. The rock is cream-coloured and felsitic in texture. In thin section it resembles hornfels, since it is composed mainly of fine-grained quartz, orthoclase, and plagioclase, with grains of pyrite and individual grains and groups of grains of titanite, a common constituent of granophyre. There are also larger grains of plagioclase, one phenocryst being 1.5 by 0.75 millimetres in diameter. The rock may be a metamorphosed acid tuff or, more probably, an altered acid porphyry.

Internal Structure of the Sill

Columnar jointage is a remarkable feature in the Gowganda sill. It is broken up into polygons, which are mostly less than 10 feet in diameter, but some are as large as 15 feet. The columns are again broken by roughly parallel, vertical joints into curved slabs 3 inches or more in thickness. The columns are mostly normal to the upper contact, but in the Morrison mine some of them curve around until they lie in a nearly horizontal position. Some columnar jointage is found in most of the sill, but it is most highly developed in the two large mines, especially the Siscoe. There is evidence in the mine workings of at least a little movement of the columns on one another because they show smooth surfaces on which chlorite or serpentine has been developed.

There are also many small faults that are confined to the sill. These will be described under Structural Geology. Although faulting appears to have played an important role in the origin of the veins, the columnar jointage has had a minor effect in their location. There are many small veins in the joints, but



Columnar jointing near the base of the Nipissing diabase sill on the Castle road about a mile north of the road to Gowganda. The photograph shows some evidence of concentric jointing.



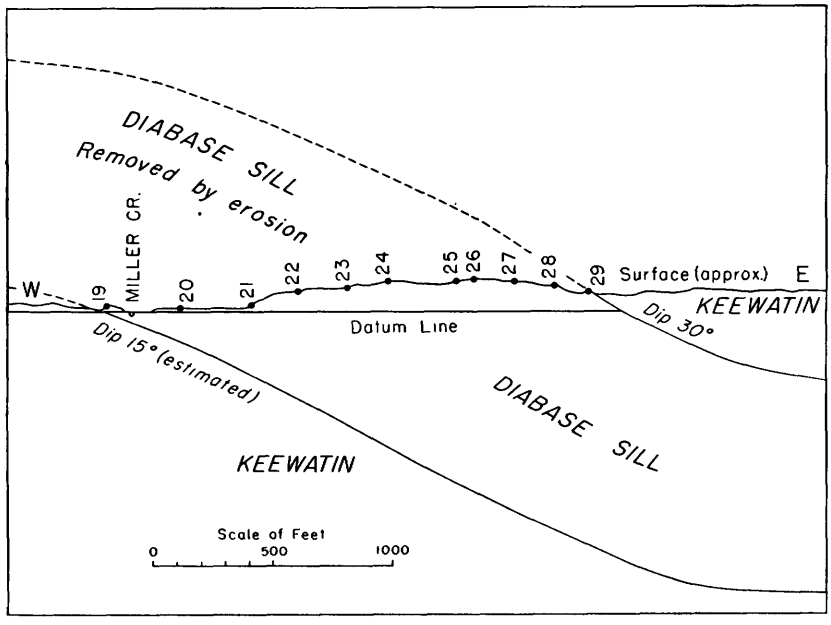
Concentric jointing in the upper part of the Nipissing diabase sill near the Siscoe shaft.

the larger veins are not greatly influenced by them. Veinlets branch off from the main veins and run around the columns thus widening the ore zones in some places. The columnar jointage and the faults confined to the sill are due to crystallization and cooling in it. The shrinkage due to these two phenomena amounts to about 10 percent of the volume of the magma that formed the sill. This was an important item, since it would mean nearly 100 feet of vertical and a large amount of horizontal shrinkage. The upper part of the sill probably solidified first, and there would be a tendency for the columns and faulted blocks

to settle towards the lower, still-liquid, portion of the sill. The sum of all the minor movements within this large body of rock would add up to a considerable amount of internal displacement.

Petrography of the Sill

Except for comparatively small amounts of granophyre and basic segregations, the sill appears to be composed of nearly uniform quartz diabase. It is coarse or fine-grained, depending upon the rate of cooling, and although the rock is mostly fine-grained near the contacts, there are places where it is surprisingly coarse right to its edge.



Section across Nipissing diabase sill. Nos. 19 to 29 show where rock specimens were taken.

A collection of eleven specimens was made across the sill from bottom to top with the object of determining whether there was much variation in its composition. The first specimen was taken on the west side of Miller Creek near the lower Bonsall shaft in claim R.S.C.83, and the last one at the upper Bonsall east shaft in claim R.S.C.84. The sill outcrop here is about 2,000 feet wide, and the spaces between the specimens averaged about 200 feet, but they were not of equal length, since outcrops were not available at equal intervals in all parts of the area. The first and last specimens were taken as close to the lower and upper contacts as possible, and although these were both in low ground, it is believed that the specimens came from close to the contacts. In this area there is no granophyre or other products of differentiation in evidence.

In the description of the thin sections that follows, the term "orthorhombic pyroxene" may mean either enstatite or hypersthene, since modern mineralogists claim that the lack of pleochroism in an orthorhombic pyroxene does not necessarily mean that the mineral is not hypersthene, and only careful optical tests on good sections of crystals will distinguish these minerals from each other. The same holds for the distinction of augite from diopside, and "monoclinic

pyroxene" will cover both these minerals, although most of the monoclinic pyroxene in these diabases is augite. The orthorhombic pyroxene found lacked pleochroism and is considered to be mainly enstatite, as suggested by Bowen[1] in his early work in this area.

Orthorhombic pyroxene was present in most of the thin sections and generally more abundant than the monoclinic species, although the opposite was true for a few slides. Much of the rock had the composition of a quartz norite, but ophitic texture was evident almost throughout the sill, with minor areas showing gabbroic texture. In these the orthorhombic and monoclinic pyroxenes, in a few cases, were in crystals up to 4 millimetres long.

The plagioclase of this sill has been identified by several petrographers as acid labradorite to basic andesine. The proportions of feldspar to pyroxene in the slides varied considerably, from 3 to 1 for feldspar to the opposite proportion. The feldspars were generally smaller than the pyroxenes.

The only primary magnesium or ferro-magnesium silicate observed, other than pyroxene, was a little brown biotite. No olivine has been reported from this sill, and it therefore lacks the basic differentiates found in one section of the Cobalt sill.

In a few slides, notably near the upper and lower contacts of the sill, there was considerable talc, chlorite, and uralite formed by alteration of the pyroxenes and sericite and kaolin after plagioclase.

Micrographic intergrowth of quartz and plagioclase was found in all sections, and its quantity was estimated at 1–4 percent. The quantity of quartz appeared to increase slightly towards the top of the sill. Titaniferous magnetite or ilmenite varied in amounts estimated at 1–3 percent and, some good examples of exsolution of ilmenite in magnetite were observed.

The result of this study of the section across the sill indicates that in this area it has a fairly uniform composition from top to bottom. The scarcity of granophyre in this part of the sill stands out in contrast to its frequent occurrence in many other parts farther east.

Differentiation in the Sill

In some parts of the sill there is considerable granophyre or micropegmatite. This rock has generally been called aplite, but no real aplite was found in the Miller Lake area, the acid differentiate being a true micropegmatite lacking the texture of aplite. The granophyre, however, bears somewhat the same petrogenic relation to the quartz diabase that aplite does to other basic rocks in that it is an acid phase and complementary to the basic phase.

The relation of diabase, "red rock," and adinole have been a matter of much discussion, especially by Bowen[2] and Collins.[3] Adinole is a fine-grained, felsitic rock consisting of small quartz and feldspar grains and formed from slate or slaty greywacke near diabase intrusions. It contains considerable soda, in some places as much as 10 percent. It occurs in several places in the Gowganda area, and it has generally been included in the "red rock." The name "red rock" has been applied to rocks of red, red-brown, pink, and purplish colour found along the contact of the diabase sill and the Huronian sediments. It does not occur with dikes and not everywhere along the contact of the sill and sediments. It includes

[1] Norman L. Bowen, *Diabase and Granophyre of the Gowganda Lake District, Ontario,* Jour. Geol., Vol. XVIII, 1910, pt. VII, Oct–Nov., p. 659.

[2] *Ibid.*

[3] W. H. Collins, *The Geology of the Gowganda Mining Division,* Geol. Surv. Can., Mem. No. 33, 1913.

some granophyre because it is often impossible to draw a line between altered sediments and the granophyre that is a product of differentiation in the sill. Granophyre, however, also occurs quite independently of the sediments and throughout the sill from top to bottom in some places, being more abundant in its upper part. It forms dikelets a fraction of an inch wide and dikes up to about 15 inches wide. These intrusions may have sharp walls or show a gradation to the diabase, and there are all gradations from granophyre through granophyric diabase to normal quartz diabase. The granophyric diabase may show reddish spots with some ophitic texture, and with considerable micropegmatite.

Collins, in memoir No. 33, assumed, from the study of chemical analyses of granophyre and diabase, that granophyre and diabase existed in the magma that formed the sill as two separate phases at high temperature. These separated



Photomicrograph of granophyre from the south end of Lost Lake. Quartz (white) penetrates a large crystal of plagioclase. (Crossed nicols X 65.)

during cooling, and as a result, there was little loss of silica in the diabase. In other words, the granophyre was always present in the sill as a distinct entity. In their separation, biotite and chlorite in the granophyre take the place of pyroxene in the diabase phase, titanite that of ilmenite and titaniferous magnetite, and the plagioclase is albite or oligoclase instead of andesine or labradorite. Long needles of apatite are common in the granophyre, and some of it contains calcite. The granophyre of dikes is usually pink and grey or red, often resembling granite in the hand specimen. The feldspar is readily mistaken for orthoclase, but it is nearly all albite or oligoclase, and the red colour is due to very fine flakes of hematite. Only a little microcline has been found in the rock, and a small amount of microperthite. A specimen of granophyre forming a distinct dike, about 15 inches wide, from the dump at the Coleroy mine is pink and grey in colour and coarse grained. A thin section shows that it consists of about 25–30 percent micrographic intergrowth of quartz and acid plagioclase. The feldspars reach 4.5 millimetres in length, and the quartz grains 2.5 millimetres. It contains long columns of apatite and a few flakes of chlorite in rosettes, prob-

ably after biotite. There is a little microperthite and considerable titaniferous magnetite partly altered to leucoxene. The magnetite has a sort of sieve-like texture. Epidote also occurs in this specimen, possibly introduced, since there are a number of veinlets of this mineral in the diabase near the dike.

Another thin section of a red granophyre, resembling fine-grained granite, was made from a dikelet, about an inch wide, from the old Millcrest shaft. The micrographic intergrowth is prominent and scattered through it are tiny crystals of titanite. The feldspar and quartz grains do not exceed 0.75 millimetres in diameter.

The most interesting and extensive occurrence of "red rock" and granophyre is found around the south part of Lost Lake. Several thin sections were made from specimens collected in this area where the diabase is in contact with Huronian sediments. One specimen, taken from the dump of the adit on the Wigwam property, on the east shore of the lake, is typical of the granophyre, generally called aplite, in this area. It came from a dikelet in the diabase, and it shows much micrographic intergrowth of quartz and acid plagioclase, the latter up to 2 millimetres long. There is a little chlorite and black iron oxide but no pyroxene. Another specimen, collected on the road running along the east shore of the lake and about half way between the adit mentioned and the south end of the lake, shows a transition from granophyre to diabase. The rock looks like diabase with reddish spots. In thin section, it shows monoclinic pyroxene up to 2.5 millimetres long and much altered to uralite. There is considerable micrographic intergrowth of quartz and feldspar but not in as large proportion as in the last slide described; there is a little chlorite and an estimated 5 percent of magnetite. The rock is a granophyric diabase.

A third specimen came from the road at the south end of Lost Lake, and it appeared to be fairly typical of the "red rock." It is dull-red to brownish red, with greenish streaks and spots. In thin section, it shows both ophitic and micropegmatitic textures with some of the feldspar laths being 6 millimetres long. No pyroxene was found, but there was some chlorite, apparently after biotite. Magnetite occurs in single grains and in groups of grains, and these are often closely associated with the chlorite. Fine grains and smears of red iron oxide add colour to the rock.

Three specimens were taken on the road where it crosses the contact between the diabase and Huronian sediments. The contact can be located here within a distance of about 4 feet. The first specimen was taken from the south side of the road, within about 2 feet of the contact, from rather fine-grained diabase. In thin section it is seen to possess typical ophitic texture with plagioclase laths up to 1.5 millimetres long. Monoclinic pyroxene crystals are about 1 millimetre long, and they are partly altered to uralite and serpentine. The feldspar is also partly altered to kaolin. Black iron oxides show exsolution of ilmenite in magnetite. Micrographic intergrowth and free quartz amount to only about 3 percent by volume. A little brown biotite occurs, and part of it has lost its colour by alteration. The second of the three specimens was obtained about 5 feet from the one just described and within about 2 feet of the diabase. It was taken as an example of fine-grained "red rock," and it has a dark-red colour. In thin section this proves to be a fine-grained arkosic quartzite composed of angular grains of quartz, plagioclase, and microcline, and minute flakes of chlorite. The rock has not been completely recrystallized, since the broken edges of feldspar grains are still evident. Some very fine-grained quartz indicates that some evidence of banding still remains in the sediment.

The third specimen, which was taken from the north side of the road, about 15 feet from the contact, was considered to be a coarser type of "red rock." In hand specimen it is dull-red and granitic in appearance. In thin section it offers some surprising features, since, in the field, it appears as part of a distinctly sedimentary formation, but under the microscope it has some of the characteristics of a granophyre. It has an estimated 15–20 percent of quartz and 4–5 percent of micrographic intergrowth of quartz and plagioclase. A few lath-shaped feldspar crystals are as much as 4 millimetres long. There is no pyroxene, but many flakes of chlorite and considerable titanite in small groups of tiny crystals are present. A little microcline was also observed. This rock must be regarded as a sediment altered so that it assumes some of the features of a granophyre.

In addition to the granophyre there are differentiation products of more basic composition in the sill. These occur in small bodies a few inches or feet in diameter and large bodies many feet in diameter. Their maximum limits could not be determined because they were observed only in the Siscoe mine, and although workings cut through them, these did not expose their borders on all sides. These segregations do not, so far as is known, ever form dikes as the granophyre does but form irregular bodies in the diabase with and without sharp contacts. Some of them grade into the diabase, whereas others do not. The rock is very coarse and rather gabbroic in texture, with long black crystals cutting through a light-greenish grey groundmass. Thin sections show the rock usually much altered, with the plagioclase sericitized and kaolinized, and the orthorhombic pyroxene changed to bastite. Orthorhombic pyroxene is more abundant than the monoclinic, and the micrographic intergrowth of quartz and feldspar is estimated at about 5 percent. Magnetite is interesting since some of it is in large, very irregular grains that send fingers out into the surrounding minerals, indicating that the mineral has crystallized later than the other minerals and has replaced parts of them. Some of the magnetite shows fine lines that produce a pattern like that seen where exsolution of ilmenite in magnetite occurs, but no ilmenite can be detected. Crystals of feldspar and augite have a maximum length of about 4 millimetres, whereas those of orthorhombic pyroxene are blocky in shape and reach 3 millimetres in width.

Summing up the data bearing on the relations of diabase, granophyre and "red rock" to each other, certain definite conclusions may be drawn regarding them, but there are still certain matters about which there is considerable obscurity. Conclusion may be reached on the following: granophyre occurs only in sills and not in diabase dikes; it may form dikes in any part of the sill with distinct or indistinct walls, but it is more abundant in the upper part and in the coarser-grained parts; it is more abundant where the sill is in contact with certain portions of the Huronian sediments than elsewhere; granophyre differs greatly in composition in different places; it grades almost imperceptibly into diabase on the one hand and "red rock" on the other; and the granophyre, and the patches of more basic rock described above as occurring in the sill, are definitely the products of differentiation in the magma that formed the sill.

Collins[1] considered the granophyre, which he called aplite throughout his report, the same as "red rock," and he stated that the granophyre kept undergoing differentiation by steps until the mineral veins developed as the final product of this process. This matter will be considered further when the origin of these veins is discussed. Bowen considered the "red rock" as the result of the action of solutions, given off during the formation of the granophyre, on the Huronian sediments.

[1]W. H. Collins, *op. cit.*

If the "red rock" is entirely granophyre, as suggested by Collins, the question is asked why there are acres of "red rock" only where the sill is in contact with certain portions of the Huronian sediments but is absent elsewhere. Further, the granophyre elsewhere is in relatively small quantities and in dike form in the diabase. Was some reaction between the diabase and sediments in the Lost Lake area necessary to set off the differentiation that produced so much granophyre in that area? The possibility of assimilation of sediments by the diabase naturally presents itself as an explanation, but Collins considered this and rejected it because of lack of evidence that much assimilation had occurred.

The author believes that reaction with the sediments had something to do with initiating the formation of granophyre where diabase and sediments were in contact, and that some features of each of the hypotheses advanced by Collins and Bowen[1] must be accepted. He does not agree that all "red rock" is granophyre, but solutions from the diabase acting on the sediments produced, in some places, rock that strongly resembles it. These solutions must have been higher in soda than the diabase magma because the feldspar in the granophyre is albite and oligoclase, whereas that in the diabase is more basic. Such soda-rich solutions could produce adinole in certain sediments and granophyre-like rocks in others.

STRUCTURAL GEOLOGY

The Keewatin formations are highly sheared and folded, and some shearing of the Algoman granite has also occurred. Probably most of this deformation occurred in the Algoman period. Since that time there has been little deformation in the Gowganda area except by faulting. The Huronian sediments are almost undisturbed, except very locally at the contact with the diabase sill. Structural features of this area have, since the Algoman, been due in large part to igneous intrusions.

The intrusion of an Algoman granite batholith must have had much influence in shaping the Miller Lake basin. The diabase sill rests, to the north and south, on granite. It is believed that between these two outcropping bodies of granite there is a trough in the surface of the batholith, which was full of Keewatin rocks and into it the diabase sill was intruded. The presence of this trough seems to be partly responsible for the great thickness of the sill in the Miller Lake basin and its thinning rather rapidly to the north and south of this basin.

The Matachewan diabase dikes were intruded in a very definite pattern, since they all strike almost north in contrast to the later diabase dikes, which show no such regular arrangement. The earth's crust in Matachewan time in this area must have been under a tensional strain along an east-west line to cause all these dikes to intrude in such a regular manner. The long quartz and olivine diabase dikes north and south of Miller Lake are arranged in an interesting way. They run tangentially to the Miller Lake basin and meet at a point near the west apex of this basin, enclosing it in a triangular space open to the east. It is suggested that the shrinkage in the sill, due to crystallization and cooling, and the settling of the basin may have been responsible for the course followed by these dikes. The same cause explains the extensive columnar jointage and numerous faults in the sill, since the shrinkage would be about 10 percent of the volume of the magma when it was intruded.

[1]Norman L. Bowen, *op. cit.*

Faulting

Faults are very numerous in the Gowganda area, and some of them are of considerable magnitude and cut more than one formation. The majority seen are, however, comparatively small and restricted to the diabase sill. The Gowganda Lake fault is the largest of those recognized. It is of normal type with a strike nearly north. It is estimated to have a throw of about 500 feet, since it has dropped the diabase sill a distance at least equal to its thickness, which is considered to be about the figure mentioned. There is no evidence of appreciable horizontal displacement on this fault, since it has been shown that the diabase dike between Dinny and Obushkong lakes is a quartz, and not an olivine, diabase. Burrows[1] based his conclusion that there was a displacement of 1 mile to the north, on the west side of the fault, on the supposition that the dike mentioned was a segment of the olivine diabase dike. This fault extends as far north as Davidson Lake and possibly farther, and it seems to die out to the south near the south end of Gowganda Lake.

There appears, from topographic features, to be a strong fault under the North Arm of Gowganda Lake extending northward to beyond Diabase Lake. Another one that was suspected because of topographic conditions and proven by underground work occurs on the Mann property just west of Milner Bay of Gowganda Lake. It is in the diabase sill and, according to Burrows, has a crushed zone up to 4 feet wide dipping 45°W.

A fault of considerable magnitude, in some places following the contact of the sill and Cobalt conglomerate, and in others cutting one or other of these formations, runs southwest from Mud Lake, in the central part of Haultain township. It follows a marked depression for a mile or more. A dip of 70°SE. was measured on a small conglomerate scarp. This fault may be joined by a north-south fault passing just east of Babs Lake as there is a very pronounced depression in that locality. The author has no evidence that the long diabase dike, which crosses this depression, has been offset by a fault. This, however, is not conclusive evidence that such a fault does not exist, because the age of the faulting is not known. The author believes, however, that it is later than these dikes, since it is reported that the C fault in the Siscoe mine cuts a similar dike.

The topography indicates that there is a fault running through Jacobs Lake, a series of small lakes, and along a stream, in the central part of Nicol township. This fault, if such exists, would be older than the sill, and probably the Huronian sediments, since they are not offset. It might have had some influence in later faulting, since its northwest strike would carry it through Percy Lake, if it continued that far.

Numerous faults have been encountered in mining in the sill, and there has been much discussion among geologists and engineers regarding their age and the role they have played in the origin of the ore. Some present evidence that the faults are definitely post-ore, whereas others argue that the ore is closely related to them. One engineer has claimed that some of the faults are of the reversed type, but this is disputed by others. Before discussing the faults in the operating mines, brief mention will be made of faults, recorded by Burrows,[2] in a number of mines now inactive and full of water. The data will throw further light on the situation in the whole area. A strong fault was found in the lower Bonsall mine near Miller Creek,[3] in claim R.S.C.83. It strikes north, dips 45°E.,

[1] A. G. Burrows, *Gowganda Silver Area (Fourth Report, Revised)*, Ont. Dept. Mines, Vol. XXXV, 1926, pt. 3, p. 18.

[2] *Ibid.*

[3] *Ibid.*, p. 25.

and comes to the surface in the bed of the creek. There is a zone of crushed diabase, 12 feet wide along the fault, but Burrows does not make clear whether the veins are offset, or whether any ore was found in the fractured zone on which drifting was done for 60 feet. In the Chapelle mine,[1] on the southeast side of Leroy Lake, there was an ore vein striking N.20°E., which was offset 55 feet to the southeast by a fault striking northwest and dipping 60°NE. Several faults were found displacing the veins in the Silver Bullion mine,[2] at the east end of Leroy Lake, as much as 6 feet, and in the Coleroy mine,[3] on the northwest shore of this lake, veins were offset from a few inches to a few feet. Work on the Reeve-Dobie property,[4] west of Gowganda Lake, uncovered many fractures in the diabase and a number of strong faults apparently later than the veins. The evidence from the properties mentioned indicates that at least many of the faults are post-ore in age.

In the operating mines many faults were found, some of them of considerable length. A strong fault in the Siscoe mine, striking north and dipping about 50°E., is known as the C fault. It has been found in the workings to a depth of at least 525 feet below which the workings lie to the east of the fault. It is agreed that this fault is not only post-ore, but that it cuts the large quartz diabase dike, which runs through the sill in this mine. The main orebodies in the upper part of the mine lie below this fault, whereas those in the lower part have been found above it. Another fault that lies nearly parallel to the C fault occurs between it and the Miller Creek fault in the Bonsall mine described above. This fault is crossed by the drive on the 730-foot level to the bottom of the sill. Its dip is roughly parallel to that of the C fault.

An important fault, known as No. 6, was found in the part of the Castle-Trethewey mine that is not at present operating. According to Burrows[5] it comes to the surface between Nos. 2 and 3 shafts and crosses No. 3 shaft between the 325- and 400-foot levels. It dips 38°E. and strikes N.15°E. This strike indicates that these faults in the sill, like the veins, tend to swing around with the change in direction of the sill contact. Nearly all the ore in No. 3 shaft occurred on the hanging-wall side of this fault, and Burrows does not state whether the evidence indicated that the fault was pre-ore or post-ore but mentioned that several other faults offset the veins a few feet.

In the Capitol mine, now operating, there are many faults nearly parallel to each other and to the upper contact of the sill. These tend to cut the sill into slices. Some are quite large, since A. Omerod[6] estimated one as nearly 700 feet long. They dip about 35°–45°E.—more steeply than the contact, which in this part of the mine is less than 15°. It is difficult in some cases to decide by examining these faults whether the footwall or the hanging wall is the upthrow side, but in view of the facts that all the other faults in the area are normal faults, and there is evidence of tensional rather than compressional stresses throughout the area, it is concluded that all these faults are of the normal type. They offset some veins, but it appears that veins have followed fault fractures for short distances.

A large fault, striking nearly northwest and dipping 24°NE., occurs in the Morrison mine. It may be observed near the shaft on the 175-foot level, and some distance to the east of it on the 300-foot level. It lies above the ore zone and therefore has not affected it. There is a crushed zone along the fault, 8 inches

[1] A. G. Burrows, *op. cit.*, p. 41.
[2] *Ibid.*, p. 47.
[3] *Ibid.*, p. 45.
[4] *Ibid.*, p. 53.
[5] *Ibid.*, p. 35.
[6] Engineer, Castle-Trethewey mine

wide in some places. It is possible that this fault meets a north-south fault under a prominent depression a short distance east of the shaft, since the topography strongly suggests a fault in that area.

The evidence of post-ore age for most of the faults in the Gowganda area is very strong, but the close relation of the veins to many of the faults in the sill is so evident that it must be concluded that there were important fractures in existence when the ore-bearing solutions invaded the sill, and that post-ore movement occurred on them and others in their vicinity. Experience with faults elsewhere shows that all the movement does not, as a rule, occur at one time. This matter will receive further consideration when the origin of the veins is discussed.

ECONOMIC GEOLOGY

Silver and cobalt are the only metals that have so far been mined in commercial quantities in the Gowganda area, although small quantities of copper, zinc, lead, nickel, bismuth, antimony, and even gold occur. Silver, cobalt, and nickel are usually closely associated, but cobalt and cobalt-nickel veins with little silver have been mined, as well as silver veins with little of the other metals. The proportion of silver to cobalt and nickel is greater here than at Cobalt, but the Gowganda veins resemble those of Cobalt in their composition, calcite gangue, small size, and great richness. The most spectacular example of high-grade ore in a small vein was in the Millerett mine where a vein only about 2 inches wide with a couple of feet of disseminated ore in the walls produced 611,822 ounces of silver and 5,000 pounds of cobalt. Ore of over 10,000 ounces of silver to the ton has been reported, and ore of several thousand ounces to the ton has been found in a number of veins.

THE FORM, COMPOSITION, AND ORIGIN OF THE VEINS

The veins are mostly fissure-fillings, but considerable replacement of their walls by ore occurs in some of them. They are very numerous, but all comparatively small. Valuable veins range from a fraction of an inch to about 1 foot wide, most of them being less than 6 inches wide. Cracks in diabase may carry sheets of silver not much thicker than paper, and where such veinlets occur near mineable veins, they may supply considerable milling ore. The common gangue mineral is calcite, and veins of this mineral, as much as 3 feet wide, have been found, but the large ones do not carry ore. Narrow, white calcite veins may also be barren, but grey calcite is generally considered favourable for ore.

Most of the veins are short, but a high-grade vein, No. 3, on the Mann property was, according to Burrows,[1] trenched for 1,300 feet although its maximum width is only 5½ inches. The Kilpatrick vein, near the Capitol shaft, was trenched for 700 feet. It had a width up to 2 inches and contained cobalt and nickel with little silver. Few of the veins have ore for their full length, and very rich shoots alternate with barren gangue. The longest shoots probably do not exceed 300 feet in length. Vein No. 133 in the Capitol mine produced over 800,000 ounces of silver from a shoot not much over 250 feet long and of the same height. It is reported that a mass of silver weighing over 50 pounds was found on the Morrison property in the early days, and although a shaft was sunk to 90 feet on a strong calcite vein and some drifting done in it, no more silver was found.

A group of parallel and branching veins may constitute a wide ore zone.

[1]A. G. Burrows, *op. cit.*, p. 51.

The widest such zone so far mined was in the Miller Lake O'Brien mine where ore was stoped to a width of about 40 feet in what was named the "glory hole."

In the Miller Lake basin there are certain trends in the strike of the major veins, and this feature is of some importance in the search for ore. The veins tend to run normal and parallel to the contact of the sill with the Keewatin. There are many deviations, but these directions have been recognized as dominant. Many veinlets diverge to follow the columnar jointage in the diabase, but the main veins, as a rule, do not. In the Morrison mine the veins occur in a narrow, nearly vertical zone in the sill, parallel to its upper contact.

Photo by T. Menary



A 6-inch calcite vein, carrying some thousands of ounces of silver, discovered on the 1,200-foot level of the Siscoe mine in 1954. This vein results from the junction of several veinlets. It widened to nearly 1 foot, but the proportion of calcite and quartz gangue increased.

Veins have been found mainly in the sill and within 300–400 feet from its upper contact. Although the productive veins are confined to this zone, there are calcite veins all through the sill and some in the rocks beneath it. Many veins were seen in the lower part of the sill and in the underlying Cobalt conglomerate, east of Everett Lake, on claims held by J. M. Hunter. The diabase and conglomerate on these claims have been highly fractured, with fractures running out from the contact and parallel to it. These are filled with calcite, which, in places, has weathered out, leaving cavities up to 10 feet deep. Some of the veins carry considerable chalcopyrite and bornite, a little cobalt, and galena. One had a little native silver, and one vein in the conglomerate carried magnetite. Where veins have been trenched along the diabase contact in this locality the dip of the contact appears to be very steep, even vertical at some points. This is believed to give a false impression of the dip of the sill because a few feet away the conglomerate has a regular and gentle dip towards the sill of only about 20 degrees. The situation may be due to the sill pushing the conglomerate at the contact or to slipping along it.

The Keewatin rocks are generally considered as unfavourable for the occurrence of veins. Only a few have ever been found in them. The discovery vein on the Castle-Trethewey property was, however, in the Keewatin just above the sill, and it was a rich silver vein. The Big Four vein was in the Keewatin beneath the sill, but it has been a common experience to find the veins, and particularly the ore, ending at the contact of the sill with the Keewatin.

A few important veins have been found in the Cobalt conglomerate above the sill. The most notable of these was the Millerett, which was found in the conglomerate that overlay Keewatin lying on the sill. The ore did not extend down into the Keewatin. The Kilpatrick was another vein in the conglomerate, and although trenched for 700 feet, it was only 2 inches wide. This was a cobalt-nickel vein with little silver. The original Capitol shaft was sunk on it to a depth of 44 feet. So far as known the vein did not continue into the Keewatin, which occurs between the sill and the conglomerate. A vein known as the "cobalt vein" was mined for cobalt. It was located south of the Castle-Trethewey No. 3 shaft along the contact of Cobalt conglomerate and Keewatin, and it followed the contact for a short distance before entering the sediment. It is reported to have produced a considerable quantity of cobalt, but little silver.

Very little ore has been found in the lower part of the sill. The lower Bonsall mine, in claim R.S.C.83, produced some high-grade silver-cobalt ore, and some was found on the Crews-McFarlan property in Milner township. These few occurrences would tempt mining men, with the history of Cobalt in mind, to consider the possibility of finding ore in the lower part of the sill provided sufficient money were available for exploration.

A few small veins have been found in and along Matachewan dikes, but such occurrences are due simply to structural conditions since the dikes have had nothing to do with the source of the ore.

Mineralogy

E. W. Todd[1] published, in 1926, the results of a detailed study he made of the vein minerals found up to that time in the Gowganda area. Little can be added to the information he obtained so the author has not attempted to restudy the minerals in detail. Todd listed the following metallic minerals, in addition to native silver:

Loellingite ($FeAs_2$)	Argentite (Ag_2S)
Safflorite ($CoAs_2$)	Hematite (Fe_2O_3)
Skutterudite ($CoAs_3$)	Bornite (Cu_5FeS_4)
Cobaltite (CoAsS)	Sphalerite (ZnS)
Arsenopyrite (FeAsS)	Bismuth (Bi)
Smaltite ($CoAs_2$)	Dyscrasite(?) (Ag_3Sb)
Breithauptite (NiSb)	Amalgam
Niccolite (NiAs)	Erythrite ($Co_3As_2O_8.8H_2O$)
Chalcopyrite ($CuFeS_2$)	Temiskamite (Ni_4As_3)

There might be added to this list, bismuthinite (Bi_2S_3), galena, pyrite, and annabergite or "nickel bloom." It was thought there was a little pyrargyrite, the dark-ruby silver, and considerable dyscrasite in one place in the Castle-Trethewey mine, according to Mr. Omerod. Todd considered loellingite the most common and smaltite possibly the rarest of the arsenides in the ores, with cobaltite generally present in subordinate amounts. The commonest gangue mineral is calcite with scarcely any dolomite.

Quartz occurs in many of the veins, in some of them exceeding calcite in

[1]E. W. Todd, *Gowganda Vein Minerals*, Ont. Dept. Mines, Vol. XXXV, 1926, pt. 3, p. 77.

quantity. Hematite is fairly abundant in at least one mine, the Walsh. Epidote and axinite, a purple mineral containing boron, occur in the Castle-Trethewey mine on the lower levels. A specimen containing axinite, silica, epidote, actinolite, and tremolite came from a fault that was responsible for the amphiboles, since they were mainly in the form of asbestos. Epidote was seen in the form of narrow veins in the diabase in several localities, and its occurrence in a vein with axinite is of interest in throwing some light on the temperature of formation of the vein. Harpum[1] recently made a study of the epidote minerals and concluded that they do not crystallize directly from a magma, and their temperature of formation is between 300 and 500 degrees centigrade. The axinite-epidote veins are considered to have formed early in the history of vein formation and before the metallic minerals came in.

There is a problem as to whether granophyre should be considered gangue material in some places. In the Morrison mine many of the veins are banded with granophyre next to the diabase walls, quartz next, and then calcite with the silver in the centre. This arrangement is found even in veins only 1 inch wide, and the problem is whether such veins should be regarded as being formed by regular steps in deposition of the three constituents or by the quartz and calcite, common gangue minerals elsewhere, penetrating a previously-formed granophyre dike because it fractured more readily than the tough diabase. The regularity of the pattern in these veins, however, lends some support to Collins' hypothesis[2] that the granophyre continued to differentiate until the mineral veins formed as an end product of the process. It would be remarkable if the calcite veins always penetrated the granophyre dikes along their centre line, if they were just following fractures in that rock. In other parts of the area, some veins were seen running along the contact of granophyre dikes and others ending when they came in contact with them, where they lay across the strike of the veins.

The lack of ore in many calcite veins of promising appearance, or in parts of such veins, seems to be due to the existence of calcite of more than one generation and a different degree of fracturing at the time the ore-bearing solutions were available for the deposition of ore. Such types of phenomena have long been recognized in gold veins where more than one generation of quartz is of common occurrence, and where gold is found only in those portions of the quartz that have been at least minutely fractured at a certain stage in the development of the ore deposit. It is considered that the silver and arsenides, and at least some calcite, were deposited contemporaneously.

Origin of the Veins

Finding a logical explanation of the source of the silver in the Gowganda area is a matter of much economic importance, since the source from which it was derived influences the possibility of important deposits being found in the lower part of the sill. In the author's opinion, there can be only two possible sources, the sill itself and a source beneath the sill, which would be the parent magma of the sill. If the sill is the sole source of the metals, there is less chance of important deposits in its lower part. This is because hot solutions tend to rise, and if ore-bearing solutions were escaping from the still hot magma in the sill into fractured upper layers, which had cooled first, the ore would tend to form

[1]J. R. Harpum, *Formation of Epidote in Tanganyika.* Geol. Soc. Amer. Bull. Vol. 65, 1954, pp. 1075–92.

[2]W. H. Collins, *The Geology of the Gowganda Mining Division,* Geol. Surv. Can., Mem. No. 33, 1913.

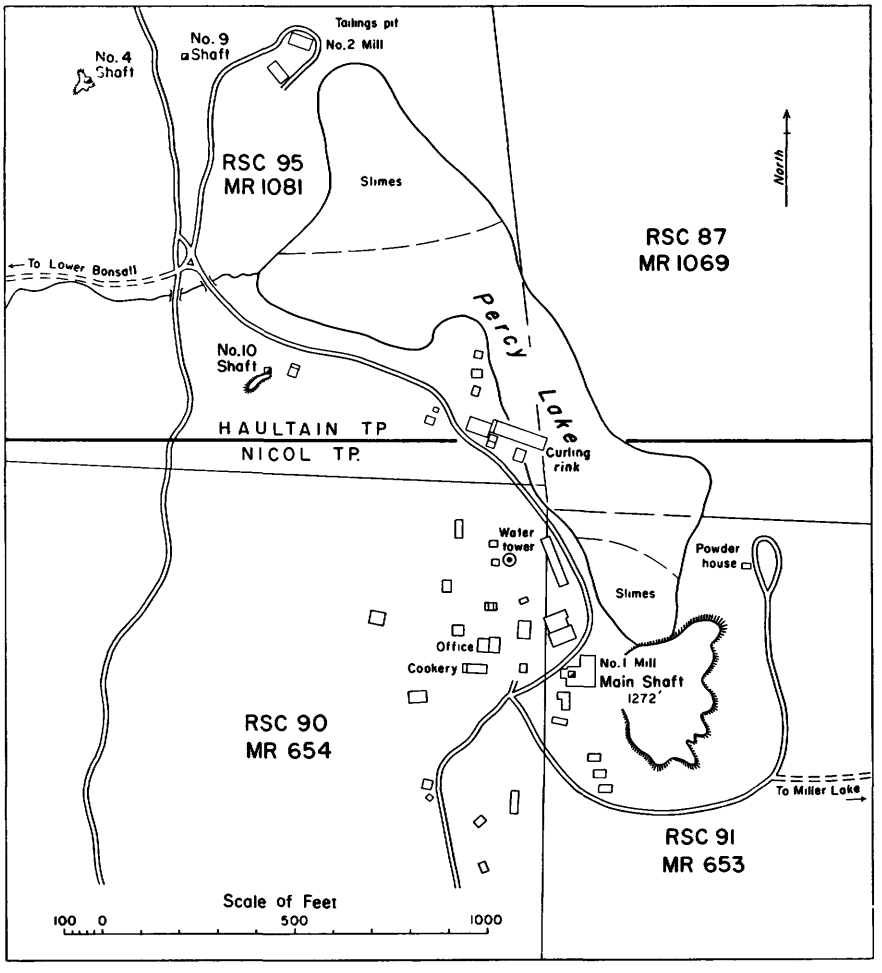
in its upper part. If the solutions came up from a deeper source the chance of their being impounded in the lower part of the sill would be greater. In considering this problem one naturally turns to the Cobalt area where the geological situation is similar in some respects, but different in others. There, the greater part of the ore came from beneath the sill and its lower portion. A relatively small portion has been found in the Keewatin rocks above the sill and not far from the area in which the sill came up from below. Ore was found in at least one of the major faults, and most of it in veins formed in smaller fractures considered related to the major faults. This would point to the deposition of the ore after the sill had been solidified so it could be fractured. Further, several deposits of base metals, including copper, zinc, and lead, have recently been found in the Keewatin beneath the sill. These grade into the silver-cobalt veins in some places. This suggests that the base-metal deposits may represent earlier, deeper, and higher-temperature deposits made by the solutions that deposited the silver. In the Gowganda area, on the other hand, nearly all the ore mined has come from the upper part of the sill, and no commercial base metals have been found beneath it. Columnar jointage is developed on a scale not found in the Cobalt area, and granophyre is widely distributed in the sill. The jointage is most highly developed in and near the most productive mines.

The author[1] has always favoured the opinion that the Cobalt ores came from a somewhat more acid phase of the magma which made the sill, and, therefore, from a source below the sill. The sill acted simply as a control in the distribution of the ore-bearing solutions. In an attempt to determine whether the diabase contained sufficient silver to make the deposits, a lot of specimens were collected from the Cobalt sill, and a few from the Gowganda sill and the sills near Port Arthur. The "older gabbro" of Noranda was also tested to see whether silver was a common constituent of all rocks of this type, because the Noranda gabbro is similar in composition to the sill diabases. These specimens were carefully assayed for silver by J. Satterly and A. M. Bell at the University of Toronto some years ago. Six specimens were taken from the Cobalt sill in the Frontier mine, in South Lorrain township, to give a section across it from top to bottom. These specimens of apparently barren diabase showed from 0.016 to 0.031 ounces of silver per ton with an average of 0.023 ounces, or 0.000079 percent. Four other specimens from other parts of the Cobalt sill assayed from 0.019 to 0.047 ounces with an average of 0.034 ounces, or 0.000113 percent. The "older gabbro" from Noranda contained 0.008 ounces, and the sill near Port Arthur 0.0185 ounces per ton. Three specimens from the Gowganda sill showed from 0.025 to 0.039 ounces, or an average of 0.031 ounces per ton. These results seem to demonstrate that many diabases and all the Keweenawan diabase sills contain a minute amount of silver enmeshed in the crystals of the rock minerals, and that its existence may not determine the formation of silver deposits.

In an effort to obtain more data on the situation in Gowganda, and see whether the granophyre carries more silver than the diabase, 23 samples of what appeared to be barren diabase and granophyre, without evidence of any gangue or ore minerals, were collected. This was done because the granophyre is definitely an acid differentiate of the sill and, according to Collins' hypothesis,[2] it represents an intermediate stage in the differentiation of the diabase to ore veins. The samples were taken from various properties in the Miller Lake basin, from the

[1]E. S. Moore, *Genetic Relations of Silver Deposits and Keweenawan Diabases in Ontario*, Economic Geol. Vol. XXIX, 1934, No. 8, Dec., pp. 747–56.
[2]W. H. Collins, *op. cit.*

most productive mines and from those that produced very little silver. It was surprising, when looking for granophyre, to find that it was quite abundant on those properties that produced little silver, and almost absent in the most productive mines.



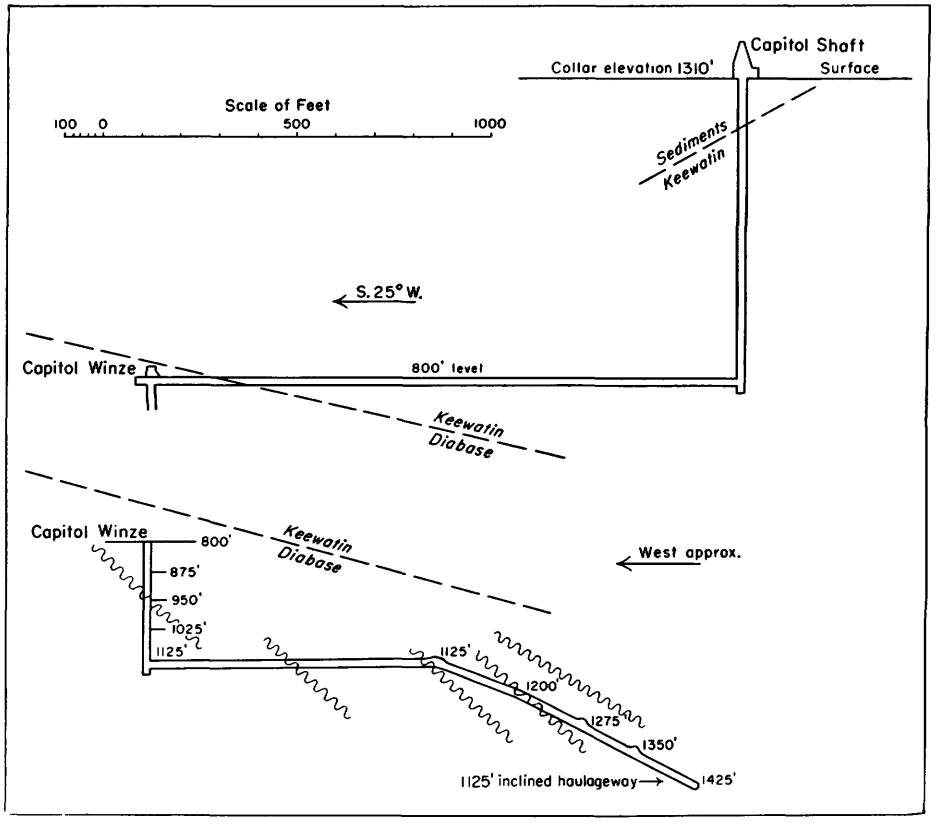
Surface plan of the Miller Lake O'Brien mine, Siscoe Metals of Ontario, Limited.

This collection was sent to D. A. Moddle, Ontario Provincial Assayer, who made spectrographic analyses of all the samples and fire assays of a few of them to check results obtained by the different methods. The figures presented here are considered to be accurate to plus or minus 10 percent. The silver content of the diabase from various parts of the area is remarkably uniform, running from 0.0001 to 0.0006 percent, for an average of 0.0002 percent, or 0.06 ounces per ton. Two specimens from the coarse basic segregation in the diabase in the Siscoe mine gave 0.0002 and 0.0003 percent silver.

The ten samples of granophyre ran from 0.0001 to 0.05 percent with an average of 0.0062 percent. This is considerably higher than the figure for the diabase. A sample from a dikelet found on the rock dump of the Siscoe mine had the highest proportion of silver, 0.05 percent, equivalent to 14.6 ounces

per ton. The next highest, 0.005 percent, came from the Chapelle claim, which had considerable granophyre and little silver, and the third highest from the Siscoe mine, 0.004 percent. The highest silver, therefore, came from a mine where the granophyre is rare. Very little silver has been found around Lost Lake where by far the largest quantity of granophyre in the Gowganda area occurs.

Summing up the data on the relations of silver, diabase, and granophyre, it is evident that they are inconclusive in so far as determining the source of all the silver to be in one or the other of the two categories mentioned above. The



Section through the Capitol mine, Castle-Trethewey Mines, Limited, showing the diabase sill–Keewatin contact.

granophyre carries more silver than the diabase, but this might be because one rock is more easily impregnated with the ore-bearing solutions than the other. The distinct relation of the silver and granophyre in the Morrison veins, described above, however, strongly supports the hypothesis that the veins in that mine, at least, are the result of differentiation in the diabase. Further, the occurrence of many small, but rich, veins in the sill west of Gowganda Lake and about 5 miles from the centre of the Miller Lake basin favours the concept of the source being in the sill. This is strengthened by the fact that there is considerable granophyre associated with some of these veins. There may, of course, be another feeder for the sill beneath this area, and since the sill is highly fractured there, the ore-bearing solutions could come up to its upper part. There is strong evidence that at least some of the silver is due to differentiation in the sill.

Favouring a deeper source for most of the silver is its abundance near the centre of the Milier Lake basin where most of the sill originated and in mines in which granophyre is rare. Further, the diabase in these mines is highly fractured by faults of considerable size, and by extensive columnar jointing. It is recognized that ore is more likely to be found in the sill where most jointage occurs. This jointing certainly preceded the formation of the ore deposits, and although the faults appear to be post-ore in age, many of them must have been in existence before the veins were formed, since there is such a definite relation between them. This highly fractured condition of the sill would account for a difference in the position of the veins, with respect to the sill, in the Cobalt and Gowganda areas. It would permit the silver-bearing solutions to rise through the sill to its upper part where they would be trapped by the tight Keewatin at its contact. The numerous calcite veins in the lower part of the sill and beneath it may represent calcite deposited in the early stage in the formation of the vein system, before the silver-bearing solutions had entered the sill.

MINING OPERATIONS

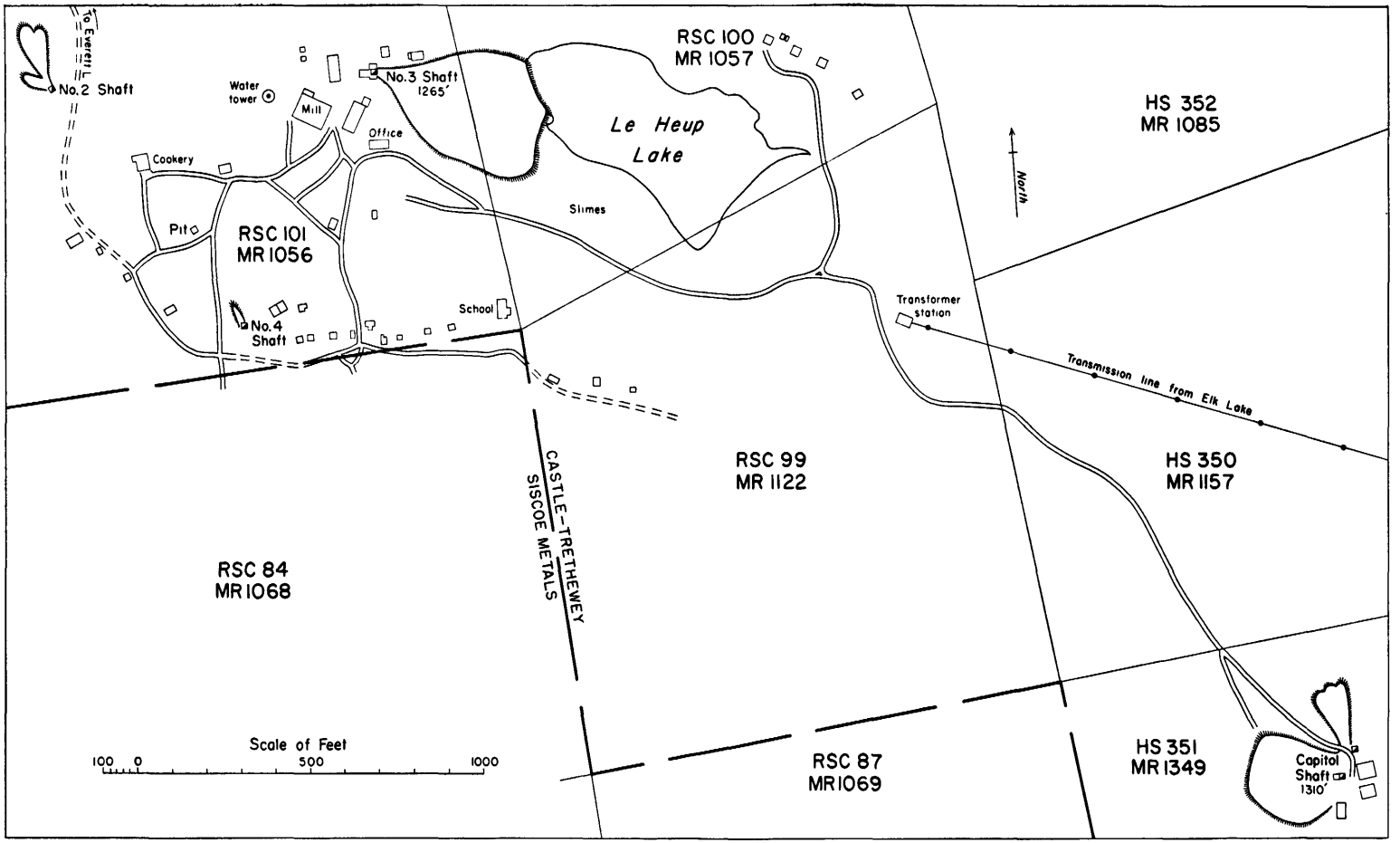
Castle-Trethewey Mines, Limited, New Morrison Mines, Limited, and Siscoe Metals of Ontario, Limited, were all operating in the Miller Lake basin during the summer of 1954. The operations of the two larger mines (Castle-Trethewey and Siscoe Metals), the properties of which are adjoining, are similar in many respects owing to geological conditions. Since the ore occurs in the upper part of the sill, which dips eastward, the workings are continually receding from the shafts as they grow deeper. It is impossible, because of the small size of the veins and the great variation in their silver content, to predict the ore reserves far in advance of the workings. The sinking of new and costly shafts is therefore avoided as much as possible, and the method followed is to sink winze after winze as the workings grow deeper. This method is satisfactory except for the unreasonably high cost of tramming and hoisting ore.

Developing the mines here is a gamble as it was in the Cobalt area because of the small size, irregular ore-content, and irregular distribution of the veins. There are certain features, however, that serve as guides in the search for ore. It occurs in the upper 300–400 feet of the sill, it is likely to be found in the more highly fractured parts of the sill, and it occurs mainly on the hanging-wall side of faults. Further, the main veins usually lie parallel to, or normal to, the upper contact and the faults. Rolls in this contact are also usually favourable features.

Castle-Trethewey Mines, Limited

Castle-Trethewey Mines, Limited, was formed by an amalgamation of Trethewey Silver Cobalt Mines, Limited, and Capitol Silver Mines, Limited. The company holds a large block of land covering 35 claims, containing about 1,343 acres, and a licence to operate under part of Miller Lake. The claims nearly surround Miller Lake on the north and east.

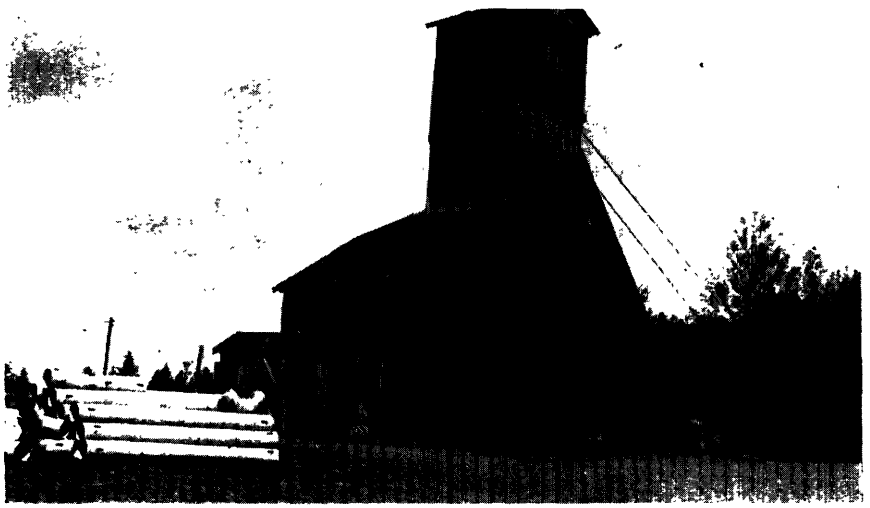
Production by the company began in 1920 and continued until 1931, when 30-cent silver and the apparent exhaustion of the ore in shafts No. 2 and No. 3 caused the mine to close. In 1948 steps were taken to renew operations, and work was shifted to the old Capitol shaft. Mining was started in 1949, and the total production by the company from the beginning of operations to the end of June, 1954, has been 9,014,470 ounces of silver, the average recovery being 28.56 ounces per ton. The production for the year ending March 31, 1954, was 1,011,730



Surface plan of the Capitol mine, Castle-Trethewey Mines, Limited.

ounces, the largest in the company's history. A. D. Campbell[1] has stated that the recovery of silver in the mill, before it closed in 1931, averaged 94 percent, and a very regular recovery of cobalt, 7.2, and nickel, 2.3 percent, from the jig and sand tailings was achieved. There has, therefore, been no object in attempting to re-treat the tailings on this property as has been done on the Miller Lake O'Brien property. A description of the operations at shafts Nos. 2 and 3 may be found in Burrows' report.[2] They are now full of water.

A nickel-cobalt vein containing little silver was discovered in 1908 near the location of the present Capitol shaft. It is known as the Kilpatrick vein and although not over 2 inches wide it was trenched for 700 feet, making it one of the longest veins in the Gowganda area. It occurred in the conglomerate, and it shows the finest display of cobalt bloom seen in any vein. A shaft was sunk to a depth of 44 feet and then abandoned. Another shaft was later started 60 feet to

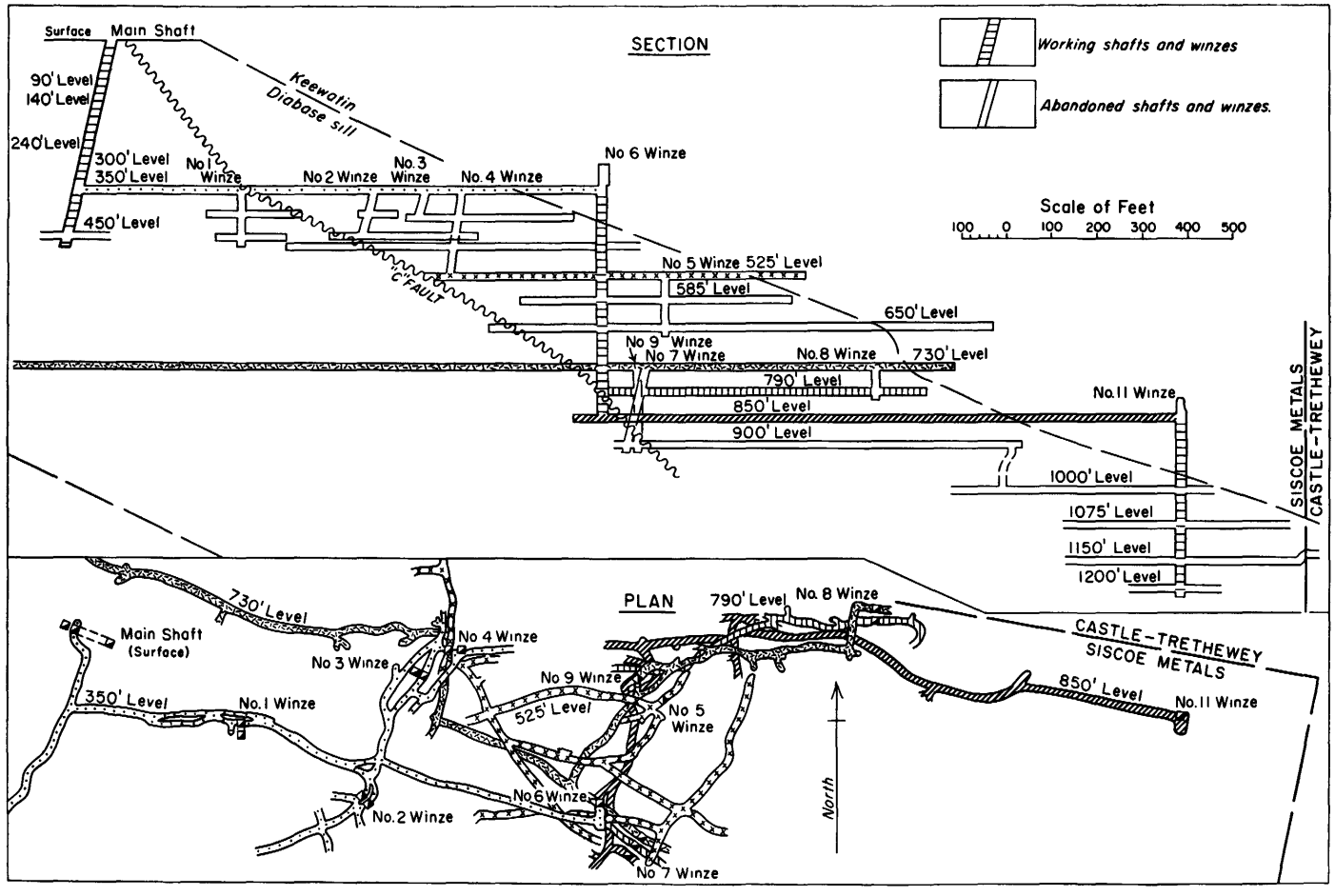


The Capitol shaft, Castle-Trethewey Mines, Limited.

the east, and it is now the company's only operating shaft. It is 819 feet deep and ends in Keewatin, after passing through 130 feet of Cobalt conglomerate near the surface. From the shaft a drift 1,500 feet long was driven S.25°W. to the diabase, on the 800-foot level. A winze was sunk from the 800-foot level to the 1,125-foot level, and from this level an inclined haulage way was sunk to the 1,425-foot level, the deepest in Gowganda. The dip of the sill, which averages 16°E. for the workings, is becoming nearly flat, indicating that the bottom of the Miller Lake basin is being approached. Many faults have been encountered, some several hundred feet in length. They dip 35°–45°E. and are much steeper than the upper contact of the sill. The veins are mainly in the hanging wall sides of these faults. Vein No. 133 on the 1,200-foot level had a very productive shoot about 250 feet long and of similar height, which produced over 800,000 ounces of silver. High-grade ore was found during the summer of 1954 in a continuation of the rich vein described as occurring on the 1,200-foot level of the Siscoe mine.

[1]Mine manager.

[2]A. G. Burrows, *Gowganda Silver Area (Fourth Report, Revised)*, Ont. Dept. Mines, Vol. XXXV, 1926, pt. 3, p. 33.



Plan and longitudinal projection on east-west line, Miller Lake O'Brien mine, Siscoe Metals of Ontario, Limited.

The large diabase dike that runs through the Siscoe is also found in the Castle mine, and it is nearly 100 feet wide.

The mine is operated all year, but the mill for only about seven months. Ore is stockpiled during the winter months and milled in the summer. It has a capacity of 125 tons a day, but only about 90 tons a day is being treated.

Consolidated Morrison Explorations, Limited

This property lies south of Miller Lake and crosses the upper contact of the sill. Silver was discovered on it quite early in the history of the camp, a shaft was sunk to 90 feet, and drifting was done on a strong calcite vein that carried a large lump of silver near the surface. Trenching was also done on several veins, and the property then remained idle for several years. Tonopah Canadian Mines Company, which operated the Walsh mine on Miller Lake, took an option on the property in 1925, sank a shaft to a depth of 575 feet, and did considerable development work. Some good silver ore was mined, and then the property again became idle. In August, 1953, Siscoe formed a subsidiary known as New Morrison Mines, Limited,[1] to operate the mine under an agreement with Lost Lake Mines, Limited, these companies to split the profits between them. The ore was hauled to the No. 1 mill for treatment.

The veins in the Morrison form a narrow ore zone about 400 feet long, dipping steeply south and striking parallel to the sill contact. It was bottomed close to the 500-foot level. Just why this ore zone formed there can not be explained unless its occurrence resulted from the development of pronounced columnar jointage in the sill in this area. Some of the columns are unusual in that they curve around into a nearly horizontal position. Further, the veins, as previously described, are peculiar in that most of them show bands of granophyre next to the diabase walls, followed by a band of quartz on either side with calcite and ore minerals in the centre of the vein. It is possible that they owe their existence to differentiation in the sill, and that they are therefore of local derivation. A large fault striking nearly northwest and dipping 24°NE. cuts through the mine and may be seen on the 175-foot level near the shaft and on a long drift on the 300-foot level east of the shaft. At the latter point there is a crushed zone along the fault several inches wide. Since this fault passes above the ore zone it seems to bear no important relation to it. The ore coming from this mine during the summer of 1954 amounted to about 60 tons a day, averaging about 25 ounces per ton. The mine was closed in the autumn.

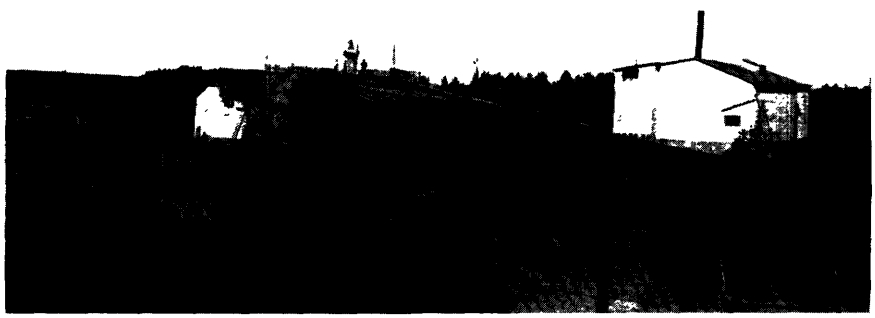
Siscoe Metals of Ontario, Limited

Miller Lake O'Brien Mines, at O'Brien, started producing in 1910 and operated continuously until World War II broke out. In 1913, the Millerett property, which had a short, but spectacular career was purchased, and the mill on that property was used for some years to treat ore from various shafts, about twenty in number. The ore was trammed from the south end of Percy Lake to the mill at the north end. The production from the O'Brien properties to the date of closing operations in 1939 was 17,555,646 ounces of silver and considerable cobalt, the amount not recorded. Between 1940 and 1944 it has been estimated that lessees took out about 620,000 ounces.

Siscoe Metals of Ontario, Limited, a subsidiary of Siscoe Gold Mines, Limited, purchased the O'Brien property, and preparations were made to start operations, in November, 1945. The main shaft and No. 1 mill, with a daily capacity of

[1] Name changed to Consolidated Morrison Explorations, Limited, May, 1955.

60 tons, on the south end of Percy Lake were put into operation. This mill and No. 2, a 400-ton mill on the north end of Percy Lake, are gravity and flotation mills. The No. 2 mill was built in the summer of 1950, and much of the machinery was brought from the Siscoe gold mine in Quebec. It has been found that the crushing machinery can handle less than half as much of the tough Gowganda diabase as it did of the rock at the gold mine. The mill has been used to treat tailings, rock pile, customs ore, and mine ore. According to the management, about 250,000 tons of tailings left by Miller Lake O'Brien Mines at the northeast end of Percy Lake and carrying around 5 ounces to the ton have been profitably treated, but this supply is almost exhausted. It is considered that about 150,000 tons of rock pile at the main shaft may be treated, but this will require crushing, an expensive operation, and the silver content is not quite as high as in the tailings that have been treated. The huge rock pile left by Miller



The No. 2 mill, Siscoe Metals of Ontario, Limited, which has a daily capacity of 400 tons. The machinery in this mill came mostly from the Siscoe gold mine in Quebec.

Lake O'Brien Mines is due to the practice of hoisting nearly all the waste rock from the mine. The practice of Siscoe Metals is to use it for fill and thus avoid hoisting it. T. Menary, mill superintendent, stated that mine ore and tailings are mixed in definite proportions and the recovery of silver is quite regular, about 85 percent, whereas on straight mine ore the recovery may be as high as 96 percent. The gravity concentrates run 5–6 percent cobalt.

The total production for Siscoe Metals to the end of June, 1954, was 4,622,598 ounces of silver and 83,745 pounds of cobalt. The Annual Report of the company indicates that for the year 1953 the production was 826,433 ounces of silver and 13,462 pounds of cobalt. This was obtained from 21,981 tons of mine ore, 15,599 tons of rock pile, and 41,086 tons of tailings, at a cost of $5.80 a ton, or $0.56 per ounce of silver. Siscoe has done custom milling of ore and tailings from several properties. An option was taken in 1952 from H. Wright of Cobalt on the old Mann property west of Gowganda Lake. The shaft was dewatered, about 3,000 feet of diamond-drilling was done, and 3,094 tons of tailings were hauled to the mill at O'Brien. The tailings treated carried about 8 ounces of silver, and 20,150 ounces were recovered before the option was dropped. About the same time Siscoe treated 880 tons of tailings from the Bartlett property, on

a custom basis, for a recovery of 4,376 ounces of silver. During the autumn of 1954 plans were made by Siscoe to mine ore from the Copley property, west of Elk Lake, and truck it to the mill at O'Brien.

The accompanying plans and sections illustrate the pattern of workings in the Siscoe mine. The main shaft, sunk by Miller Lake O'Brien, is only 450 feet deep and operating to the 340-foot level. The lowest workings on the 1,200-foot level are reached through two winzes. A very high-grade vein was mined on the lowest level during the summer of 1954 and another near the old No. 20 shaft south of the diabase dike. It was thought that conditions for the occurrence of ore south of this dike did not seem to be as good as north of it. There is, however, no reason why the dike could have any influence in the occurrence of ore.

INDEX, PART 5

A

PAGE

Acid volcanics 6, 7
Acknowledgments 1, 2
Adinole 17, 19, 21
Algoman intrusives 6–8, 21
Amygdaloidal lava 7
Aplite 17, 19
Arkose 9
Axinite 27

B

Babs Lake 22
Bartlett silver m. 2, 3, 36
Basic volcanics 6, 7
Bibliography 4
Bloom Lake 2
Bonsall silver m. 3, 26
  Fault 22
  Rocks 16
Boyd-Gordon silver m. 3
Burrows, A. G. 4

C

Calcite veins.
  Character and origin 24–31
  Photo 25
Campbell, A. D. 1, 12, 33
Capitol silver m. 3
  See also Castle-Trethewey s.m.
Capitol Silver Mines, Ltd. 31
Castle-Trethewey Mines, Ltd. 3, 4, 31
  See also Castle-Trethewey s.m.
Castle-Trethewey silver m.
  Axinite 27
  Faults 23
  Historical notes 3, 31
  Location. *See* Maps ..... *in pocket*
  Photos 3, 33
  Production 4, 31
  Report and plans 31–35
Chapelle silver m. 23, 30
Cobalt 24, 26, 33, 36
  Production 3
Cobalt bloom 33
Cobalt series 6, 8–10
  See also Conglomerate.
Cobalt silver area 28
Coleroy silver m. 13, 18, 23
Columnar jointing.
  In diabase, notes and photo 14, 15, 21
    Castle-Trethewey s.m. 10
    Morrison s.m. 35
Concentric jointing, notes and photo 14, 15
Conglomerate 6, 8
  Contact with diabase sill 14, 22, 25
  Photos 9, 14
  Veins in 26, 33

PAGE

Consolidated Morrison Explorations, Ltd.
  See Morrison s.m.
Contacts.
  Diabase with Keewatin 7, 14, 30
    with sediments, notes and photo 14, 19–21
Relation of veins to 25, 26
Copley silver m. 37
Crews-McFarlan silver m. 3, 26
  See also Bartlett s.m.

D

Davidson Lake 13, 22
Diabase
  See also Olivine, Quartz diabase.
  Silver in 28, 29
Diabase Lake 22
Diabasic lava 6, 14
Dinny Lake 4, 10, 22
  Serpentine 7
Drainage 5

E

Economic geology 24–37
Elk Lake 2
Epidote 27
Eskers 12
Everett Lake 7, 25

F

Faulting 15, 22–24
Felsite 7
Formations, table of 6

G

Gabbro 28
Geology, economic 24–37
Geology, general 6–12
Geology, structural 21–24
Glaciation 12
Gowganda formation, notes and photo 8, 9
Gowganda Lake 2, 5
  Fault 22
  Rocks 10, 13
Granite 7, 8
  Intrusive effect of 21
Granophyre.
  Photomicrograph 18
  Relation to sill diabase 17–21
  Silver in 28–30
  Vein gangue 27
Greywacke 8

H

PAGE

Haileyburian rocks ... 7
Haultain tp.
  Fault ... 22
  Rocks ... 9, 13
  Silver discovery ... 2
    mines, locations. *See* Maps ... *in pocket*
    mining. *See* Castle-Trethewey s.m.
Historical notes ... 2–4
Hunter, J. M. ... 25
Huronian Belt silver m. ... 13
Huronian sediments ... 6
  Contact with Nipissing diabase ... 17, 19–21
    fault at ... 22
    photo ... 14
  Lithology and photo ... 8–10

I

Ilmenite, notes and photomicrograph ... 11
Iron formation ... 7

J

Jacobs Lake ... 22
Jointing.
  Columnar ... 10, 14, 21
    photo ... 15
    silver ore related to ... 35
  Concentric, notes and photo ... 14, 15

K

Keewatin rocks.
  Contact with diabase sill ... 7, 14
    relation of veins to ... 25, 26, 28
    section diagram ... 30
  Lithology ... 6, 7
  Structure ... 21
  Thickness ... 13
Kell silver m. ... 3
Keweenawan rocks ... 6
  Lithology ... 10–12
  Silver in ... 28
  See also Nipissing quartz diabase.
Kirkpatrick vein ... 24, 26, 33

L

Lamprophyre ... 7
Lavas ... 6, 7
Lawson tp., rocks ... 8
Leroy Lake ... 7
  Fault ... 23
  Rocks ... 13
Londry, J. ... 1
Lorrain formation ... 6, 9
Lost Lake ... 10
  Diabase sill ... 5, 13
  Granophyre ... 19, 30
    photomicrograph ... 18
Lost Lake Mines, Ltd. ... 3, 35

M

Mann silver m. ... 3
  Fault ... 22
  Optioned by Siscoe ... 36
  Veins ... 24
Maps, geological ... *in pocket*
  Notes on ... 4, 5
Martin Lake ... 8
Matachewan diabase ... 6, 8, 21
  Silver veins in ... 26

PAGE

McKinnon, A. J. ... 1
McLeod, G. D. ... 1
Menary, T. ... 36
Micropegmatite ... 17, 18
Millcrest silver m. ... 13, 19
Miller Creek ... 12
  Fault ... 22, 23
  Rocks ... 16
Miller Lake ... 5
  Rocks, diabase ... 12, 13, 21
    volcanic ... 6, 7
  Silver mg. near ... 3
Miller Lake and Everett silver m. ... 3
Miller Lake O'Brien Mines, Ltd. ... 35
Miller Lake O'Brien silver m.
  See Siscoe s.m.
Millerett silver m. ... 3, 35
  Ore, high grade ... 24
  Rocks ... 9
Millner Bay ... 22
Milner tp. ... 26
  See also Bartlett, Mann s. mines.
Mineralogy of veins ... 26, 27
Moddle, D. A. ... 29
Morrison silver m. ... 3
  Diabase, jointage in ... 14
  Fault ... 23
  Report on ... 35
  Veins ... 25, 27, 35
  Workings, plan of ... *facing* 36
Mud Lake ... 9, 22

N

New Morrison Mines, Ltd. ... 3, 35
  See also Morrison s.m.
Nickel ... 24, 26, 33
Nicol tp.
  Fault ... 22
  Glacial deposits ... 12
  Rocks ... 7, 13
  Silver mines. *See* Maps ... *in pocket*
    mining. *See* Morrison, Siscoe s. mines.
Nipissing quartz diabase ... 5, 12
  Differentiation in ... 17–21, 28, 31
  Jointing in, notes and photos ... 10, 14, 15, 35
  Petrography and section ... 16, 17
  Silver in, source of ... 27–31
  Thickness and structure ... 12–16

O

Obushkong Lake ... 4, 10, 22
Olivine diabase ... 10, 11
Omerod, A. ... 1, 23, 26
Ore deposits.
  Character and origin ... 24–31
  Localization of ... 31
  Relation to faulting ... 22

P

Peach, P. A. ... 2
Pearson, N. E. A. ... 1
Percy Lake ... 10
  Conglomerate, notes and photo ... 9
  Fault ... 22
  Silver mg. *See* Millerett, Siscoe s. mines.
Pettipher Lake ... 13

PAGE

Photomicrographs.
Granophyre ... 18
Ilmenite, exsolution of ... 11
Pillow lava ... 7
Pleistocene ... 12
Porphyritic diabase ... 8, 11
Porphyritic granite ... 7
Porphyry ... 7
Precambrian rocks ... 6–12

Q

Quartz diabase.
Dikes ... 5
Keweenawan ... 10, 11
Matachewan ... 8, 21
silver veins in ... 26
Sill. *See* Nipissing quartz diabase.
Quartz porphyry ... 7
Quartz veins ... 26, 27
Quartzite ... 8–10

R

"Red rock" ... 17, 19–21
Reeve-Dobie silver m. ... 3, 23
Rhyolite ... 7

S

Schists ... 7
Sections.
Capitol s.m. ... 30
Nipissing diabase sill ... 16
Siscoe s.m. ... 34
Structure. *See* Map 1955-3 ... *in pocket*
Sedimentary rocks.
See Huronian sediments.
Serpentine ... 7
Shartner, G. ... 1
Sills.
Keewatin ... 6
Keweenawan. *See* Nipissing quartz diabase.
Silver ... 7, 21
Discoveries ... 2
Mines, historical notes ... 3
locations. *See* Maps ... *in pocket*
production ... 3, 4, 31, 36
reports on ... 31–37

PAGE

Silver—*Continued*
Ore. *See* Ore deposits.
Silver Bullion silver m. ... 13, 23
Siscoe Gold Mines, Ltd. ... 3, 35
Siscoe Metals of Ontario, Ltd. ... 3, 35
Properties. *See* Maps ... *in pocket*
See also Millerett, Siscoe s. mines.
Siscoe silver m.
Faults ... 23
Historical notes ... 3, 35
Photos ... 2, 36
Plans and section ... 29, 34, *facing* 34
Report on ... 35–37
Rocks ... 10, 12
jointing in, notes and photo ... 14, 15
Vein, photo ... 25
Structural geology ... 21–24
Syenite ... 7

T

Tailings, treatment of ... 36
Thomson, Robert ... 1, 2
Tillite, notes and photo ... 8, 9
Tindale, J. L. ... 2
Todd, E. W. ... 26
Tonapah Canadian Mines, Ltd. ... 3, 35
Topography ... 5
Tower Hill ... 5
Trethewey Silver Cobalt Mines, Ltd. ... 31
Tuffs ... 7

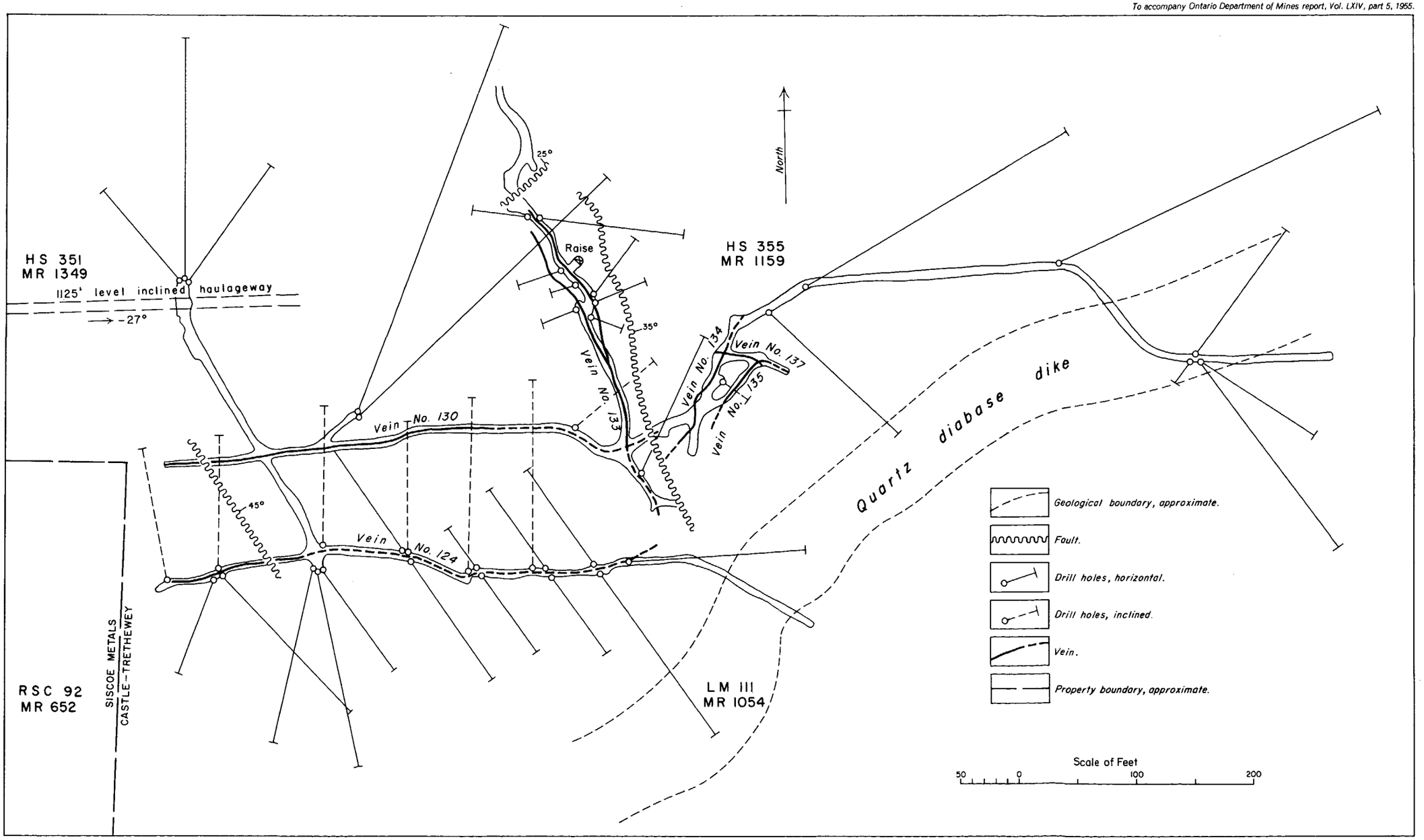
V

Veins, character and origin ... 24–31
Volcanic rocks. *See* Keewatin rocks.

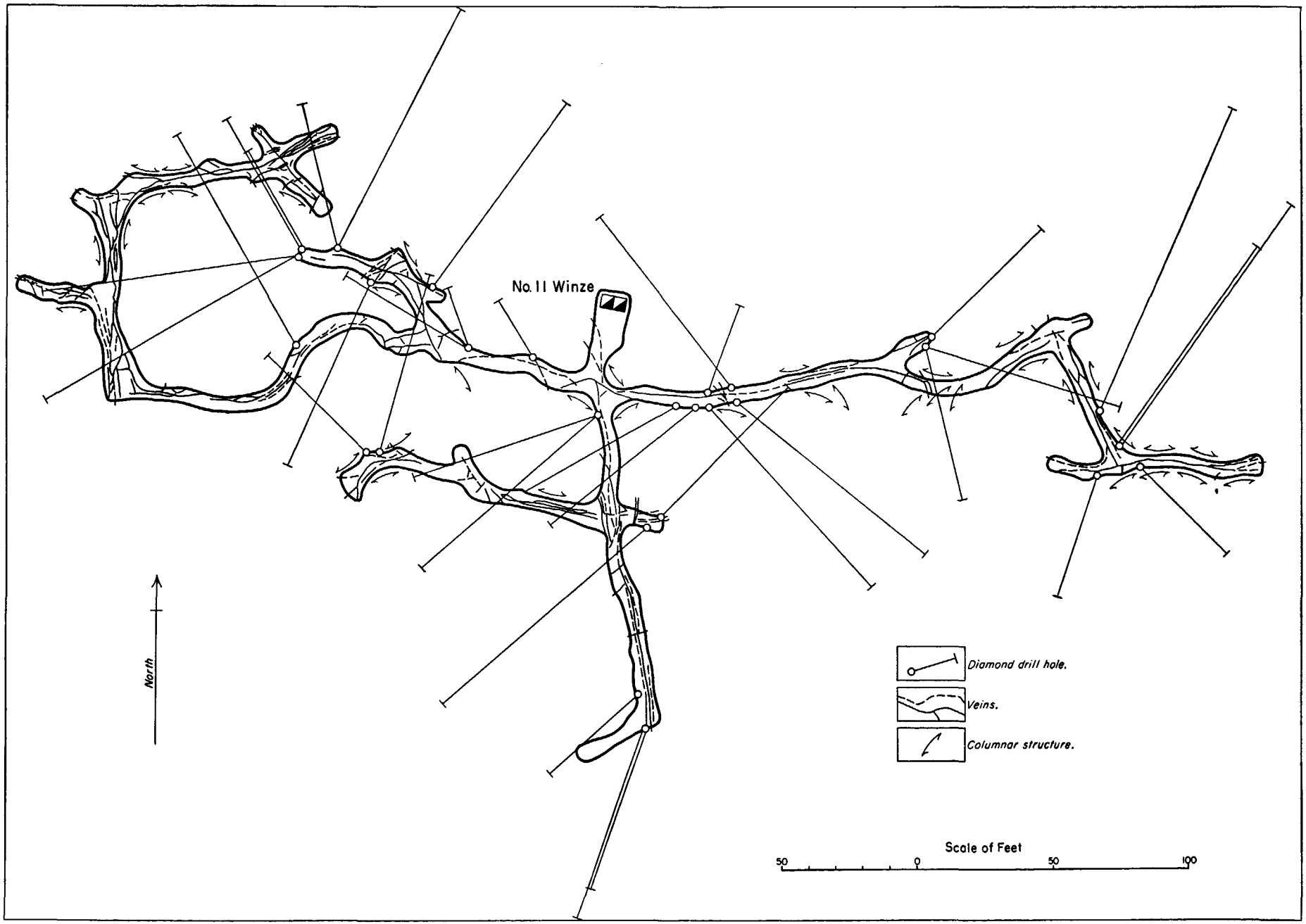
W

Walsh silver m. ... 3, 27
Rocks ... 13
Welch silver m. ... 3
Wigwam silver m. ... 3, 19
Wilson Lake ... 7
Workings, mine.
Depth of ... 13
Plans of. *See* Plans.
Wright, H. ... 36

To accompany Ontario Department of Mines report, Vol. LXIV, part 5, 1955.

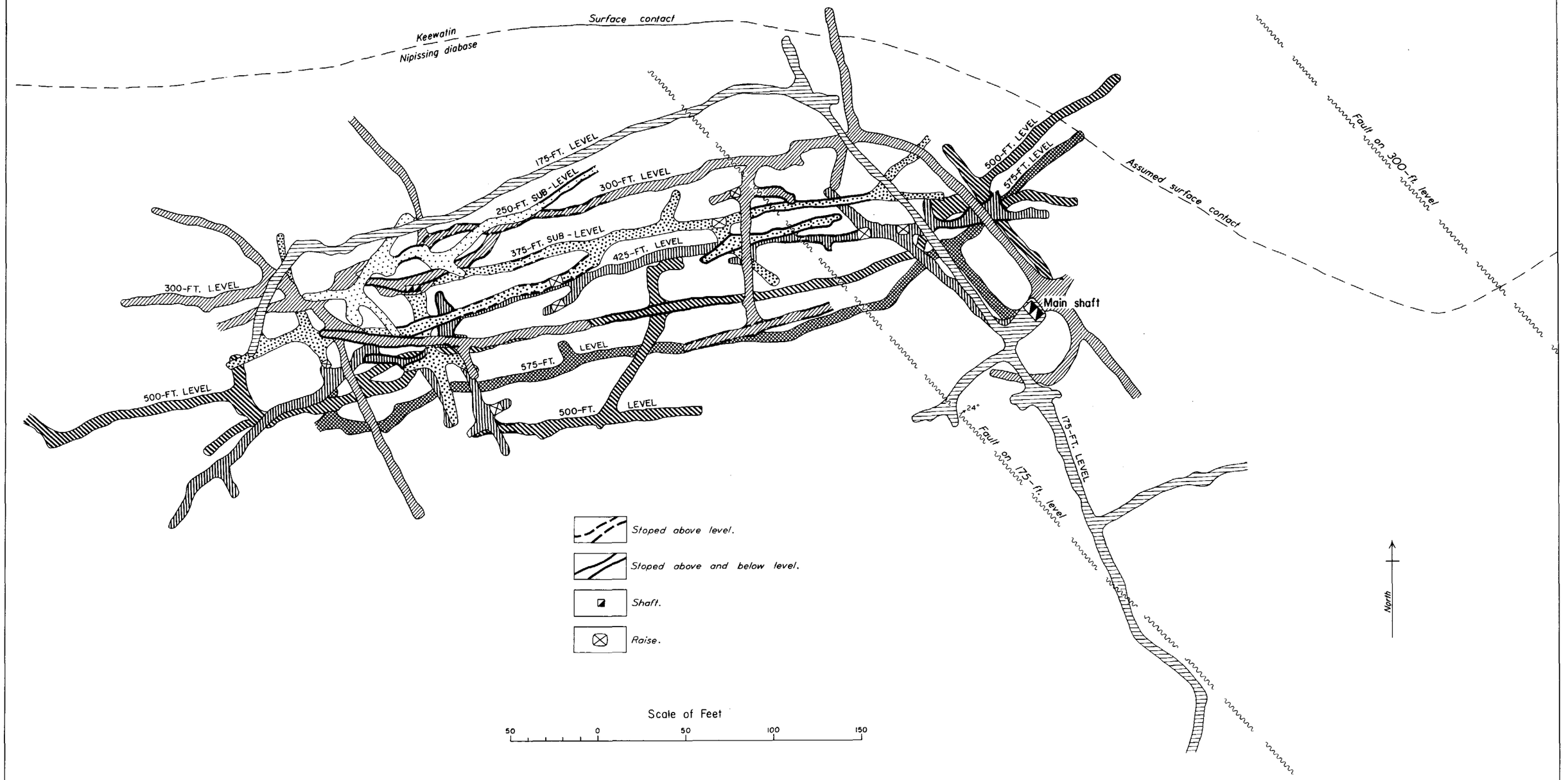


Plan of 1275-foot level, Capitol mine, Castle-Trethewey Mines Limited, showing direction of main veins and diamond-drilling practice.

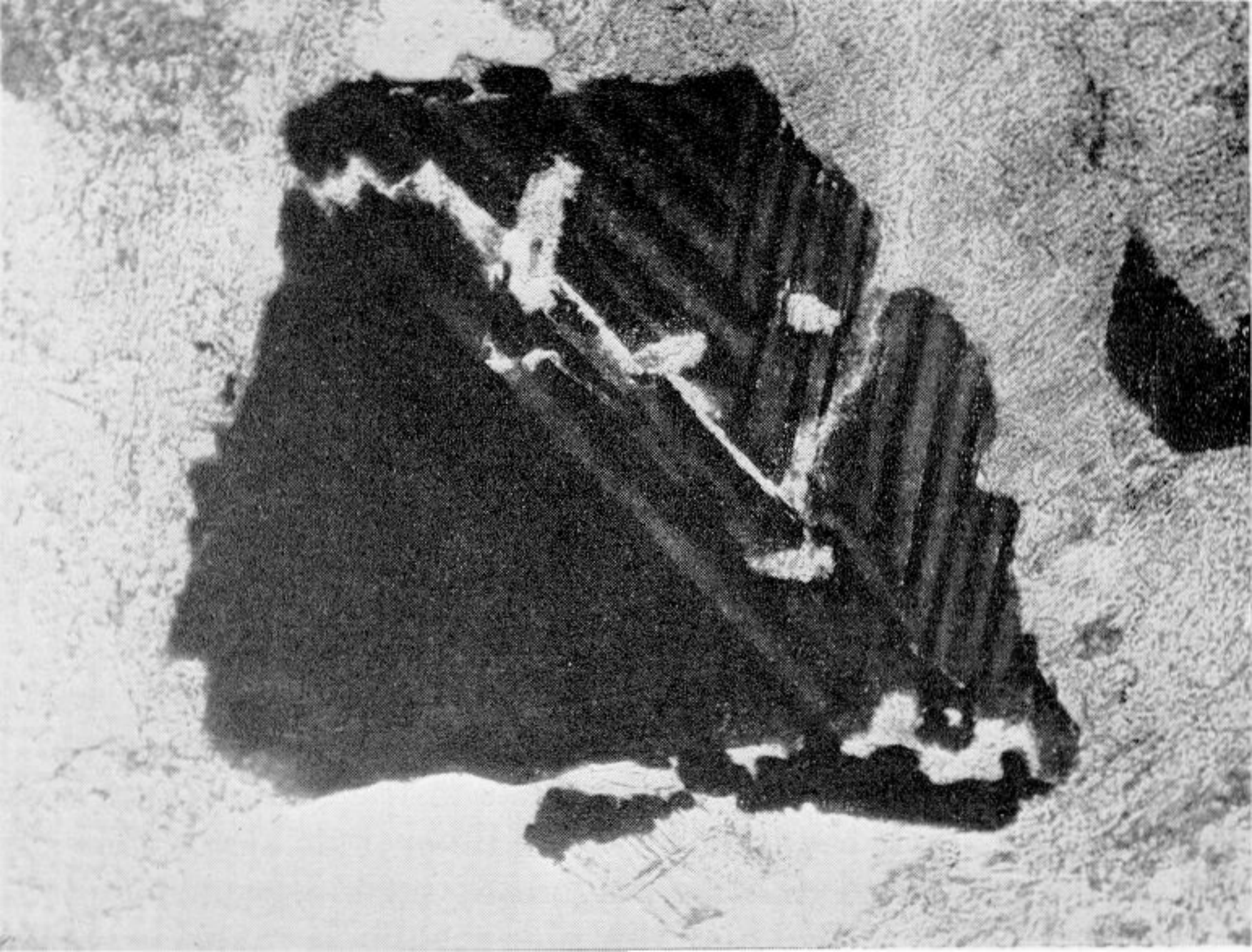


Plan of the 1,200-foot Level, Miller Lake O'Brien Mine, Siscoe Metals of Ontario, Limited.

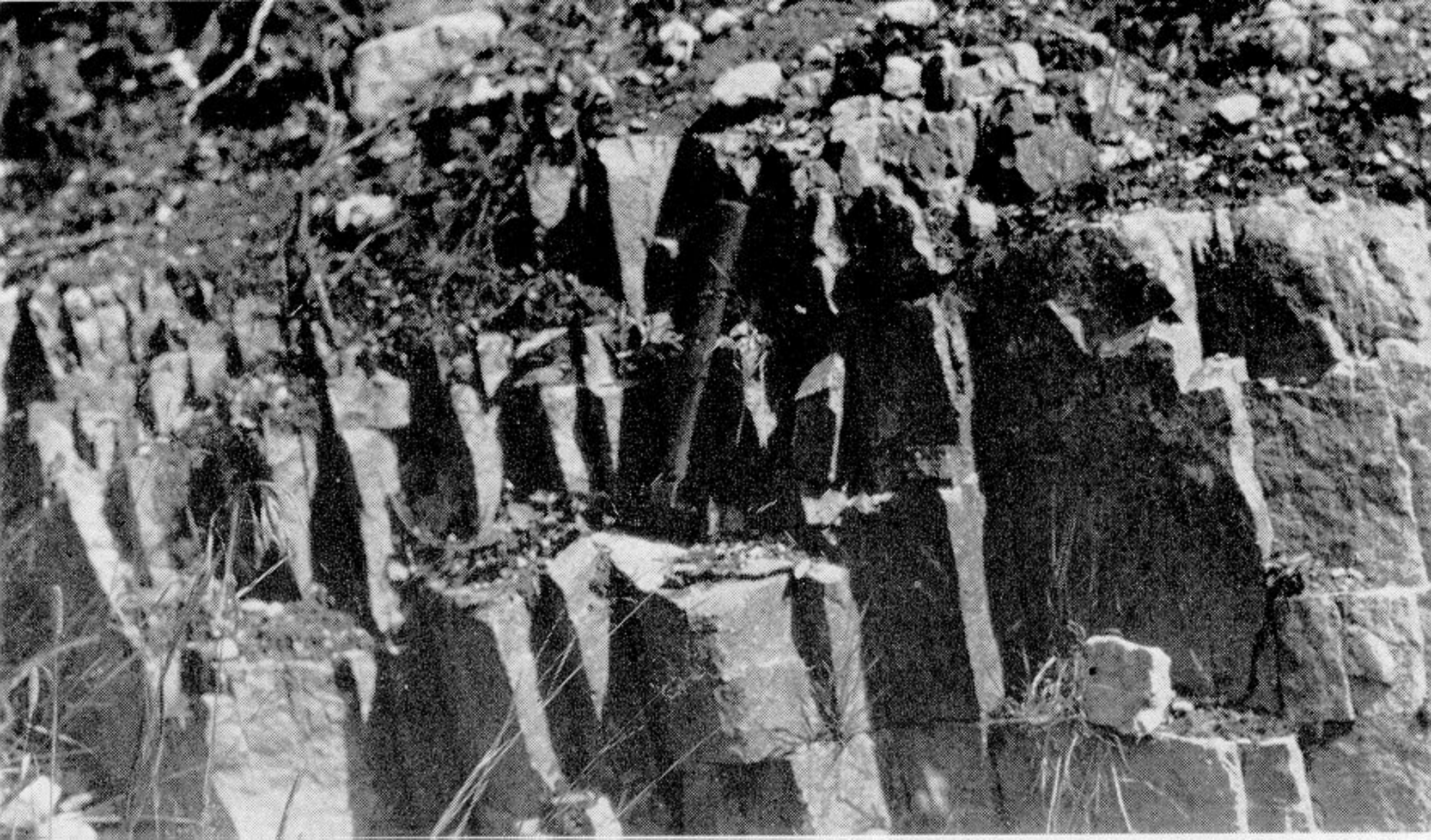
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Morrison Mine, Consolidated Morrison Explorations Ltd.





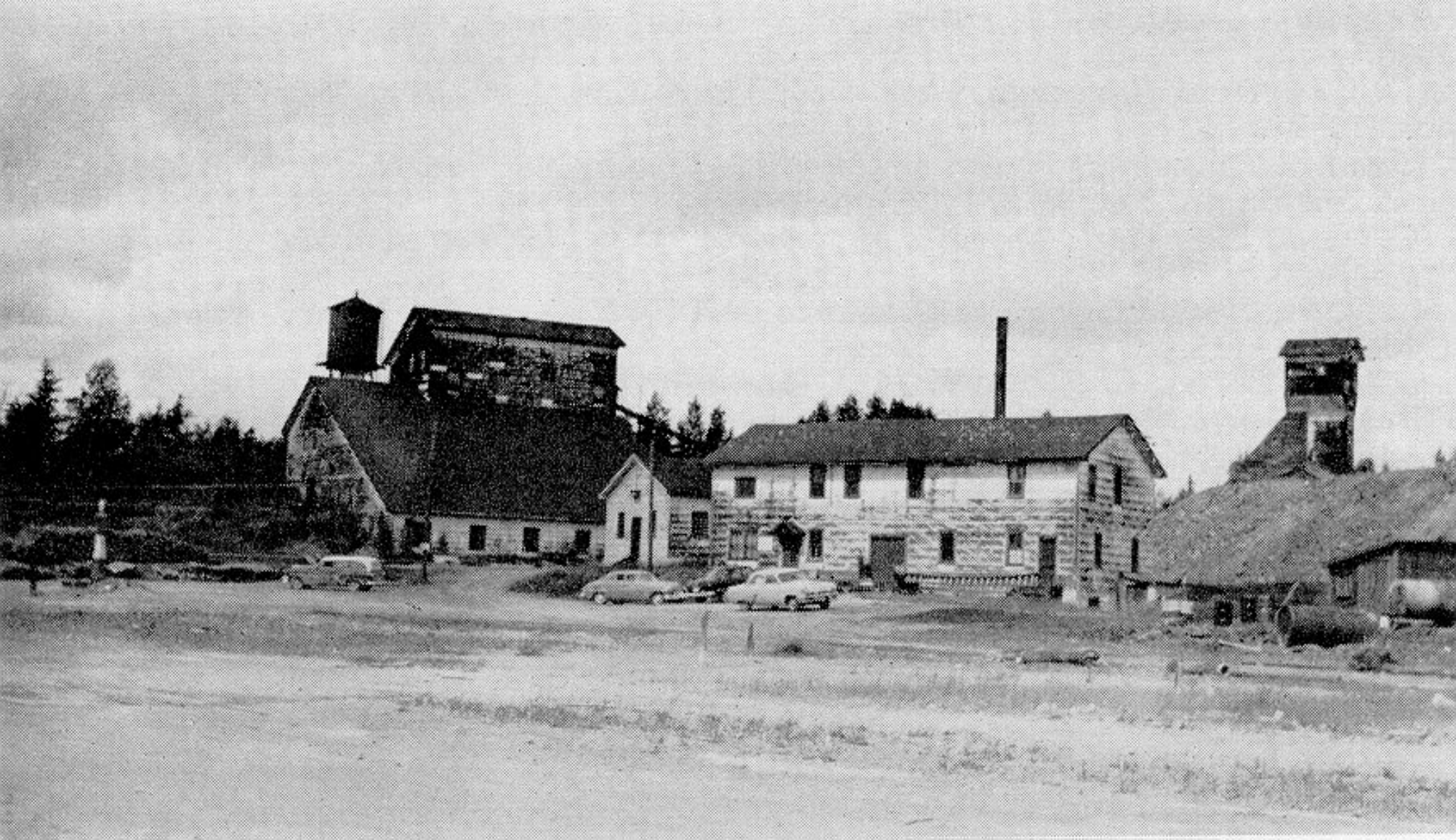




















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PROVINCE OF ONTARIO

DEPARTMENT OF MINES

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M. E. HURST, *Provincial Geologist*

SIXTY-FOURTH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. LXIV, PART 6, 1955

Geology of Lount Township

By

J. SATTERLY

PRINTED BY ORDER OF

THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO

Printed and Published by Baptist Johnston, Printer to the Queen's Most Excellent Majesty

1956

TABLE OF CONTENTS

Vol. LXIV, Part 6

	PAGE
Introduction	1
Scope of Map and Report	2
Acknowledgments	2
Means of Access	3
Previous Geological Work	3
Topography and Drainage	4
Natural Resources	6
Agriculture	6
Forests	6
Tourists	6
Early Settlement	7
General Geology	7
Table of Formations	8
Precambrian	8
Metasediments	8
Paragneiss-Amphibolite Group	8
Crystalline Limestone Group	14
Plutonic Rocks	15
Older Basic Intrusive and Meta-Intrusive Group	15
Granite Group	16
Younger Basic Intrusives	20
Cenozoic	20
Pleistocene	20
Structural Geology	21
Folding	21
Faulting	24
Economic Geology	25
Copper	25
Concession I, Lot 28	25
Concession III, Lot 14	25
Concession V, Lot 14	25
Concession XII, Lot 13	26
Concession A, Lot 124	26
Concession B, Lot 124	26
Feldspar	26
Garnet	27

	PAGE
Economic Geology—*Continued*	
Graphite	27
Concession II, Lot 25	27
Gravel	27
Iron	27
Concession I, Lot 16 or 17	31
Concession I, Lot 19	31
Concession III, Lot 17	32
Concession VIII, Lot 22	32
Concession VIII, Lot 32	33
Concession XIII, Lot 20	33
Concession XIII, Lots 23 and 24	33
Concession XIV, Lot 22	34
Concession A, Lot 125	34
Concession A, Lot 126	36
Concession A, Lot 129	37
Concession A, Lot 130	37
Concession A, Lot 132	37
Concession A, Lot 133	38
Concession A, Lot 135	38
Concession A, Lot 136	38
Concession B, Lot 124	39
Concession B, Lot 126	39
Concession B, Lot 129	39
Concession B, Lot 137	39
Concession B, Lot 144	39
Concession B, Lot 145	40
Limestone	40
Mica	41
Concession III, Lot 10	41
Concession V, Lot 3	41
Concession B, Lot 137	42
Molybdenum	42
Concession II, Lot 18	42
Rare Element and Radioactive Minerals	43
Concession A, Lot 126	43
Concession V, Lot 5, and Concession VI, Lot 5	43

ILLUSTRATIONS

	PAGE
View from the narrows on Rye (Pickerel) Lake	4
The chutes on Commanda Creek at low water	5
Well-bedded biotite paragneiss. Lot 13, concession II	11
Biotite-hornblende paragneiss. Lot 8, concession VI	11
Garnet-biotite gneiss with feldspar porphyroblasts. Lot 9, concession VII	12
Limestone tectonic breccia at the narrows, Rye Lake	13
Limestone tectonic breccia, Crystal Island, Fowke Lake	13
Limestone tectonic breccia, Lake of Many Islands	14
Biotite paragneiss with schlieren of amphibolite, Birds Eye Island, Fowke Lake	17
Granite pegmatite dike cutting drag fold in biotite paragneiss	19
Drag-folding in biotite paragneiss	21
Contorted fragment of hornblende gneiss in limestone tectonic breccia, Rye Lake	22
A boudin of garnet amphibolite in biotite paragneiss, Birds Eye Island, Fowke Lake	23

MAPS AND PLANS

FIGURE		PAGE
1	Key map showing the location of Lount township	1
2	Sketch map showing linears in Lount township	24
3	Sketch map showing location of diamond-drill holes and aeromagnetic anomalies on claims of A. C. McLean and associates	*facing* 30
5	Plan of diamond-drilling on lots 23 and 24, concession XIII	35
6	Plan of diamond-drilling on lot 22, concession XIV	35

COLOURED GEOLOGICAL MAPS
(In pocket at back of report)

Map No. 1955-4—Township of Lount, District of Parry Sound, Ontario.
Scale, 1 inch to ½ mile.

Figure 4—Geological Map of Part of Lount Township showing Iron and Garnet Occurrences.

Geology of Lount Township

By J. Satterly

INTRODUCTION

In March, 1953, the Ontario Department of Mines had an aeromagnetic survey made of an 800-square-mile area in the Parry Sound district between latitudes 45°30′ and 46°00′ and longitudes 79°30′ and 80°00′. This area includes the townships of Mills, Ferrie, Lount, Croft, and parts of Hardy, Patterson, Pringle, Wilson, Gurd, McKenzie, Machar, Hagerman, Chapman, Ferguson,

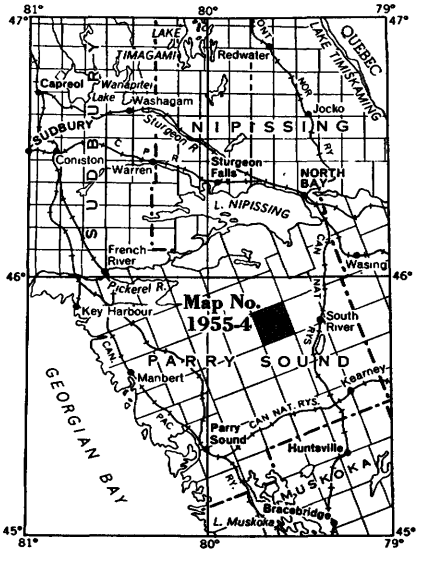


Figure 1 — Key map showing the location of Lount township, district of Parry Sound. Scale, 1 inch to 50 miles.

McKellar, Spence, and Ryerson. The aeromagnetic maps, in 12 sheets on the scale of 1 inch to 1,320 feet (20 chains), were published in July, 1953.[1]

This area was chosen because a number of iron showings had been prospected and developed in Lount township at the turn of the century, and previous reconnaisance mapping[2] had indicated the presence of favourable host rocks in adjoining townships. As a check against the aeromagnetic survey, one township, Lount, was chosen for further mapping on the scale of 1 inch to 1,320 feet, with special

[1]Copies may be obtained from the Publications Office, Ontario Department of Mines, Parliament Buildings, Toronto, for 25 cents a sheet.

[2]J. Satterly, *Mineral Occurrences in Parry Sound District*, Ont. Dept. Mines, Vol. LI, 1942, pt. 2, p. 41.

emphasis on the iron (magnetite) occurrences. This was carried out by the author and three assistants during the 1953 field season; in 1954 three days were spent in remapping several of the metagabbro masses.

The aeromagnetic survey led to a renewed interest in the area with the result that there was considerable preliminary exploration and re-examination, in June and July, 1953, of the old iron showings. Owing to the disappointing results of dip-needle and ground-magnetometer surveys on the old showings and the low values of the anomalies indicated by the aeromagnetic survey, interest faded soon after the release of the maps, and only one group (A. C. McLean and associates) completed a program of exploration drilling.

Scope of Map and Report

The base map for Lount township was compiled by the author from the maps of the Forest Resources Inventory, Ontario Department of Lands and Forests (Nos. 457793 and 458793 on a scale of 1 inch to 1,320 feet). To this base was added the concession and lot lines from the surveys of the Nipissing road and the township made in 1865 and 1874, respectively. These surveys could not be made to fit the Forest Resources Inventory base map, and the lots and concessions as shown on the geological map must be considered to be only approximate in their location. They have been added as an aid in the location of mineral occurrences. Practically none of the township, concession, or lot lines, with the exception of those on farm lands, were found.

The geological mapping was carried out by mapping on Perfatrace over the air photographs where possible, mostly on farmlands or abandoned farmlands, or by traversing at 20-chain intervals in the hardwood forest in which, in most cases, it was impossible to locate the rock exposures from the air photographs.

Chain-and-compass or pace-and-compass surveys were made of a number of new roads or trails.

Although the field party was primarily interested in iron occurrences, all other showings previously known or brought to the author's attention were examined. Many of these are small and will probably never be of any commercial interest; but because from time to time they are brought to the attention of individuals or mining companies as prospects, all these occurrences and old workings have been described for the sake of record.

Acknowledgments

The author was ably assisted in the field by R. R. Waterhouse, R. G. Moore, and L. M. Augustine. He is also much indebted to the residents of Lount township, particularly to T. R. Russell, for help in the location of old mineral showings, to Kelly and Queen Milne of Camp Pocono, Deer Lake, and to the Schmeler family of We-Na-Nak Camp, Lake of Many Islands, for many courtesies, including the loan of boats. Messrs. A. C. and P. McLean gave freely of information and made accessible all drill core obtained in the exploration of their properties.

Acknowledgment is made to D. A. Moddle and his staff of the Provincial Assay Office for assays and mineral determinations. The author also wishes to acknowledge his indebtedness to his colleague, D. F. Hewitt, for helpful criticism and discussion on geological problems of the Grenville subprovince.

Means of Access[1]

Much of Lount township is readily accessible by road. A good gravel highway extends west from South River, a town on highway No. 11, to Machar (Eagle) Lake in Machar township and continues west to the farm of T. R. Russell, about the centre of Lount township, where it meets the old Nipissing road built in 1872-73.[2] This road runs north and south across the township, but parts of it are now abandoned or rarely used; it divides the township into two sections, that to the east containing most of the farms in the township, and that to the west being still largely forest and with few farms.

The east section is serviced by a number of roads, which allow fairly easy access except to that part of the township between Commanda Creek and the east boundary.

Few motor roads have been built in the section west of the Nipissing road. The more important of these are: the Fowke (Spring) Lake road, which ran originally to Tough's sawmill on Fowke (Spring) Lake and is now extended to White's sawmill on South Boundary Lake; the road to We-Na-Nak Camp on Lake of Many Islands; and the road to one of the Tough lumber camps in lot 16, concession XII. Several trails and wagon or tractor roads may also be noted: the tractor road north from the We-Na-Nak road to Fowke (Spring) Lake; the tractor road west from We-Na-Nak Camp to Ferrie (Little Deer) Lake in Ferrie township; the trail from the Fowke (Spring) Lake road north to Rye (Pickerel) Lake; and the tractor road from the Tough lumber camp road noted above west to Rye (Pickerel) Lake.

Previous Geological Work

The only geological mapping of Lount township before the present survey was a geological reconnaissance by the author in 1941.[3] The earliest reference to the rocks in the township is by Robert Bell[4] on the occurrence of limestone on the Nipissing Road lots, which is also quoted verbatim in Miller's report.[5]

The iron occurrences have been described by Carter,[6] Lindeman and Bolton,[7] and the Ontario Iron Ore Committee of 1923.[8] Brief reference by the Mining Recorder to prospecting for iron, copper, and nickel are given in the annual reports of the Department.[9]

Reference has already been made[10] to the aeromagnetic survey carried out by the Ontario Department of Mines in 1953 and to the set of 12 aeromagnetic maps issued by the Department the same year. Lount township is largely covered by the Lount and Ferrie sheets in that series.

The only ground magnetometer survey filed with the Ontario Department

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[1]Many of the lakes in the area have been re-named by the Canadian Board on Geographic Names. The old names, however, are still used locally and, as an aid to the reader, are given in brackets after the official names on the map and in the report.

[2]W. A. Barnard, Chief Cartographer, Ontario Department of Lands and Forests, personal communication.

[3]J. Satterly, *op. cit.*, pp. 8, 14, 32, 33, 41–49, 51.

[4]*Report of Progress for 1876–77*, Geol. Surv. Can., 1878, p. 206.

[5]Willet G. Miller, *The Limestones of Ontario*, Ont. Bur. Mines, Vol. XIII, 1904, pt. 2, p. 94.

[6]W. E. H. Carter, *The Mines of Ontario*, Ont. Bur. Mines, Vol. XI, 1902, p. 262.

[7]E. Lindeman and L. L. Bolton, *Iron Ore Occurrences in Canada, Vol. II*, Can. Dept. Mines, Mines Branch, No. 217, 1917, pp. 110, 111.

[8]*Report of the Ontario Iron Ore Committee, 1923*, Ont. Dept. Mines, 1924, p. 215.

[9]Ontario Bureau of Mines: Vol. XVII, 1908, p. 47; Vol. XVIII, 1909, pt. 1, p. 50; Vol. XIX, 1910, pt. 1, p. 53; Vol. XX, 1911, pt. 1, p. 54; Vol. XXI, 1912, pt. 1, p. 51; Vol. XXIV, 1915, pt. 1, p. 62.

[10]Page 1.

of Mines for assessment work credit was one made for the Shenango Furnace Company.[1]

In May, 1952, a geomagnetic survey for the Shenango Furnace Company was carried out by Canadian Aero Service, Limited, on mining claims P.S.1687–1693 and P.S.1705–1740 in the southern part of Lount township adjacent to the old Nipissing road. The survey indicated an elongated anomaly extending from lot 123, concession A, northward and northwestward to lot 130, concession B, in the old Nipissing road area. Bartley states that within this zone the magnetic relief is not sufficiently pronounced to indicate a large concentration of magnetic material. Bartley's aeromagnetic contour map shows a maximum reading of 4,700 gammas and a minimum reading of 3,600 gammas. The maximum relief therefore is only 1,100 gammas, which is not sufficient to indicate any sizable concentration of either magnetite or pyrrhotite.



Rye (Pickerel) Lake. View south from the narrows. Limestone tectonic breccia in the foreground. Mixed forest in background with a few white pine that escaped cutting in the early lumbering of the township.

Topography and Drainage

The general elevation of the township is between 1,000 and 1,200 feet above sea level. Only a few spot elevations are available and are shown on the geological map (back pocket). Local relief is not great and rarely exceeds 100 feet.

Lount township lies at the headwaters of several large streams in the Lake Huron drainage basin. Lake of Many Islands (1,000 feet) and Fowke (Spring) Lake (975 feet) are drained by the Ferrie (Deer) River west and south to the Magnetawan River. Deer Lake drains north by Commanda Creek to the French

[1]M. W. Bartley, *Geomagnetic Survey of Mining Claims P.S.1687 to P.S.1693 and P.S.1705 to P.S.1740, Lount Township, District of Parry Sound, Ontario, May 13, 1953*, Ont. Dept. Mines, File No.63.374.

River. A number of small lakes in the northwestern part of the township drain into Rye (Pickerel) Lake, which is the headwaters of the Pickerel River, draining westward and northwestward to the French River. The extreme southeastern part of the township is crossed by the Distress River flowing from Machar (Eagle) Lake in Machar township westward and southward to the Magnetawan River.

Structural control has played an important part in the development of the drainage pattern in Lount township. An examination of the Byng Inlet (No. 41 H/NE.) and Sundridge (No. 31 E/NW.) sheets of the National Topographic Series or Map No. 51a of the Ontario Department of Mines shows two sets of watercourses, one, the most prominent, running east-west, the other, northeast-southwest. These courses owe their existence to a regional jointing, or they may follow diabase dikes, igneous contacts, or bedding, but very rarely, if at all, faulting.[1]

In the northwest part of Lount township the following lakes and their con-



The chutes on Commanda Creek at low water, August 9, 1953. View southeast, showing the section of the creek parallel to the structure in the steeply dipping hybrid gneisses.

necting waterways lie along the east-west set: (1) North Boundary Lake, (2) May and Tough lakes, and (3) South Boundary, Ragged, and Maeck lakes; and the following along the northeast-southwest set: (1) South Boundary and Hammond lakes, and (2) Stickland Lake. The geological map of Lount township indicates that the May and Tough lakes linear follows a diabase dike. The dike was found exposed in the creek bed at several points east of Tough Lake. No diabase was found on the part of North Boundary Lake examined, but a diabase dike has been mapped on strike to the east. The watercourses in this part of Lount would appear to be controlled by a system of joints, some of which served as channelways for the younger diabase.

[1]T. T. Quirke, *Origin of Watercourses near French River, Ontario,* Bull., Geol. Soc. Amer., Vol. 47, 1936, No. 2, pp. 267–87.

Several of the larger lakes in the township owe their existence to differential erosion of limestone bands in the gneissic complex. On Rye Lake a narrow band of limestone tectonic breccia, dipping 15–30 degrees south, is exposed at intervals along the north shore of the lake and at the narrows near the east end. The shape of the lake basin is largely due to the differential erosion of this band. On Fowke (Spring) Lake strikes, dips, and exposures indicate a drag-folded remnant of limestone tectonic breccia infolded with the garnet-hornblende gneiss. The removal by differential erosion of this mass of limestone would account for most of the basin of Fowke Lake. Much of the present irregular shore line of Lake of Many Islands originated from the differential erosion of drag-folded limestone tectonic breccia exposed in many places around the lake.

The chutes on Commanda Creek in lot 1, concession XIII, also illustrate the effect of structure on stream courses. A local fold in the migmatite results in the stream flowing first across the gneissic structure in a rapids, and then parallel to the steeply dipping gneiss forming a chute.

Natural Resources

AGRICULTURE

Although a few farms have been opened up west of the Nipissing road, the main area of settlement lies east of that road. In 1953 there were 26 active farms and 12 abandoned farms in the township.

FORESTS

The following information[1] on the forests in the Parry Sound district in general is probably fairly applicable to Lount township:

> The Parry Sound district is essentially a timber-producing area . . . This district once contained large areas of white and red pine but extensive lumbering and fire have removed the greater part. The general character is that of a mixed forest containing hard maple, yellow birch, hemlock and white pine. There are also areas of pure hardwood with a dominance of hard maple. Many of the original pine areas are now covered with second growth poplar and white birch stands, following logging and forest fires.
>
> . . . . . .
>
> The forests of the district are separated into three main cover types, coniferous, hardwood and mixedwoods.
>
> . . . . . .
>
> The hardwood type occupies 57 per cent of the productive forest area of the district, 34 per cent is mixedwoods, 8 per cent coniferous and one per cent is classified as reproducing forest.

In 1953 small lumber mills were in operation on Deer and Fowke (Spring) lakes within the township, and on South Boundary Lake just beyond the west boundary of the township.

Tourists

Lount township contains a number of large and small lakes attractive to visitors. A few summer resorts are now established and cater to tourists for the summer and fall seasons. These resorts are located on Deer Lake and Lake of Many Islands. The oldest of these, We-Na-Nak Camp on Lake of Many Islands, has been in operation for more than 40 years.

A few cottages have been built in recent years on Deer and Fowke (Spring) lakes. In the western part of the township hunting camps have been built on or near Fowke (Spring), Rye (Pickerel), Hammond, and Tough lakes.

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[1] *Forest Resources Inventory, 1953 (Report No. 8, Parry Sound District)*, Ont. Dept. Lands and Forests, Division of Timber Management, pp. 9, 12.

Early Settlement

The Nipissing road location was surveyed by J. H. Dennis in 1864–65, and the lots by J. M. Fitzgerald in 1866–67. The road was started at Rosseau in 1867, the section in Lount township being built in 1872–73. The survey of Lount township and the subdivision into lots was carried out by R. W. Hermon in 1874. A number of roads were then built: the Eagle Lake road in 1879–80; the Jerusalem road between concessions XII and XIII in 1881; the German Settlement road, now known as the Wattenwyl road, between concessions IV and V in 1882; and the Lount road between concessions II and III in 1885. To the west, the Spring Lake road was built in 1891.[1]

There were quite a few settlers along the Nipissing road in 1880, and others took up land along the other roads as they were built. Most of the original settlers were of German or Swiss descent, and quite a number of them were immigrants direct from Europe.[2]

A number of hotels were built on the Nipissing road, the one in Lount township being known as the "Bummers Roost." It was situated on what is now the farm of T. R. Russell, being built by his father about 1882. It was about half way between Magnetawan and Commanda. The hotel burnt down in 1926. The present farmhouse was built on the old hotel foundation.[3]

GENERAL GEOLOGY

Lount township lies within the Grenville subprovince of the Precambrian Shield. All the bedrock in the township is Precambrian in age. Unconsolidated deposits of Pleistocene age are locally abundant and mask the nature of the underlying bedrock.

D. F. Hewitt[4] has introduced a field classification for the Precambrian rocks of the Grenville subprovince based primarily on lithology, with secondary emphasis on age and genesis. His classification was used in mapping Lount township. The Precambrian rocks are subdivided by him into nine groups as follows:

IV: 9) Younger diabase.

III:
8) Granite.
7) Syenite.
6) Nepheline and associated alkaline syenite gneiss.
5) Granite.

II: 4) Older basic intrusives and meta-intrusives.

I:
3) Crystalline limestone.
2) Paragneiss and amphibolite.
1) Volcanics.

The relative ages in general are as indicated: I, II, III, and IV. In Lount township the author found representatives of all the groups in the table except groups Nos. 1, 5, 6, and 7.

Owing to the high degree of metamorphism the author had great difficulty in separating the amphibolites of sedimentary and igneous origin. This problem has been discussed in detail by Hewitt.[5]

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[1] Dates of road building supplied by W. A. Barnard, Chief Cartographer, Ontario Department of Lands and Forests.

[2] T. R. Russell, personal communication.

[3] *Ibid.*

[4] D. F. Hewitt, *Geology of the Brudenell-Raglan Area*, Ont. Dept. Mines, Vol. LXII, 1953, pt. 5, p. 11.

[5] *Ibid.*, pp. 90–92.

The rock types recognized in Lount township are listed in the accompanying Table of Formations.

Table of Formations

CENOZOIC	
PLEISTOCENE:	Boulder clay, sand, silt, gravel.
	Great Unconformity
PRECAMBRIAN	
PLUTONIC ROCKS:	Younger Basic Intrusives: Diabase. *Intrusive Contact* Granite Group: Pink and white leuco-granite: granite gneiss. Hornblende granite; hornblende granite gneiss. Biotite granite; biotite granite gneiss. Hybrid granite gneiss (interbanded granite gneiss and amphibolite); migmatite (mixed gneisses). Granite pegmatite. *Intrusive Contact* Older Basic Intrusive and Meta-Intrusive Group: Metagabbro; hornblende-plagioclase gneiss, amphibolite. Peridotite.
	Intrusive Contact
METASEDIMENTS:	Crystalline Limestone Group: Crystalline limestone. Interbedded crystalline limestone and paragneiss. Silicated limestone; skarn. Limestone tectonic breccia. Paragneiss-Amphibolite Group: Amphibolite, hornblende-plagioclase gneiss, hornblende amphibolite, biotite amphibolite, biotite-hornblende gneiss. Garnet amphibolite, garnet-hornblende gneiss, garnet-pyroxene gneiss. Biotite paragneiss. Garnet-biotite gneiss. Quartzite.

Precambrian

METASEDIMENTS

In Lount township the metasediments are mainly members of the paragneiss-amphibolite group with a few irregular areas or bands of crystalline limestone. These rocks are of the Grenville type.

Paragneiss-Amphibolite Group

The paragneiss-amphibolite group includes all the metasediments other than crystalline limestone and associated rocks. In Lount township the dominant members of the paragneiss-amphibolite group are amphibolite, garnet amphibolite, and their gneissic equivalents. In some areas biotite paragneiss, garnet-biotite gneiss, and crystalline limestone are interbanded with the amphibolites or hornblende gneisses, and this at first led the author to believe that all the interbanded gneisses were metasediments. However, in the Adirondacks, in the United States, metagabbro occurs as small stocks, lenses, and large concordant sheets within the Grenville limestones and dolomites.[1] It would appear that a similar association is perhaps present in the northwest part of Lount township, and that the majority of the garnet amphibolites there are of intrusive origin with relatively

[1]A. F. Buddington, *Adirondack Igneous Rocks and Their Metamorphism*, Geol. Soc. Amer., Mem. 7, 1939, p. 56.

minor amounts of easily recognizable biotite or garnet-biotite paragneiss forming the footwalls and hanging walls of numerous concordant sheets of metagabbro or pink leuco-granite.

Metasediments of argillaceous and arenaceous origin are not so abundant. Biotite and garnet-biotite paragneiss are common as interbeds with the amphibolites or hornblende gneisses but do not occupy large areas exclusive of them. Typical quartzite is very rare and was only found at one locality. An exposure of a brick-red arkose was seen on the north shore of Fowke (Spring) Lake.

AMPHIBOLITE.—Amphibolite is the most abundant rock type of the Grenville series in the township. Although in the field it is possible to distinguish amphibolite, hornblende-plagioclase gneiss, hornblende amphibolite (over 90 percent hornblende), biotite amphibolite, biotite-hornblende gneiss, garnet amphibolite, and garnet-hornblende gneiss, all gradations between these rock types occur, and it is simpler to divide them into two—those with or without garnet. In some exposures these rocks show excellent banding owing to a varying content of mafic minerals from band to band, which may be bedding accentuated by metamorphism. Elsewhere they are massive without a trace of banding or gneissic structure, and sometimes the mafic minerals are segregated into clots or lenticular aggregates parallel to the gneissosity.

The interbanding of the amphibolite with paragneiss, and occasionally with limestone, led the author to believe that most of the amphibolite was a metasediment. However, in a number of places the amphibolite appears to grade into coarser rock that may be metadiorite or metagabbro (see page 15). Since the change from one rock type to the other is so gradual, it has only been possible to draw definite boundary lines in a few places. These coarse "cores" of basic intrusive (?) may be seen in the following places:

1) Road, concession I, lot 18.
2) Southwest of Fowke (Spring) Lake, concession VI, lot 30.
3) North of Deer Lake, concession VII, lots 9 and 10.
4) Northeast of Fowke (Spring) Lake, concession VIII, lot 22.
5) Nipissing road, concession A, lot 133.
6) North of Holly Pond, concession A, lots 155–57.
7) North of Rye (Pickerel) Lake, concession XIII, lots 33–35.

Thin-section study of 21 specimens shows an absence of quartz and a frequent occurrence of orthopyroxenes and clinopyroxenes. The mineral assemblages in the rocks indicate that they belong to the amphibolite facies[1] showing that they are products of medium- to high-grade regional metamorphism.

The mineral assemblages found are:

1) Plagioclase-augite-garnet.
2) Plagioclase-hornblende-augite-hypersthene.
3) Plagioclase-hornblende-augite-garnet.
4) Plagioclase-hornblende-augite.
5) Plagioclase-hornblende-garnet.
6) Plagioclase-hornblende-biotite-garnet.
7) Plagioclase-hornblende-biotite.

[1]Francis J. Turner, *Mineralogical and Structural Evolution of the Metamorphic Rocks*, Geol. Soc. Amer., Mem. 30, 1948, pp. 76–88.
Francis J. Turner and Jean Verhoogen, *Igneous and Metamorphic Petrology*, McGraw-Hill Book Co., Inc., New York, 1951, pp. 446–60.

Some of these mineral assemblages are more likely to develop during progressive regional metamorphism of basic igneous rocks than from sediments.

In the above assemblages the plagioclase ranges in composition from oligoclase to labradorite but is commonly oligoclase-andesine. Scapolite was found in assemblages Nos. 1 and 3 and may completely replace plagioclase. The scapolite imparts a blue-grey colour to the rocks.

The augite, in thin section, ranges in colour from a very pale green to a deep green. It alters to hornblende or is displaced by it in the lower grades—retrograde metamorphism. In an amphibolite with much epidote, on the Nipissing road south of T. R. Russell's farm, the green pyroxene is a soda-rich hedenbergite. The hornblende is a fresh, yellow-green to brownish-green variety. It may replace the augite marginally. Wormy (kelyphite) intergrowths of quartz in hornblende were noted in a specimen of assemblage No. 4. Biotite, if present, is a reddish brown variety. Magnetite and apatite are common accessory minerals, the latter often abundant. Titanite as an accessory was observed in about half the slides examined.

As a rule the higher grades are found in the northern and western parts, and the lower grades in the southeastern part of the township. Rocks with hypersthene are exposed on the road at and to the north of Rye school, concession A, lot 146.

BIOTITE PARAGNEISS.—In Lount township the over-all grade of metamorphism is high and in only a few places are low-grade metamorphic argillaceous sediments found. The best exposures are in lots 13 and 14, concession II, and in lots 7 and 8, concession VI. Elsewhere, the biotite paragneiss is interbedded with amphibolite or garnet amphibolite and, in much of the township, is injected *lit par lit* by pegmatite, or granitized so that all gradations exist between biotite paragneiss and migmatite with the result that consistency in mapping from day to day is difficult. Other workers in the same area might map a greater proportion of the gneisses as hybrid granite gneiss or migmatite.

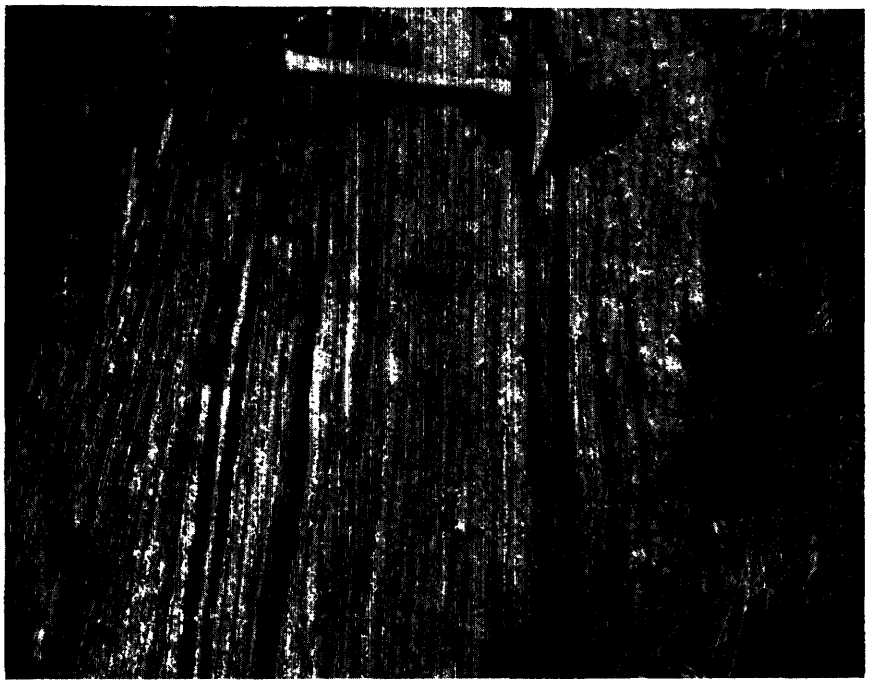
The least-altered paragneiss is very similar in many respects to Engel and Engel's[1] major paragneiss. In Lount township the frequent occurrence of hornblende indicates the presence of some limy material in the original sediment. A very typical paragneiss is one from lot 8, concession VI, which is a sugary, well-banded, fine-grained rock showing alternating light, grey, and dark bands owing to the variation in the content of mafic minerals. It is a biotite-hornblende-quartz-oligoclase gneiss with accessory apatite, titanite, epidote, and zircon. A little microcline is present, possibly 5 percent. The biotite is a greenish-brown variety.

GARNET-BIOTITE GNEISS.—Garnet-biotite gneiss is common as interbeds in the garnet-hornblende gneiss or garnet amphibolite. What is thought to be a fairly typical example, from a road cut on the Eagle Lake road in lot 9, concession VII, consists of oligoclase-andesine, quartz, biotite, garnet with accessory apatite, ilmenite, epidote, carbonate, and titanite. The biotite is a dark-brown variety, being neither the typical greenish-brown variety of the least altered paragneiss nor the reddish-brown type, although the flakes adjacent to the garnets are reddish-brown in colour. In this road cut the rock is interbedded with garnet-hornblende gneiss with some bands containing abundant porphyroblasts or stringers of white feldspar.

[1]A. E. J. Engel and Celeste G. Engel, *Grenville Series in the Northwest Adirondack Mountains, New York, Part II: Origin and Metamorphism of the Major Paragneiss*, Bull., Geol. Soc. Amer., Vol. 64, 1953, No. 9, pp. 1049–98.

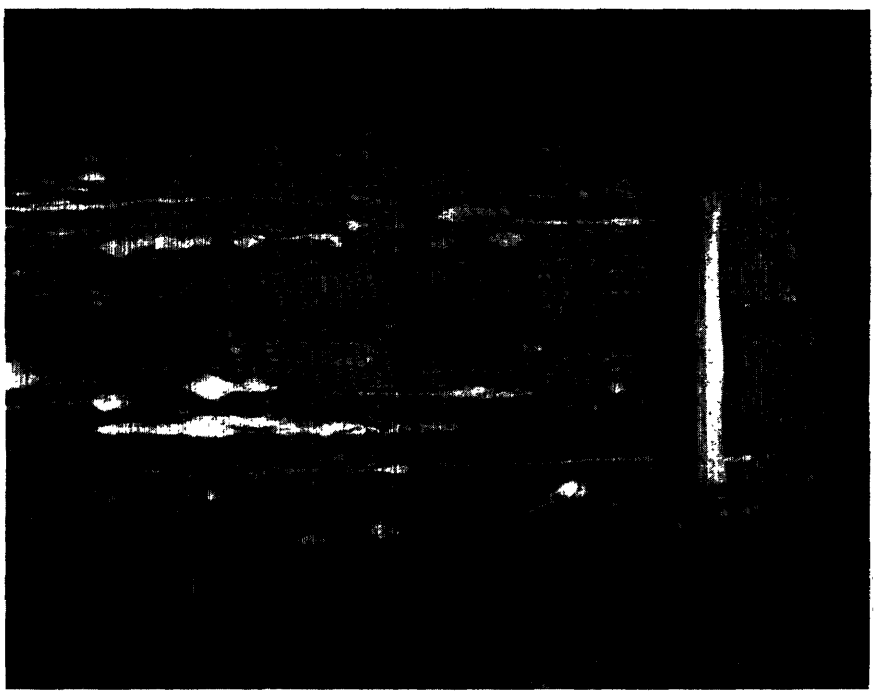


Well-bedded biotite paragneiss with a few dark interbeds of amphibolite cut by two pegmatite stringers. Lot 13, concession II.



Biotite-hornblende paragneiss with very narrow interbeds of hornblende gneiss. Lot 8, concession VI.

A possible horizon marker is a narrow band of garnet gneiss with muscovite interbedded with garnet-hornblende gneiss. This rock type was found in four places: lot 7, concession VIII; lot 9, concession VI; and lot 13, concession IV (two exposures). A specimen from the southern exposure is a garnet-muscovite-biotite-oligoclase gneiss with accessory apatite, ilmenite, titanite, and zircon. In one part of the thin section studied, andalusite in small to large porphyroblasts is present. The biotite is a reddish-brown type. A specimen from lot 7, concession VIII, illustrates retrograde metamorphism. The essential minerals are as noted above. The biotite is altered almost entirely to a pale-green chlorite (penninite), only traces of reddish-brown biotite remaining. The fractured porphyroblasts of garnet have the fractures filled with a similar chlorite.

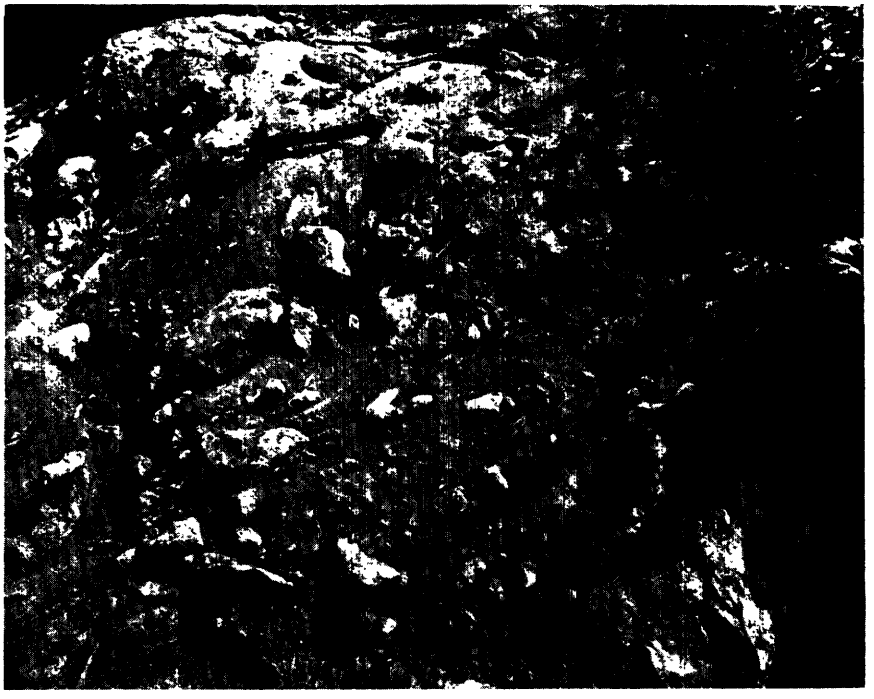


Garnet-biotite gneiss with porphyroblasts of white feldspar. Lot 9, concession VII.

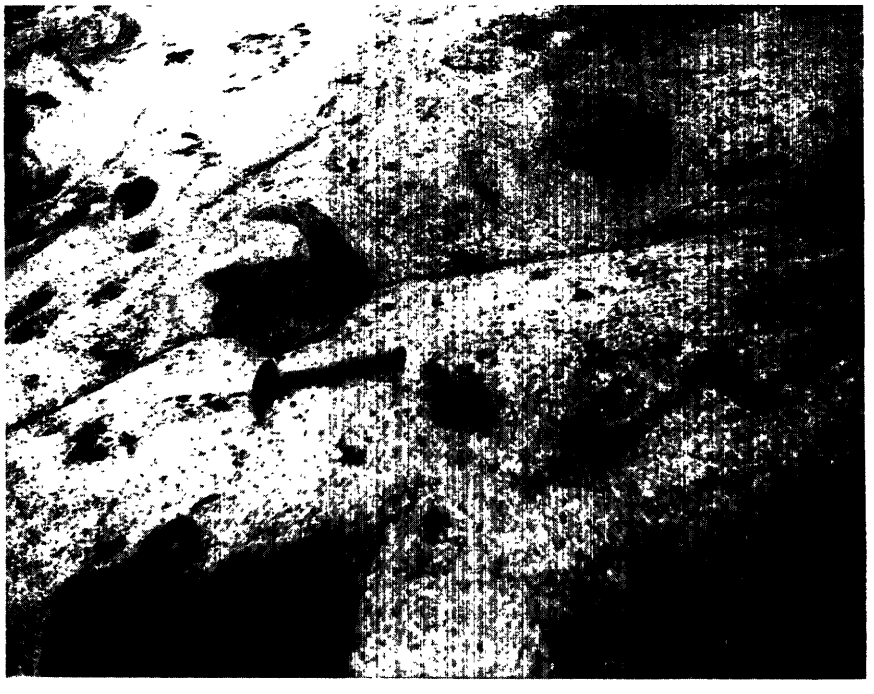
Another persistent horizon is a band about ¼ mile wide of garnet-biotite gneiss with feldspar porphyroblasts mapped from lot 9, concession I, north to lot 1, concession IV. This band is mainly a grey, fine-grained, garnet-biotite paragneiss with fresh, pale-grey porphyroblasts of microcline from ½ to 1½ inches across.

QUARTZITE.—True quartzite is almost unknown among the metasediments of the township. A typical quartzite was found as a remnant in an area of hybrid granite gneiss in lot 5, concession III. Here a white-weathering, grey-to-brownish quartzite has an exposed width of 60 feet. The beds are ½–3 inches thick, and marked by films of mica flakes—muscovite and biotite.

Interbeds of feldspathic quartzite may occur in the paragneiss. One occurrence on the Wattenwyl road in lot 11, concession IV, is a well-banded pink, grey and green rock. Narrow to paper-thin green bands mark the bedding. The



Limestone tectonic breccia at the narrows, Rye (Pickerel) Lake. Owing to differential erosion the amphibolite fragments are in high relief.



Limestone tectonic breccia. Crystalline limestone with contorted fragments of amphibolite. Crystal Island, Fowke (Spring) Lake.

rock is composed of quartz, oligoclase, microcline, orthoclase, and a green biotite. Epidote, apatite, and titanite are accessory minerals.

Crystalline Limestone Group

The crystalline limestone group has been subdivided into a number of members by Hewitt. The following are present in Lount: crystalline limestone or dolomite, interbedded crystalline limestone and paragneiss, limestone tectonic breccia, silicated limestone, and skarn.

Although crystalline limestone or interbedded crystalline limestone and paragneiss are present in Lount township, the common member of this group is a lime-



Limestone tectonic breccia with fragments of hornblende gneiss, which are assumed to have been originally present as interbeds, north shore of Lake of Many Islands. Lot 33, concession III.

stone tectonic breccia. The best exposures are on Rye (Pickerel) Lake, north and south of T. R. Russell's farm (lot 137, concession B,) on Fowke (Spring) Lake, and on Lake of Many Islands. The crystalline limestone is white to cream, and in the breccias is also pink, orange, or grey. They are usually coarse-grained, the average grain size being ⅛–¼ inch.

On Rye (Pickerel) Lake, north and south of the narrows, limestone tectonic breccia is well exposed (photos, pages 13 and 22). The limestone is white, cream, pink, orange, and grey in colour and contains numerous contorted masses of hornblende or garnet-hornblende gneiss. The rocks were originally interbedded crystalline limestone and gneiss. During the process of metamorphism the limestone became extremely mobile with the result that the interbeds of what is now a hornblende gneiss broke and, in the flowage of the limestone, became contorted.

All the other exposures are similar. In some cases pegmatite dikes became

involved, and some of the inclusions are irregular-to-rounded masses of pegmatite.

The impure limestones, that is the sandy or clayey varieties, become silicated limestones on metamorphism. The silicates noted in Lount township are diopside, serpentine, scapolite, titanite, garnet, and epidote. Others may be present since no detailed microscopic examination of the limestones was made.[1]

Skarns consisting of pyroxene, garnet, titanite, scapolite, carbonate, and possibly other minerals were noted at a number of the old iron showings and at a molybdenite showing. Superficially some of these rocks look like pegmatites. At the old molybdenite showing in lot 18, concession II, there is locally a skarn composed of glassy, grey scapolite, dark-green pyroxene with dark-red garnet coronas, and small crystals of reddish-brown titanite.

PLUTONIC ROCKS

Older Basic Intrusive and Meta-Intrusive Group

In Lount township the author found it difficult to identify and separate the members of this group from the amphibolite of the paragneiss-amphibolite group. Therefore basic intrusives and their metamorphic equivalents may be much more widespread than the geological map would suggest.

By progressive metamorphism, diorite and gabbro may be altered to amphibolite, hornblende gneiss, garnet amphibolite, or garnet-hornblende gneiss that are indistinguishable from similar rocks derived from sediments.

The central cores of metamorphosed basic intrusives may be relatively unchanged medium- to coarse-grained, massive metagabbro or metadiorite, but as the margin of a mass is approached, the rocks become more gneissic and pass gradationally into rocks mapped as members of the paragneiss-amphibolite group. The contacts therefore as shown on the geological map are somewhat arbitrarily drawn.

METAGABBRO.—The rocks mapped as metagabbro in the field are fairly massive, medium- to coarse-grained, light and dark rocks. They were originally gabbro, anorthositic gabbro, and anorthosite. Thin-section study shows the least metamorphosed rocks to contain relic plagioclase grains surrounded by a granoblastic aggregate of small grains of the same mineral. The plagioclase is andesine, but with increasing metamorphism, is oligoclase-andesine or oligoclase. When pyroxene is present it is a pale-green variety and may show marginal alteration to a deep yellow-green hornblende, Hornblende forms poikiloblastic aggregates, and biotite is in brown flakes. Accessory minerals are magnetite, apatite, and, more rarely, sphene. Scapolite was present in two of the seven thin sections examined. The small Deer Lake mass in lots 9 and 10, concession VII, contains small-to-large, rounded-to-lenticular inclusions of fine-grained biotite-hornblende gneiss or amphibolite.

The Schmeler gabbro mass lies south of Fowke (Spring) Lake, astride the tractor road to the lake from the We-Na-Nak road. The aeromagnetic map indicates two anomalies in this area, one with a maximum reading of 4,400 gammas. In the field, magnetic attraction was found over one of these anomalies. Bedrock at this place was concealed by overburden. Scattered rock exposures indicate an elongate mass of metagabbro trending northwest. The rock is a medium-grained, light and dark, metagabbro composed of plagioclase (andesine), hornblende or pyroxene, and accessory apatite, titanite, pyrrhotite, and, in some exposures, a red garnet.

[1] J. Satterly, *Mineral Occurrences in Parry Sound District*, Ont. Dept. Mines, Vol. LI, 1942, pt. 2, p. 9.

The Spring Lake mass is a small body of metagabbro north of the east end of Fowke (Spring) Lake. The metagabbro is a light and dark, medium- to coarse-grained rock. It is in part completely scapolitized. The east boundary of the mass is in contact with crystalline limestone and is well defined, being marked by the development of garnet-pyroxene skarns. The north boundary, however, is not so distinct since metagabbro, gneissic metagabbro, and amphibolite are exposed along the road, and the contact here must be arbitrarily drawn.

The Nipissing road mass covers parts of lots 155–58, concessions A and B, Nipissing road. The metagabbro is a medium- to coarse-grained rock and is well exposed at intervals along the old Nipissing road and in an old farm clearing on lot 157. In these exposures numerous small-to-large, ghost-like inclusions of partially assimilated amphibolite may be seen. Towards the north end of the mass the metagabbro becomes progressively finer-grained and more gneissic.

An exposure of anorthosite was found on the trail from the Fowke (Spring) Lake road to Rye (Pickerel) Lake on lot 35, concession XII. Nearby exposures are of garnet amphibolite. The white-weathering rock has a blue-grey colour and a faint banding of foliation produced by oriented mica flakes. In thin section the rock is found to consist of a granoblastic aggregate of fresh andesine, some scapolite, scattered flakes of a brown biotite, and a few grains of epidote. The rock is believed to be a slightly scapolitized anorthosite, and as such to be related to the metagabbro. Its occurrence would suggest that the adjoining garnet amphibolite is also of igneous origin.

Narrow anorthositic bands up to 5 feet wide were also found interbanded with garnet amphibolite in McMarmac drill hole No. 3 on lot 23, concession XIII.

PERIDOTITE.—A hornblende peridotite was mapped at two places on the Pickerel River just west of the outlet of Rye (Pickerel) Lake. The rock occurs as a narrow dike or sill cutting interbedded amphibolite and crystalline limestone. In a hand specimen it is a jet black, massive, medium-grained rock. A Rosiwal analysis gave: olivine, 28 percent; hornblende, 51; enstatite, 17; magnetite, 3; and spinel, 1 percent. The olivine is partially serpentinized, the hornblende is a greenish-brown variety, and the spinel is a dark-green pleonaste.

A related rock, a feldspathic hornblendite, was found in narrow bands (less than 5 feet wide) interbanded with garnet amphibolite in McMarmac hole No. 1 on lot 24, concession XIII. In thin section the rock is seen to consist largely of a greenish-brown hornblende, minor interstitial oligoclase, and a few flakes of reddish-brown biotite.

Granite Group

Lount township lies at the west edge of an extensive area of granite and hybrid gneisses that extends eastward beyond South River.[1]

For mapping, Hewitt[2] has divided the granite group into five types:

8a: pink and white leuco-granite, granite gneiss, and alaskite.
8b: hornblende granite, hornblende granite gneiss.
8c: biotite granite, biotite granite gneiss.
8h: hybrid granite gneiss (interbanded granite gneiss and amphibolite), migmatite.
8p: granite pegmatite, pegmatitic granite.

[1]J. Satterly, *op. cit.*, (map No. 51a, *Portions of the Districts of Parry Sound and Muskoka, Province of Ontario*).

[2]D. F. Hewitt, *Geology of the Brudenell-Raglan Area*, Ont. Dept. Mines, Vol. LXII, 1953, pt. 5, p. 28.

Representatives of most of these varieties were found in Lount township. The commonest rock types are biotite or hornblende granite gneiss, hybrid granite gneiss, or migmatite. With the hybrid granite gneiss there is usually an abundance of pegmatite. Leuco-granite is common in the granite complex in the southeast corner of the township, but elsewhere its occurrence is mainly as sills. No large stocks, masses, or batholiths were mapped. The largest intrusives recognized were sills 10 or more feet thick. These are usually pink leuco-granite or biotite granite. The large areas underlain by biotite or hornblende granite gneiss are considered to be migmatitic rather than intrusive in origin.



Biotite paragneiss with porphyroblasts of hornblende (black) and feldspar (white) and schlieren of amphibolite. Birds Eye Island, Fowke (Spring) Lake.

GRANITE, GRANITE GNEISS.—The minerals of the granite or granite gneiss are potash feldspar (often microcline), quartz, minor plagioclase, a green biotite, and hornblende. The leuco-granite contains no mafic minerals, or less than 5 percent.

HYBRID GRANITE GNEISS, MIGMATITE, GRANITIZATION.—The hybrid granite gneisses or migmatites are of a number of types dependent on the composition and structure of the host rock, the granite juice or ichor, and the metamorphic or metasomatic processes. All gradations are found from paragneiss or amphibolite to a granitoid gneiss. The migmatites may be *arteritic* or *veinitic* in origin; *arteritic* if the gneiss has been injected, permeated, or replaced by granitic materials originating outside the metasediments or amphibolite; *veinitic* if a potash-rich granitic juice or ichor is derived from the metasediment itself.[1]

The common type of hybrid granite gneiss derived from paragneiss is an arteritic migmatite in which bands of paragneiss, from a few inches to 10 or more

[1]Engel and Engel, *op. cit.*, pp. 1078–80.

feet wide are interbanded with granite or *lit par lit* granite pegmatite. By metamorphism and metasomatism the final product becomes a biotite or biotite-hornblende granite gneiss. These rocks always contain potash feldspar, which replaces, wholly or in part, the plagioclase of the original metasediment. The author's field experience indicates that the paragneiss is more easily "granitized" than the amphibolite.

In the amphibolites the results of granitization are different. A common type is a kind of veinitic migmatite in which the amphibolite or hornblende gneiss contains pseudo *lit par lit* hornblende pegmatite with gradational boundaries to the gneiss. If the pegmatite forms less than 50 percent of the rock this veinitic migmatite is shown on the map as "2a, 8p" rather than "8h." The possible end stage of this process is a hybrid rock that looks like a diorite and contains biotite in addition to hornblende. The author was unable to distinguish these rocks from metadiorite or metagabbro.

There appears to be no granitization of the crystalline limestone that retains its identity through the highest grades of metamorphism. However, in the higher grades, the limestone became mobile, and tectonic breccias were formed; the interbands of amphibolite, hornblende gneiss, or paragneiss, and any dikes of pegmatite, if present, are contorted and broken to become the fragments in the breccia (see photograph, page 13).

One horizon in the paragneiss-amphibolite group illustrates the process of granitization fairly clearly. This horizon is marked by the presence of porphyroblasts of hornblende. It shows fairly distinct to gradational contacts across the strike and shows a transition along the strike from paragneiss to migmatite. The horizon has been traced from lot 14, concession II, northward to lot 7, concession VIII. The few specimens collected may be fitted into the stages discussed by Engel and Engel[1] in their paper on the Grenville series.

In lot 14, concession II, a long rock ridge exposes, near the road between concessions II and III, a medium-grained pink and dark-green hornblende granite gneiss with minor amounts of pink leuco-granite gneiss. This rock grades southward into a migmatite of pink hornblende granite gneiss (specimen No. 71)[2] interbanded with paragneiss in 1-inch bands. About 1,500 feet south of the road, the rock is a poorly banded biotite paragneiss (specimen No. 72) with ¼-inch hornblende porphyroblasts and occasionally ¼–1-inch, white feldspar porphyroblasts. Thin-section study of No. 72 shows it to be a hornblende-biotite-microcline-oligoclase gneiss with accessory apatite and titanite. The biotite is a greenish-brown variety. The microcline content is probably less than 10 percent. The large feldspar porphyroblasts are oligoclase. This rock approximates Engel and Engel's average gneiss.

The migmatite (No. 71), into which specimen No. 72 grades, contains the same suite of minerals. The specimen from which a thin section was made contains 50 percent pink feldspar and quartz in stringers about ⅛ inch wide. The biotite is still a greenish-brown variety. Both microcline and microperthite are present and may be seen replacing oligoclase. Accessories include apatite, titanite, magnetite, epidote, and zircon.

Exposures in lot 12 along the road between concessions IV and V show a transition across the strike. At the crest of the hill there is exposed a biotite gneiss with hornblende porphyroblasts and occasional porphyroblasts of a white feldspar

[1]Engel and Engel, *op. cit.*

[2]Specimens are numbered, for easier identification and reference, and correspond to the author's numbering of specimens collected.

(No. 73). The rock contains 10–50 percent quartz and feldspar as pink lenses and stringers. The hornblende porphyroblasts are present in both the biotite gneiss and feldspar stringers. The gneiss contains oligoclase, microcline, microperthite, quartz, biotite, and hornblende. Common accessories are apatite, titanite, and epidote. The biotite is pleochroic from yellow-brown to almost opaque. This rock illustrates a more advanced stage than No. 71. Along this concession road to the west the amount of introduced pink feldspar diminishes to nothing, and the rock is a well-banded biotite-hornblende gneiss (No. 74) with ⅛–¼-inch hornblende porphyroblasts and occasional white feldspar porphyroblasts ¼–1-inch across. The exposure contains lenses of fine-grained hornblende gneiss and, rarely, interbands of white biotite-poor gneiss up to 1 inch wide. A thin section of the gneiss shows the minerals to be oligoclase, quartz, hornblende, and biotite,



Granite pegmatite dike, 1 foot wide, filling fracture in drag-folded biotite paragneiss. Lot 8, concession VI.

with apatite and titanite as accessories. Very little potash feldspar is present, so this gneiss is the least altered gneiss of the four specimens examined.

On the Sohm farm, lot 9, concessions VI and VII, the same gneisses, with hornblende porphyroblasts, are exposed. The west boundary of the migmatite is fairly well defined against a garnet-hornblende gneiss on the hill in lot 9, concession VI, but in concession VII there is more interfingering, and the west boundary is not as distinct as the map would suggest.

PEGMATITE.—Narrow stringers of pegmatite are abundant in the migmatite or hybrid granite gneiss and common in the rocks of the paragneiss-amphibolite group. In Lount township dikes of granite pegmatite are mostly narrow, and only a few have been explored for their mica or feldspar content.

The minerals of the pegmatites are microcline-microperthite, minor oligoclase, quartz, muscovite, or biotite. The potash feldspar in most of the dikes

mapped was in crystals or masses less than 1 foot in diameter. Some muscovite was shipped from a dike in lot 3, concession V. Accessory minerals are uncommon. Martite was observed in dikes in the southeast corner of the township. Trigonal prisms of black tourmaline were seen in one dike in lot 34, concession II, Lake of Many Islands. Allanite was recognized in a dike on lot 3, concession V (see page 42).

In the paragneiss-amphibolite and crystalline limestone groups metasomatism has resulted in the formation of other varieties of pegmatite. Although some of these may be true syenite or diorite pegmatites, the field relations would suggest that they are the product of a reaction between granitic juices and the host rock. Such a rock was found in scattered exposures in a field northeast of the Fowke (Spring) Lake iron showing in lot 22, concession VIII. It is a coarse pegmatite composed of a yellowish oligoclase (An_{22}), pyroxene, abundant accessory titanite, and a little graphite. The reddish-brown titanite occurs as crystals up to ½ inch in length. The nearest country rock is crystalline limestone or amphibolite.

Another pegmatite of this type, with graphite and titanite, is noted under "Graphite" (page 27).

Younger Basic Intrusives

DIABASE.—Exposures of a fresh, reddish-brown-weathering diabase indicate a swarm of about eight dikes in the extreme northern part of the township in concessions XI to XIV. These dikes trend nearly east and west. As the dikes are narrow and the exposures not too frequent, some of the dikes as indicated on the geological map may not be correct. In some cases, owing to the well-developed cross-jointing of the dikes, glacial erosion has plucked the diabase, leaving a trench partly filled with drift. The dike's presence is indicated by patches of chilled margin frozen to the walls of the country rock as in lot 155, concession A.

The dikes are diabase or quartz diabase. Some contain reddish-brown spots on the weathered surface, which thin-section study shows to be a chlorite aggregate after, possibly, an orthopyroxene.

These diabases are very similar to those labelled Matachewan or Keeweenawan in the Precambrian of northern Ontario and are believed to be the youngest intrusives in the township.

Cenozoic

PLEISTOCENE

In the Pleistocene age the Parry Sound district was covered by a continental glacier and, during its retreat, by the waters of glacial Lake Algonquin and the Nipissing Great Lakes. Chapman and Putnam have recently studied the shore lines of these lakes.[1]

In Lount township glacial striae are poorly preserved, only six readings being obtained. These indicate that the average direction of ice movement was S.15°–28°W., with one reading of S.30°E.

The whole township has a fairly heavy cover of sand, gravel, and boulders, in part ground moraine, but possibly also glaciofluviatile in origin. All these deposits may have been reworked by the waters of the glacial lakes. They are better exposed in the farmlands to the east of the Nipissing road, but are difficult to see and interpret in the heavily-wooded country to the west.

[1]L. J. Chapman, *An Outlet of Lake Algonquin at Fossmill, Ontario.* Proceedings, Geol. Assoc. Can.,Vol. 6, pt. II, May, 1954, pp. 61–68.

Some terraces of sand and pebbles were observed in lots 2 and 3, concession XIII. These may be beaches of one of the glacial lakes.

Clay was observed only in low areas. No vertical sections were seen, and it is not known whether it is varved.

STRUCTURAL GEOLOGY

In Lount township as elsewhere in the Parry Sound district the grade of metamorphism is high and deformation is often intense, so that the usual criteria for top determinations in sediments have been destroyed. In the limestones,



Drag-folding in biotite paragneiss with minor porphyroblastic feldspar. Narrow interbeds are hornblende gneiss. Lot 9, concession VIII.

tectonic breccias have been formed. Even the strikes and dips have little meaning since strikes may change through 90 degrees or follow a zig-zag course within a few feet. Distinct marker horizons were not found. Although several horizons were traced for short distances, they have not contributed much to unravelling the regional structure.

Folding

The bedding of the metasediments and gneissic structure in the plutonic rocks dips from almost flat to vertical, although over most of the township the dips are greater than 30 degrees.

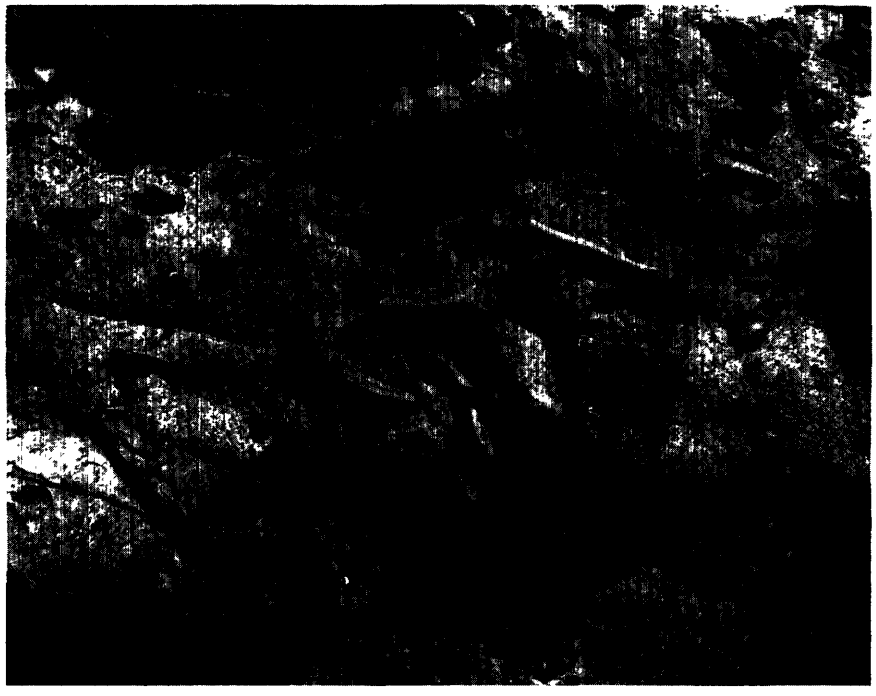
The following marker horizons are described as possible clues to an interpretation of the structure:

In the southeast corner of the township there is a band of garnet-biotite paragneiss with porphyroblastic feldspar within an area of migmatites (see page

12), which has been traced from lot 10, concession I, to lot 1, concession IV. It strikes northeast and dips 30–45 degrees northwest.

Just to the west of the area of migmatites noted above and within an area of metasediments, a narrow horizon of migmatite (see page 17) has been traced from lot 14, concession II, to lot 7, concession VIII. Parallel and just west of it, is a distinctive band of garnet-muscovite paragneiss (see page 12). The strike is nearly north and south, and the dip is from 55°W. to vertical.

Most of the crystalline limestone in the township is in the form of tectonic breccias. There is nothing particularly distinctive about the limestone in one part of the township more than in another. The bands shown on the map have some notable gaps in terms of exposures in them. It must also be admitted that the



Limestone tectonic breccia with fragments of amphibolite or hornblende gneiss. Note highly contorted fragment of a band of hornblende gneiss in the centre of the photograph. The narrows, Rye (Pickerel) Lake, lot 26, concession XII.

limestone was extremely mobile at certain times during the periods of metamorphism, metasomatism, and folding, and may have provided filling for fault fissures. Granted these possibilities, attention is drawn to a band of crystalline limestone that has been traced intermittently from lots 26–28 on the south boundary westward to Lake of Many Islands, and traced northeast, north, and west around T. R. Russell's farm (lot 137, concession B) and is shown cut off by a fault in lot 20, concession IX. Dips in this band range from 20 to 60 degrees and are mainly outwards from the curve of the band.

Extensions of this band to the west of the fault are not clear. A band is indicated by isolated exposures on Rye (Pickerel) Lake, which appears to owe its existence to differential erosion along this interband of limestone tectonic breccia. Dips are low, 15–30 degrees south.

Another isolated area of limestone is indicated mainly by scattered exposures

on the shores of Fowke (Spring) Lake. Strikes and dips show this to be an infolded remnant in the paragneiss-amphibolite group that has been dragfolded (see map). The removal by erosion of this mass of limestone accounts for the basin of Fowke (Spring) Lake to the east of Birds Eye Island.

A narrow limestone band is also indicated by isolated exposures on the west and north shores of Lake of Many Islands, and the erosion of this band may account for the lake's existence.

Whether all these bands are part of a single limestone horizon is pure conjecture. The author would point out that a faulted anticlinal structure is suggested by the distribution of the main band and remnants. The presence of more granite, granite and hybrid granite gneisses within the core of the anticline,



A boudin of garnet amphibolite in biotite paragneiss with porphyroblastic feldspar and hornblende and schlieren of amphibolite on Birds Eye Island, Fowke (Spring) Lake.

representing a deeper section of the earth's crust, is in keeping with such a structural interpretation.

The intense deformation has resulted in the stretching and rupture of bands in members of the paragneiss-amphibolite group. This is known as "boudinage." Cloos[1] has described it as follows:

> Boudinage (sausage structure) . . . is a very common, but rather rarely observed structure, in rocks in which competent and incompetent layers alternate. The competent layers break, and the fragments separate. Incompetent material flows in the gap, or new materials fill it. Boudinage can form by tension and elongation parallel to the fold axes or perpendicular to them and down dip of the limbs of folds.

The individual ruptured masses or sausages are known as "boudins." In Lount township boudinage structure is not uncommon. The example illustrated

[1]Ernst Cloos, *Lineation, A Critical Review and Annotated Bibliography*, Geol. Soc. Amer., Mem. 18, 1946, p. 8.

by the photograph is on the west side of Birds Eye Island, Fowke (Spring) Lake. Here a grey biotite-hornblende-oligoclase gneiss with porphyroblastic feldspar and hornblende contains numerous schlieren of black medium-grained amphibolite and a string of three boudins of garnet amphibolite measuring 3½ by 6½, 3 by 4½, and 6 by 10 feet; the competent bed is a garnet amphibolite, and the incompetent one a biotite paragneiss.

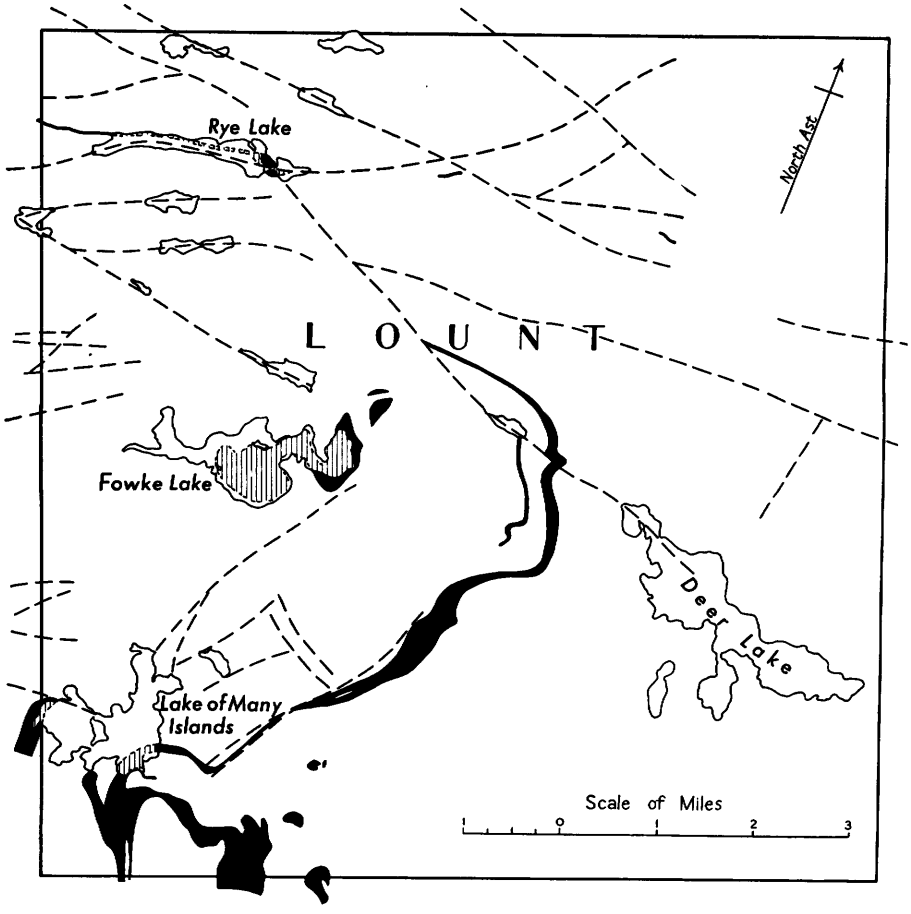


Figure 2 — Sketch map showing linears (broken lines) in Lount township. Bands or areas of crystalline limestone in solid black.

Faulting

Little to no evidence of faulting other than minor offsets to be measured in inches or a few feet was found in the field. However, by a study of a mosaic of the air photographs of the township, a large number of linears were located. By correlating these with the geology and topography on the ground it is thought that a number of them may indicate faults. They are shown as assumed faults in Figure 2. No names have been assigned to these faults. It will be noted that a number of them are marked by straight stream courses and elongate lakes. Some of these linears coincide with the location of the younger diabase dikes. All of these nearly east-west linears are possibly tension joints of late Precambrian date.

ECONOMIC GEOLOGY

Iron (magnetite) occurrences have been the main reason for prospecting or exploration in the township, and some ore was shipped from one property. Other mineral occurrences include copper, feldspar, garnet, graphite, mica, molybdenum, and the rare-element and radioactive minerals. Many of these occurrences are of no economic importance, but are described for the sake of record.

Copper

A number of minor copper occurrences are described below. They fall naturally into two groups. In one the copper occurs as chalcopyrite with associated pyrrhotite and pyrite disseminated in amphibolite or garnet-hornblende gneiss. In the other type the mineralization is pyrrhotite, pyrite, and chalcopyrite in a garnet skarn at the contact between crystalline limestone and amphibolite. None of the occurrences examined appear to be of any economic significance. The one point of interest is that the occurrences are so widely distributed.

CONCESSION I, LOT 28

On the farm of Frank Schmeler, lot 28, concession I, a pit was put down many years ago to explore a nickel-copper showing.

The pit is 8 by 10 by 5 feet deep, at the base of a 30-foot cliff. It exposes a contact between crystalline limestone and hornblende gneiss (west). This contact dips 55°–70°W. A band of skarn 12–18 inches thick is present along the contact and may be traced north from the pit for 10 feet where it lenses out. On strike to the north there is a little pegmatitic material along the contact. The skarn consists of calcite, red garnet, and pyroxene. A 1-foot square patch in the skarn contains coarse pyrrhotite and some chalcopyrite; in the remainder of the skarn zone the sulphide content is low, and the over-all average is probably not more than 1 percent. A small dump adjacent to the pit contains much massive red garnet rock containing a minor amount of hornblende and disseminated splashes of pyrrhotite.

Assays were made on well-mineralized grab samples, taken by the author, of the skarn and garnet rock. The skarn carries copper, 0.05 percent; and nickel, trace; and the garnet rock copper, 0.08 percent; and nickel, trace. The samples contain only a trace of gold and no silver.

CONCESSION III, LOT 14

In the course of road work a little disseminated chalcopyrite was exposed by blasting in a feldspathized hornblende gneiss in lot 14, concession III. The sulphide content is less than 1 percent. A grab sample of well-mineralized material taken by the author gave: copper, 0.60 percent; nickel, trace; gold, trace; and silver, none.

CONCESSION V, LOT 14

There is a copper-nickel showing on the farm of C. Maeck, lot 14, concession V. An old pit 7 by 7 by 5 feet deep in the woodlot to the west of the barn and 200 feet north of the concession road was dewatered in the summer of 1953. It exposes garnet amphibolite cut by pink stringers of granite gneiss. In the bottom of the pit, over an area roughly 1 yard square, there is random sulphide mineralization of pyrite, with lesser amounts of chalcopyrite and pyrrhotite in splashes. The mineralized rock is a skarn of grey-white calcite, hornblende, garnet, minor

magnetite, and splashes of pyrite, chalcopyrite, and pyrrhotite. A grab sample of well-mineralized material taken by the author gave on assay: copper, 0.23 percent; nickel, trace; gold, trace; and silver, none.

CONCESSION XII, LOT 13

In 1953, A. C. McLean did some exploratory work on a small showing of disseminated sulphides in lot 13, concession XII.[1] The country rock is a garnet-hornblende gneiss. A small test pit on the south side of the road to Tough's lumber camp exposes scattered splashes of pyrite and chalcopyrite in a rusty-weathering garnet-hornblende gneiss.

Three diamond-drill holes were put down at this location to cross-section the gneiss, one to the north and two to the south, for a total of 1,173 feet. These holes cut interbedded garnet-hornblende gneiss, amphibolite, impure crystalline limestone, and a dike of fresh diabase. Scattered disseminated pyrrhotite, pyrite, and some chalcopyrite were intersected in the upper parts of the holes.

A fourth hole was drilled for assessment work credit on the adjoining lot 14, 190 feet west of the others, for a length of 201 feet. This hole also intersected interbedded garnet-hornblende gneiss, amphibolite, paragneiss, and impure crystalline limestone. No mineralization was recorded by P. C. McLean in the log.[2]

CONCESSION A, LOT 124

An old pit, 6 by 9 by 3–4 feet deep, exposes a rusty-weathering, sulphide-bearing amphibolite at the west edge of a clearing and outcrop in lot 124, concession A. Well-mineralized material contains 10–25 percent of disseminated coarse sulphides. The sulphides are splashes of pyrrhotite, minor chalcopyrite, and cubes of pyrite accompanied by quartz and a red garnet. A grab sample taken by the author gave on assay: copper, 0.38 percent; nickel, trace; gold, trace, and silver, none. The author was unable to determine the dimensions or strike of the sulphide-bearing rock. It is believed to be quite small.

CONCESSION B, LOT 124

In the western part of lot 124, concession B, a vertical shaft has been sunk at a point 200 feet north of the We-Na-Nak road just north of an outcrop clearing.

The country rock is amphibolite and garnet amphibolite with minor impure crystalline limestone. The shaft is 6 by 9 feet and is reported to be 43 feet deep. The waste rock that surrounds the shaft includes amphibolite, some of which contains epidote or garnet and epidote, and impure crystalline limestone. Also present is a massive red garnet rock carrying much chalcopyrite and pyrrhotite. The association of rocks suggests that the red garnet rock is a skarn developed at the contact between the crystalline limestone and the amphibolite. The occurrence appears to be a relatively small pod or mass of the red garnet rock.

Feldspar

None of the granite pegmatites found in the course of the field work or seen at old mica properties (see page 19) contain any commercial feldspar. The pink or buff potash feldspar is usually in masses less than 1 foot in diameter and, in many cases, less than 4 inches.

[1]Held in trust for Boymar Gold Mines, Limited.
[2]Ontario Department of Lands and Forests, File No. 48090.

Garnet

A massive, fine- to coarse-grained, medium-to-dark, red garnet rock is quite common in the amphibolite and hornblende gneiss in the southern part of the township. The author assumes that the garnet bodies are skarns derived from lenses, pods, or bands of impure crystalline limestone at the contact with the amphibolite or hornblende gneiss.

Garnet is also an abundant constituent in garnet amphibolite or hornblende gneiss and in garnet-biotite gneiss. The porphyroblastic garnet in these rocks ranges from less than 1/20 inch to as much as ½ inch in diameter and may occasionally form 25 percent of the rock. Few occurrences of garnets in such gneisses in the Grenville subprovince in Ontario have yet been found to meet the commercial specifications for abrasive garnet.[1]

Graphite

No disseminated flake graphite of any significance was seen in the exposures of crystalline limestone examined.

CONCESSION II, LOT 25

About 150 feet south of the We-Na-Nak road on lot 25, concession II, a shallow trench has been put down on a small showing of coarsely crystalline graphite. This trench is 50 feet long.

The country rock is crystalline limestone. The trenching exposes a skin of hornblende syenite pegmatite, about 3 by 4 feet, on the west wall. The pegmatite contains 10 percent graphite in flakes ¼–1 inch across. Titanite occurs as an accessory mineral in crystals ¾–½ inch across. The pegmatite could not be traced beyond the shallow trenching.

The showing would appear to be of only mineralogical interest.

Gravel

About 20 gravel pits have been opened up in the township for local use. In most cases the gravel is unsorted material with much admixed silt or clay of glaciofluvial or glaciolacustrine origin.

Iron

The first exploration for iron in Lount township was in 1901 when the Cramp Steel Company, Limited, of Toronto opened up their property in lot 17, concession III, and produced 6,000 tons of magnetite ore valued at $9,000. This is the only production recorded from Lount township. Early government reports (see page 3) indicate that exploration on about 25 claims was carried out intermittently from 1907 to 1915. The author has no record of any activity until 1941 when some trenches were cleaned out at several old showings. In 1953, an aeromagnetic survey (see page 1) led to renewed interest, and a number of companies carried out geological reconnaissance, examined old showings, made geophysical surveys, or carried out diamond-drilling. This work was not successful in discovering any orebodies.

A very large block of claims were staked by A. C. McLean and associates in

[1] *The Canadian Mineral Industry in 1951*, Can. Dept. Mines and Technical Surveys, Mines Branch, No. 841, 1953, pp. 78, 79.

SUMMARY OF IRON AND GARNET OCCURRENCES IN LOUNT TOWNSHIP

Location	Development	Geology
Con. I, lots 16, 17	Surface work, 1 trench; 1 diamond-drill hole.	Amphibolite, in places coarse (2 inches); no magnetite in place; coarse magnetite dump, 10 by 10 by 2 feet; crystalline limestone, 600 feet southwest. (Analysis No. 1, p. 30.)
Con. I, lot 19	Surface work, 2 pits.	Amphibolite, garnet rock, hornblende pegmatite; disseminated and coarse magnetite.
Con. III, lot 17	Surface work, pit and open cut.	Amphibolite, in places coarse (1 inch); magnetite lens, 10 feet wide; granite pegmatite, hornblende pegmatite, and crystalline limestone. (Analysis No. 2, p. 30.)
Con. VIII, lot 22	Surface work, 2 pits; 2 diamond-drill holes.	Amphibolite (scapolitized metagabbro) with lenses of crystalline limestone. (Analysis No. 4, p. 30.)
Con. XIII, lot 20 (A. C. McLean)	Diamond-drilling, 1 hole, 881 feet to explore anomaly (1953).	Garnet-hornblende gneiss and younger diabase; disseminated magnetite in gneiss at 102–5 feet.
Con. XIII, lots 23, 24 (A. C. McLean)	Surface work, 1 pit; diamond-drilling, 5 holes, 1,993 feet (1953).	Garnet-hornblende gneiss with disseminated magnetite in zones 110–90 feet thick, dipping 30°S.
Con. XIV, lot 22 (A. C. McLean)	Diamond-drilling, 7 holes, 2,139 feet (1953).	Garnet-hornblende gneiss with disseminated magnetite in zones 10–60 feet thick, dipping 25°S.
Con. A, lot 125	Surface work, 5 pits and trenches; shaft, 16 feet deep.	Amphibolite with masses of garnet rock; epidote-calcite-garnet skarn with magnetite at shaft; no magnetite at other workings, garnet rock only.
Con. A, lot 126	Surface work, 9 pits and trenches; 1 diamond-drill hole.	Amphibolite with masses of garnet rock; coarse calcite-epidote-garnet skarn with grains of magnetite; at 5 workings only garnet rock.
Con. A, lot 129	Surface work, 2 pits.	Amphibolite, lenses of crystalline limestone, garnet rock; hornblende pegmatite with titanite; no magnetite observed.

SUMMARY OF IRON AND GARNET OCCURRENCES IN LOUNT TOWNSHIP—*Continued*

Location	Development	Geology
Con. A, lot 130	Surface work, 1 pit.	Amphibolite, garnet rock, calcite stringers; no magnetite found.
Con. A, lot 132	Surface work, 2 pits.	Amphibolite, garnet rock; crystalline limestone 250 feet southwest; no magnetite found; no local attraction.
Con. A, lot 133	Surface work, 3 pits.	Amphibolite, garnet rock, lenses or stringers of coarse calcite; practically no magnetite present; no local attraction.
Con. A, lot 135	Surface work, 1 pit.	Amphibolite; coarse magnetite, 1–3 inch seams on dump, none in place; no local attraction; flat dip.
Con. A, lot 136	Surface work, 1 pit (1902); diamond-drilling, 3 holes, 29, 31, and 92 feet (1902).	Amphibolite; disseminated and coarse magnetite (on dump) from a seam 6–9 inches thick; flat dip. (Analysis No. 3, p. 30.)
Con. B, lot 124	Surface work, 2 pits.	Amphibolite, garnet rock; disseminated magnetite and pyrite.
Con. B, lot 126	Surface work, 1 trench.	Biotite or hornblende granite gneiss with amphibolite bands; no magnetite was found.
Con. B, lot 129	Surface work, 2 pits, 2 trenches.	Amphibolite with flat seams of coarse magnetite, or magnetite-scapolite, surrounded by hornblende granite gneiss.
Con. B, lot 137	Diamond-drill hole, 50 feet (1902).	Amphibolite, biotite schist; no magnetite cut by drill hole.
Con. B, lot 144	Surface work, 1 pit.	Garnet amphibolite, garnet-magnetite rock on dump. (Analysis No. 6, p. 30.)
Con. B, lot 145	Surface work, 3 pits, 2 trenches; workings cleaned out in 1941.	Garnet amphibolite, granite gneiss; disseminated magnetite in places; minor pyrite. (Analysis No. 5, p. 30.)

the northwest part of the township. Occurrences of disseminated magnetite in garnet-hornblende gneiss were explored by 14 diamond-drill holes totalling 5,136 feet. It is interesting to note that the magnetite showings on these claims were not all indicated by anomalies on the aeromagnetic survey maps, nor did all the anomalies shown on the aeromagnetic maps contain magnetite. (See Figure 3.)

In the early exploration in the township a dark-red to almost black garnet rock that occurs in the amphibolites was mistaken for magnetite with the result that a great many pits and trenches were put down in this rock.

The distribution of a number of the iron and garnet showings in the southern part of the township is shown on a geological map (Figure 4) in the pocket at the back of the report.

A summary of the iron and garnet occurrences in the township shows that they may be conveniently classified into three groups:

1) Garnet hornblende gneiss or garnet amphibolite with disseminated magnetite or narrow seams of massive magnetite (5 occurrences).
2) Amphibolite or hornblende gneiss with disseminated magnetite or narrow seams (flat) of massive magnetite (2 occurrences).
3) Amphibolite with masses of deep-red garnet rock (8 occurrences) and with or without lenses of crystalline limestone or skarns of coarse calcite, epidote, and garnet (9 occurrences). Massive magnetite may occur as lenses, seams, or pods. The presence of the garnet rock is no indication that magnetite will also be present.

In the third group the frequent association of garnet rock, coarse calcite or crystalline limestone, and skarns seems to indicate that the magnetite occurrences may be, in part, replacements of limestone inclusions in the amphibolite and suggests that the amphibolite is of intrusive origin. The presence in a number of places of what the author believes to be relatively unaltered cores of metagabbro intrusive bodies (lot 133, concession A, and lot 22, concession VII) is in keeping with such a conclusion. Some of the magnetite occurrences may be disseminations or segregations within the intrusive body itself. The author suggests that groups Nos. 1 and 2 are of the same origin, the grade of metamorphism and the degree of metasomatism being much higher, as indicated by the occurrence of garnet, hypersthene, and augite in the gneiss. As noted previously the gabbro bodies are thought to have been sheets or sills intrusive into the paragneiss and limestone.

Analyses of a selected number of grab samples of magnetite taken by the author in 1941 from the old showings are given in the following table:

ANALYSES OF MAGNETITE, LOUNT TOWNSHIP[1]

No.	Location	Fe	SiO_2	TiO_2	S	P
1	Con. I, lot 16	55.71	6.70	2.60	0.15	0.05
2	Con. III, lot 17	59.55	4.49	1.20	0.12	nil
3	Con. A, lot 136	43.88	23.28	0.36	0.06	0.06
4	Con. VIII, lot 22	59.92	14.12	0.78	0.08	0.05
5	Con. B, lot 145	52.74	2.73	11.50	2.28	0.004
6	Con. B, lot 144	49.62	7.18	10.25	1.28	0.008

Some of the magnetites from southeastern Ontario may contain minor amounts of chromium, uranium, vanadium, and nickel.[2] Analyses by the Provincial Assay Office of five samples from Lount township taken by the author

[1]Analyses by Provincial Assay Office, 1941.
[2]Willet G. Miller, *Economic Geology of Eastern Ontario*, Ont. Bur. Mines, Vol. VII, 1898, pt. 3, pp. 232, 233.

show only traces of vanadium, nickel, and chromium (by spectrograph), and no uranium (by beta counter). These were grab samples of massive magnetite from occurrences on: lot 16, concession I; lot 17, concession III; lot 24, concession XIII; lot 136, concession A; lot 129, concession B.

Vanadium is recorded by Robinson[1] in two analyses from Lount township: lot 136 [concession A], 0.34 percent; and lots 143 and 144 [concession B], 0.23 percent.

In 1941 the author wrote:[2]

> From the field work it appears that the bands or bodies of magnetite are of small dimensions, having no great length, width, or depth. It is understood that in many cases exploration of these deposits ceased because the ore body played out, and search failed to reveal others in the near vicinity. In some pits little to no magnetite was to be seen on the walls, indicating that the magnetite bodies were small and had been completely removed. It is likely that detailed prospecting would lead to the discovery of more magnetite bodies in the areas underlain by the hornblende rocks, but judging by the results attained to date, the possibility of finding workable deposits of iron in Lount township cannot be considered encouraging.

The detailed mapping and re-examination of the iron showings in 1953 have revealed nothing to change the author's opinion.

CONCESSION I, LOT 16 or 17

Close to the line between lots 16 and 17, concession I, there is a curved trench, 10 by 50 by 10 feet deep, trending northeast. This trench may be reached from the bend in the road on the line between lots 17 and 18 on the Lount-Chapman boundary by following an old wagon road eastward for about 1,500 feet. The trench is about 300 feet north of that point. (See Figure 4 in back pocket.) When examined in August, 1953, the trench was dry. The country rock is a dark-green amphibolite, with coarse phases made up of crystals of hornblende 2 inches across. The author was unable to find any magnetite in place. Adjacent to the pit is a small dump, about 10 by 10 by 2 feet high, of massive magnetite. It is assumed that this magnetite was present as a small pod in the amphibolite, and that all of it has been removed from the pit.

In 1941, the author was shown an old diamond-drill hole 100 feet west of the trench. It is understood the hole did not intersect any magnetite, and the compass did not show any attraction at the drill-hole location.

CONCESSION I, LOT 19

Two old pits were found on the side of a hill in lot 19, concession I. (See Figure 4 in back pocket.) One pit, now overgrown, is 5 by 8 feet by 1 foot deep. It exposes a dark-red garnet rock carrying 25 percent of coarse disseminated magnetite and, rarely, seams of coarse magnetite up to 1 inch thick. The second pit or open cut, 60 feet to the north of the first, is also overgrown. It exposes an amphibolite cut by hornblende granite pegmatite. This open cut is 10 by 4 by 3 feet deep. On the dump some massive red garnet rock is present carrying about 25 percent disseminated coarse magnetite. Although there is very marked magnetic attraction at the workings, it is very local.

These workings lie within a narrow anomaly, shown on the Lount aeromagnetic map, extending north, from south of the Lount-Chapman boundary in lot 19 to lot 127, concession A, of the Nipissing Road lots.

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[1] A. H. A. Robinson, *Titanium*, Can. Dept. Mines, Mines Branch, No. 579, 1922, p. 35.

[2] J. Satterly, *Mineral Occurrences in Parry Sound District*, Ont. Dept. Mines, Vol. LI, 1942, pt. 2, pp. 41, 42.

CONCESSION III, LOT 17

The old workings are in lot 17, concession III, just north of the road on the boundary between concessions II and III. (See Figure 4 in back pocket.)

In 1953, the main pit on the top of the hill was filled with water and plant growth to within 3 feet of the top. The rock types present can only be determined from the broken rock on dumps around the pit. Carter[1] gives the dimensions of this pit as 50 feet long, an average of 10 feet wide, and 12–22 feet deep. About 50 feet east of the pit there is an open cut in the side of the hill, 15 feet wide by 100 feet long, which goes westward into the hill with a level floor for 50 feet and then shallows from 15 feet to 0 feet deep at 100 feet in. This open cut was put in to approach the orebody in the pit. It exposes hornblende gneiss and, in the shallow back part, a very coarse amphibolite. No magnetite was seen in place, and the local magnetic attraction is not more than 5 degrees.

Carter describes this orebody as a north-south lens, about 10 feet wide, consisting, in part, of clean magnetite or mixed magnetite and hornblende. Sulphides were only visible along the walls in irregular patches. Mining began on May 8, 1901, and by January 28, 1902, an ore pile of about 500 tons had been accumulated. The owner at that time was the Cramp Steel Company, Limited, of Toronto. Total production has amounted to 6,000 tons valued at $9,000.[2]

The country rock is a fine-grained amphibolite. On the dumps, other rocks found include a coarse amphibolite with dark-green hornblende of up to 1-inch grain size and interstitial magnetite, pink impure crystalline limestone, hornblende syenite pegmatite, and a granite pegmatite. The largest mass of magnetite found on the dump contained a 6-inch seam of massive magnetite. To the west, hybrid gneisses or migmatites are exposed, and to the north, amphibolite, garnet amphibolite with some massive garnet rock, and crystalline limestone. The occurrence appears to be a small pod, possibly a replacement of a small mass of crystalline limestone. This is not indicated by any anomaly on the Lount aeromagnetic map.

Although this showing is referred to by Carter, and in the Report of the Ontario Iron Ore Committee,[3] as the "Magnetawan" mine, it is not known by that name locally.

CONCESSION VIII, LOT 22

In June, 1941, the author was shown an old iron showing on lot 22, concession VIII, by J. W. Edwards.[4] Surface work and the cleaning out of this old pit was carried out at that time, but by 1953 the workings had become largely overgrown. The description that follows is based partly on the information gathered in 1941.

The main or west pit is about 250 feet west of the road to Fowke (Spring) Lake. This pit, 8 by 10 by 10 feet deep, has a stripping around the top, 3–4 feet across, widening to 6 feet on the north side, where an old diamond-drill hole, nearly vertical, has been plugged.

An early report states that two holes of 51 and 30 feet were put down on G. W. Fowke's property, "lot 32, concession VIII," in June, 1902. These holes intersected hornblende gneiss and schist, and in each a narrow band of magnetite was cut. There is a typographical error in the old report the lot number being given as 32 instead of 22.[5]

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[1]W. E. H. Carter, *The Mines of Ontario*, Ont. Bur. Mines, Vol. XI, 1902, p. 262.
[2]Statistician, Ontario Department of Mines.
[3]*Report of the Ontario Iron Ore Committee, 1923*, Ont. Dept. Mines, 1924, p. 215.
[4]J. Satterly, *op. cit.*, p. 44
[5]Thos. W. Gibson, *Statistics for 1902*, Ont. Bur. Mines, Vol. XII, 1903, p. 51. This report states that the Fowke property was in lot 32, concession VIII. A search of the files of the Ontario Department of Lands and Forests reveals that the Fowke property was lot 22, concession VIII. There is no iron showing in lot 32.

At this pit the country rock is a light-coloured medium-grained scapolite-hornblende gneiss, striking approximately east-west and dipping 30°N. Under the microscope, in thin section this rock is seen to be composed of an equigranular aggregate of hornblende, scapolite, plagioclase, and abundant accessory apatite, titanite, epidote, and green spinel. Bands or lenses of coarse calcite (crystalline limestone (?)), 6–18 inches thick and dipping parallel to the foliation, are exposed in the pit. On the north side of the pit there is a magnetite band containing garnet and hornblende 2 feet wide. Irregular stringers and disseminated magnetite occur across a width of 4 feet at the south side of the pit, and a band of solid magnetite 3–12 inches wide occurs 2 feet south of the mouth of the pit. A small trench, 18 inches wide and 18 inches deep to bedrock, extends 13 feet south from the pit mouth and exposes hornblende gneiss but no magnetite.

The east pit, 100 feet east of the above, is a shallow pit 7 by 17 by 1–3 feet deep. It exposes a 2-foot seam of massive, coarse magnetite overlain and underlain by a light-coloured, medium-grained rock that thin-section study shows to be a scapolite-diopside-plagioclase granulite, probably a scapolitized gabbro. At the east end of the pit a garnet-hornblende rock is exposed. The dip of the magnetite seam may be gently to the north.

Exposures around the showing are few. Crystalline limestone and some garnet skarn are exposed to the north and south. To the northwest there are exposures of a coarse, dark-green and light-grey metagabbro, and it is assumed there is a small body of gabbro intrusive into the crystalline limestone with minor bands or lenses of massive magnetite developed either near the contact or replacing inclusions of crystalline limestone in the intrusive.

This occurrence is not indicated on the Lount aeromagnetic map by any anomalies.

CONCESSION VIII, LOT 32

(See footnote on iron showing in lot 22, concession VIII)

CONCESSION XIII, LOT 20

On the basis of the association of occurrences of magnetite in lots 23 and 24, concession XIII, with an anomaly on the Ferrie aeromagnetic map, A. C. McLean and associates explored in 1953 an anomaly indicated on the same map in lots 18–21, concession XIII. This anomaly has a maximum reading of 4,575 gammas, and a relief of 425 gammas. It was explored by one drill hole for a length of 481 feet. The hole intersected garnet-hornblende gneiss and, near the bottom of the hole, dikelets of fresh diabase. From 102 to 105 feet, 3 feet of magnetite-bearing gneiss was cut. Owing to the disappointing results from this hole, no further drilling was carried out in this anomaly.

CONCESSION XIII, LOTS 23 and 24

In early 1953, A. C. McLean and associates staked a large block of claims in the northwest part of Lount township between the Nipissing Road lots and Rye (Pickerel) Lake.[1]

Adjacent to Rye (Pickerel) Lake two occurrences of magnetite were drilled during the summer of 1953. In the southeast corner of lot 24, concession XIII, an old pit 10 by 10 by 4 feet deep, and now filled with forest debris, exposes on its walls a rusty-weathering garnet-hornblende gneiss with minor disseminated magnetite. On the dump adjacent to the pit there is some massive, medium-grained magnetite containing about 10 percent of disseminated red garnet. Mr.

[1]Held in trust for McMarmac Red Lake Gold Mines, Limited.

McLean has no information as to when this pit was put down or when the original find was made. Disseminated magnetite occurs in rock exposures adjacent to this pit. Reference to the aeromagnetic map shows an anomaly at this location with a maximum reading of 4,750 gammas, and a relief of 600 gammas. In the southwest part of this anomaly, five holes, four inclined and one vertical, totalling 1,993 feet, were drilled (See Figures 3 (page 30) and 5.) These holes cut garnet hornblende gneiss with disseminated magnetite. The general dip of the gneiss and the magnetite-bearing zones is about 30°S. The apparent thickness of the magnetite-bearing zone, based on a dip of 30 degrees, is 110–190 feet. More than one zone may be present. It might be noted that this drilling was carried out prior to the publication of the aeromagnetic maps.

CONCESSION XIV, LOT 22

In 1953, A. C. McLean and associates made a discovery of disseminated magnetite in garnet-hornblende gneiss in lot 22, concession XIV.[1] This occurrence was explored by seven drill holes, two of which were vertical, for a total of 2,139 feet. (See Figures 3 and 6.) Magnetite-bearing zones in the gneiss were cut in the upper part of the holes (see Figure 6) and, assuming a dip of 25°S., range in thickness from 10 to 60 feet. The Ferrie aeromagnetic map shows these magnetite occurrences to be on the east side of a low, marked by a 3,400-gamma contour. It may be noted that the field party found local magnetic attraction near the line between lots 20 and 21, concession XIV; it occurs within a low of 3,400 gammas.

CONCESSION A, LOT 125

In 1953 the author examined a number of pits, trenches, and an old shaft, which are mainly located in the eastern part of lot 125, concession A, except for a few pits that may be in lot 124. The country rock is an amphibolite with irregular masses of almost black garnet rock in which a number of pits have been sunk along a line running N.25°W. These workings are on lands originally patented to the Great Northern Iron and Smelting Company in 1931. The mining rights of this lot were held in 1901 by the Cramp Steel Company, Limited. A small open cut (No. 1),[2] 12 by 10 by 8 feet at the face, exposes a dark-red, almost black, massive garnet rock cut by a 1-foot dikelet of hornblende syenite pegmatite. No magnetite was found, and there is no local attraction at this point.

A shallow test pit, (No. 2), 50 feet from No. 1, is 8 by 9 by 2 feet deep. It exposes only reddish-black, massive garnet rock. No magnetite was observed, and no magnetic attraction was recorded.

A small test pit (No. 3), 200 feet from No. 1, is 12 by 8, by 1–4 feet deep. The same type of garnet rock is exposed.

An old shaft, (No. 4), 250 feet from No. 1, is 7 by 10 by 16 feet deep (by poling). It is now filled with water. There is strong local attraction here, but no rock is exposed at the shaft collar. Material on the dump is a reddish-black garnet rock—epidote-calcite-garnet rock with minor splashes of coarse magnetite, but no well-defined bands or stringers.

A shallow test pit (No. 5), 325 feet from No. 1, is 7 by 8 by 3 feet deep. It is now overgrown with willow. It exposes reddish-black massive garnet rock. No magnetite was found. Slight local attraction found is probably due to No. 4.

A trench (No. 6), 600 feet from No. 1, is 5 by 70 by 4–6 feet deep. Only massive garnet rock is exposed. No magnetite was seen in place or on the dump. Local attraction is about 16 degrees

[1]Held in trust for McMarmac Red Lake Gold Mines, Limited.
[2]Numbers are shown in red on the geological map (Figure 4, in back pocket).

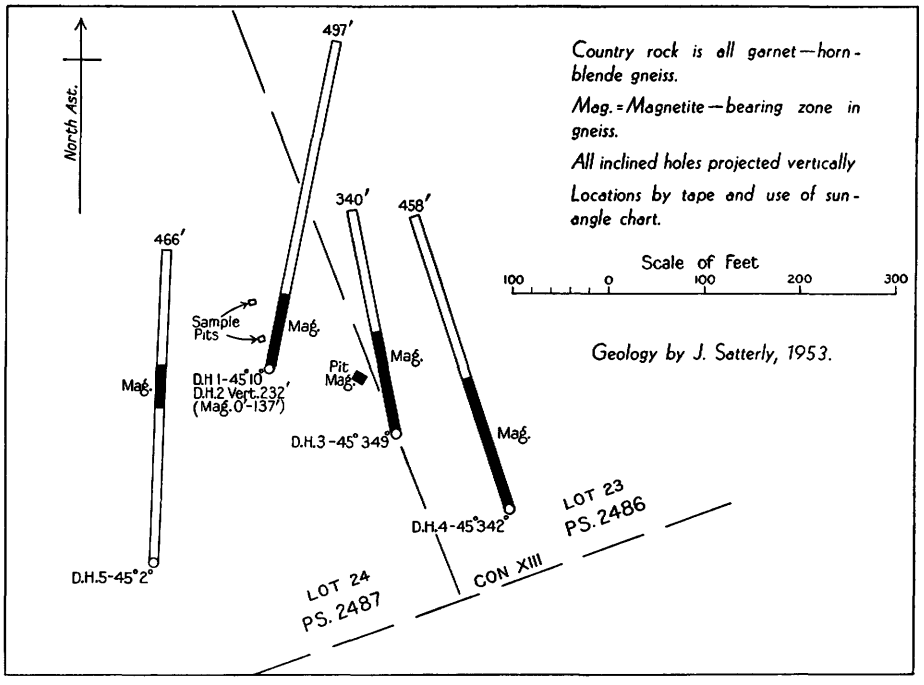


Figure 5 — Plan of diamond-drilling on lots 23 and 24, concession XIII. (A. C. McLean and associates.)

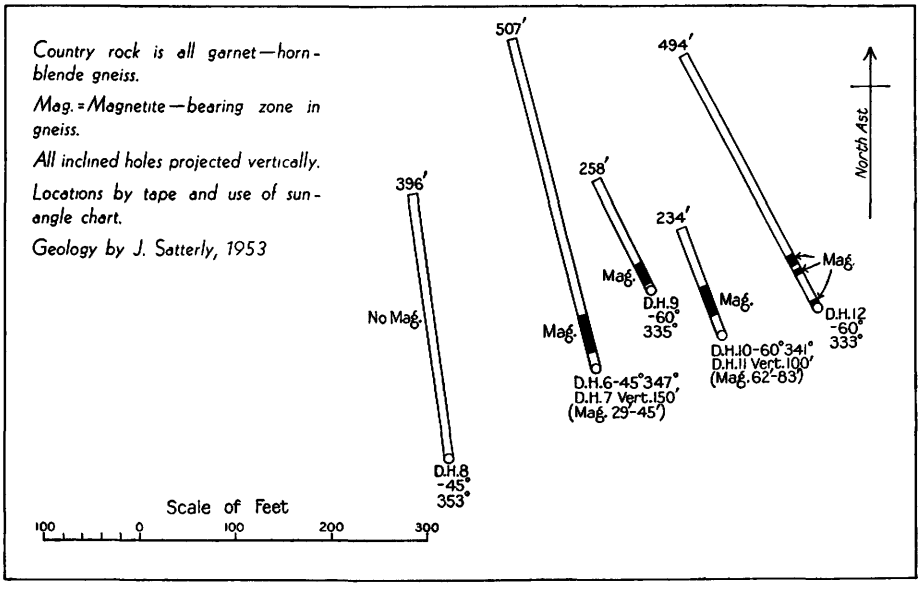


Figure 6 — Plan of diamond-drilling on lot 22, concession XIV. (A. C. McLean and associates.)

These occurrences lie within a narrow anomaly on the Lount aeromagnetic map, which extends north from lot 19 on the south boundary to lot 127, concession A. The maximum relief in this anomaly is only 880 gammas.

CONCESSION A, LOT 126

In 1953, a number of pits were mapped in the southeast part of lot 126, concession A. This lot is part of the land originally patented in 1931 to the Great Northern Iron and Smelting Company. The mining rights of this lot were held in 1901 by the Cramp Steel Company, Limited. The country rock is an amphibolite with numerous occurrences of massive, reddish-black garnet rock that have been explored in error for iron. They are described in detail for the sake of the record only.

At the west side of the south end of an outcrop area there is a round pit (No. 1), 10 by 10 by 4–7 feet deep, which has been sunk in massive, reddish-black garnet rock containing salmon-pink, coarsely crystalline calcite as patches and lenses up to 1 foot across. Associated with these are white calcite, pale-green epidote, and coarse hornblende. No magnetite was observed, and there is no local attraction.

A shallow north-south trench (No. 2), 50 feet east of the above, is 70 feet long and continues northward as barely more than a stripping for an additional 40 feet to a shallow pit. It exposes reddish-black garnet rock and, at the south end, a small hornblende pegmatite dike and a patch of coarsely crystalline limestone. No massive magnetite was found, only a few crystals in the garnet rock.

A trench (No. 3) at N.35°E. is 125 feet east of No. 1. It is 70 feet long, 4 to 10 feet deep, and is connected to No. 2 by a 40-foot long shallow cross-trench at its south end. It exposes reddish-black garnet rock, but no magnetite. Occasional fragments of pink calcite–green epidote–garnet skarn with small blebs of magnetite may be found on the dump.

A small open cut (No. 4), on the east side of the outcrop and 200 feet north of No. 3, is 9 by 10 by 6 feet at the face. It exposes reddish-black, massive garnet rock containing a few lenses of coarsely crystalline calcite. A little coarse magnetite was noted in the face of the open cut and in the outcrop adjacent to it.

A pit (No. 5) is 200 feet northwest of No. 1. It is 15 by 20 by 6–10 feet deep and exposes reddish-black, massive garnet rock cut by quartz-epidote (crystals) stringers or lenses. The garnet is redder and not so black adjacent to these stringers. Although no magnetite was found, the local attraction is 70 degrees. On the dump fragments of hornblende syenite pegmatite carry crystals of titanite and small grains of allanite. Just 30 feet to the west of the pit there is a casing of an old drill hole dipping 75°N.

Two pits (No. 6) are 800 feet northwest of No. 1 and 250 feet from the road. These pits are 10 by 10 by 10 feet deep and 10 by 10 by 6 feet deep, separated by a 10-foot shallow ledge on which a 1-foot pink pegmatite dike is exposed. Only reddish-black garnet rock is present. No magnetite was found, nor is there any local attraction.

Two pits (No. 7) are located about 300 feet southwest of No. 6, and 200 feet south of the road. The main pit is 10 by 10 by 10 feet deep, joined by a 40-foot long shallow trench to a shallow pit 10 by 10 by 4 feet deep. The main pit exposes a massive garnet-epidote-calcite rock carrying minor coarse magnetite. The local compass attraction is 65 degrees.

Pit No. 8 is on the south side of the road, 1,000 feet northwest of No. 1 and ⅔ mile west of the Williams farm. It is 5 by 8 by 2–4 feet deep. It exposes

massive dark-red garnet rock with lesser amounts of epidote and calcite. No magnetite was found.

These eight workings lie within or close to the north end of a narrow anomaly shown on the Lount aeromagnetic map extending north from lot 19, concession I, to lot 127, concession A. The maximum relief in the anomaly that occurs in this lot is only 880 gammas. Such a low relief would indicate that no sizable bodies of magnetite are likely to be present.

CONCESSION A, LOT 129

In 1953 two old workings were seen in lot 129, concession A. (See Figure 4 in back pocket.) This lot is part of the land originally patented in 1931 to the Great Northern Iron and Smelting Company. The largest of these is situated in an old clearing with two collapsed log cabins in the southwest corner of the lot. It is about 500 feet by trail from the old Nipissing road. This pit is 23 by 8 by 8 feet deep, being at the time of the visit filled with 3 feet of water so that the walls were inaccessible. The author observed crystalline limestone on the west wall and, on the north wall, reddish-black garnet rock above crystalline limestone. Rock on the dump from the pit is garnet rock with lenses of salmon-pink calcite, minor quartz, and epidote. A few dikelets of hornblende syenite pegmatite with accessory titanite were noted. Rock exposed to the north of the pit is an amphibolite. No magnetite was observed, and there is no local attraction.

About 300 feet northeast of the above, and just south of a trail, there is a pit seen in 1941.[1] It is a 10- by 10-foot pit filled with water. Material on the dump consists of a dark-red, garnet-hornblende rock, cut by pink calcite stringers; a coarse hornblende pegmatite containing a few garnets, and masses of dark-green epidote. No magnetite was observed.

CONCESSION A, LOT 130

In the northwest corner of lot 130, concession A, an old pit, 130 feet east of the old Nipissing road, is 8 by 10 feet by 15 feet deep. (See Figure 4 in back pocket.) This lot is part of the land originally patented in 1931 to the Great Northern Iron and Smelting Company. In 1953, at the time of the author's visit, it was filled with 10 feet of water. There is no rock exposed except in the pit. The country rock on the dump is a hornblende-plagioclase gneiss or amphibolite. Also present is a massive, coarse, red garnet rock with a few calcite stringers. No magnetite was found.

CONCESSION A, LOT 132

Two pits expose garnet rock on lot 132, concession A. (See Figure 4 in back pocket.) On the east side of the old Nipissing road, about 1,800 feet southwest from the junction with the Wattenwyl road, a test pit 6 by 6 by 3 feet deep was filled with leaves and overgrown by trees in 1953. On the north and west sides of the pit massive, granular, deep-red garnet rock is exposed. On the east and south sides of the pit a massive, medium-grained, light-coloured hornblende-plagioclase rock with a few pinhead-sized red garnets is exposed. There is no rock exposed except in the pit. Crystalline limestone outcrops 250 feet to the southwest.

On the north side of the old Nipissing road, about 800 feet southwest of the junction with the Wattenwyl road, is a pit 9 by 4 by 2 feet deep. The pit is sunk in dark-red, granular, medium-to-coarse garnet rock containing a little coarse, grey

[1] J. Satterly, *Mineral Occurrences in Parry Sound District*, Ont. Dept. Mines, Vol. LI, 1942, pt. 2, p. 45.

calcite. The exposed east-west dimension of the garnet rock is 50 feet. Fifty feet east, hornblende gneiss cut by pegmatite is exposed on the south side of the road. To the southwest migmatite and hornblende gneiss cut by pegmatite stringers is exposed. The garnet rock is probably an isolated pod. No magnetite was found, and there is no local attraction.

CONCESSION A, LOT 133

On lot 133, concession A, the author found three old pits about 60 feet apart. (See Figure 4 in back pocket.) This lot is part of the land originally patented in 1931 to the Great Northern Iron and Smelting Company. The southwest pit is 250 feet east of the old Nipissing road from a point 600 feet north of the junction with the Wattenwyl road.

The southwest pit is 10 by 8 by 12 feet deep, the lower 4 feet being filled with water and muck. As rock is only exposed on the walls and not easily accessible, it was necessary to depend on the waste rock. Hornblende gneiss and a granular red garnet rock are found on the dump and, to a minor extent, crystalline limestone or calcite in stringers or lenses. Very little magnetite could be found.

The northeast pit, 60 feet northeast of the above, is 7 by 7 by 4 feet deep. It was filled with leaves. Only hornblende gneiss is exposed.

The southeast pit, 60 feet southeast of the southwest pit, is 6 by 6 by 5 feet deep. Hornblende gneiss is exposed.

No magnetic attraction was found at these pits; it is another isolated occurrence of garnet rock. A patch of massive garnet rock in hornblende amphibolite is exposed on this same lot at the Wattenwyl Road junction.

CONCESSION A, LOT 135

On lot 135, concession A, 500 feet east of the old Nipissing road, there is a small pit, 5 by 7 by 3 feet deep in flat-lying hornblende gneiss. (See Figure 4 in back pocket.) A small dump adjacent to the pit shows coarse massive magnetite in seams 1–3 inches thick. None was seen in place. There is no local attraction.

CONCESSION A, LOT 136

On lot 136, concession A, 1,000 feet south of T. R. Russell's house and 250 feet east of the old Nipissing road there is an old pit which was put down in 1902. (See Figure 4 in back pocket.) The pit is 8 by 12 by 2–4 feet deep. However, as the bottom is now filled with old boards and leaves, it was probably deeper at one time. On the walls of the pit a little disseminated magnetite is present as flat-lying stringers in a hornblende-plagioclase gneiss. A small dump on the east side of the pit consists of lump magnetite, which may have come from a seam 6–9 inches thick. This cannot be seen in the pit. There is very strong local attraction, 20–30 degrees, about 50 feet west and south of the pit; there is none to the north, and very little to the east.

In an early report[1] it is recorded that in May, 1902, the Ontario Bureau of Mines put down three diamond-drill holes, 29, 31, and 92 feet in length, on lot 136, concession B. T. R. Russell claims that this is an error and should read concession A. These holes intersected hornblende rock with occasional narrow quartz veins. Several narrow bands of magnetite were cut.

[1] *Statistics for 1902*, Ont. Bur. Mines, Vol. XII, 1903, p. 50.

CONCESSION B, LOT 124

On lot 124, concession B, at the north side of the We-Na-Nak road, and 2/5 mile west of the Nipissing road, a pit 10 by 30 feet exposes hornblende gneiss. No magnetite was found. Also on the north side of the same road and 3/4 mile from the Nipissing road, a shallow pit, 5 by 5 feet, exposes rusty-weathering garnet amphibolite with a little disseminated magnetite and pyrite. Small masses of deep-red garnet rock are present in the surrounding outcrop. This pit is just south of an old shaft sunk for copper. (See page 26.)

CONCESSION B, LOT 126

On lot 126, concession B, 125 feet west of the Nipissing road, at a point 1/4 mile north of an east-west road, a 40-foot trench exposes biotite or hornblende granite gneiss containing amphibolite bands cut by pegmatite. No magnetite was found.

CONCESSION B, LOT 129

The old workings on lot 129, concession B, are about 350 feet north of an old bush road, about 500 feet in from the old Nipissing road. The bush road runs westward from the Nipissing road about 9/10 mile north of the concession II–concession III boundary. (See Figure 4 in back pocket.)

The main pit is 6 by 6 by 5 feet deep, the bottom being filled with debris in 1953. On the south wall a 3½-foot, flat-lying band, containing 90 percent magnetite, is underlain by granite gneiss, which dips in and flattens from the east. The north wall exposes 3 feet of magnetite. Shallow cross-trenches, 10 and 25 feet north of this pit, do not expose any rock.

About 50 feet south of the main pit there is an exposure of hornblende granite gneiss with an area of magnetite-bearing rock 40 by 65 feet. The rock is composed of magnetite and scapolite with bands of solid magnetite up to 3 inches thick. The dip is mainly flat or nearly so. At the north edge of this outcrop there is a small pit, 4 by 4 feet by 1 foot deep, which exposes a foot of nearly pure (90 percent) magnetite. Rock exposed just north of this pit exposes an additional 2 feet of magnetite-scapolite rock (70 percent magnetite).

Exposures of the hornblende granite gneiss or migmatite around the magnetite showing and the flat dips within the magnetite-bearing zone would indicate that the body is quite a small flat lens. If the anomaly on the Lount aeromagnetic map indicates this occurrence, then it is offset to the southwest, the highest reading being about 500 feet southwest.

CONCESSION B, LOT 137

On the farm of T. R. Russell, lot 137, concession B, a diamond-drill hole was put down to a depth of 50 feet by the Ontario Bureau of Mines in 1902.[1] This hole is about 50 feet from the northwest end of the small lake on this lot. No magnetite was cut in the hole, only hornblende and mica schist being encountered. A highly-weathered biotite schist is exposed just south of the road and, nearer the lake, rusty-weathering amphibolite.

CONCESSION B, LOT 144

In 1941, the author was shown by J. W. Edwards an occurrence said to be in

[1] *Statistics for 1902*, Ont. Bur. Mines, Vol. XII, 1903, p. 50.

the east half of lot 144, concession B. This was not seen in 1953. The description that follows is taken from the writer's 1941 report.[1]

A pit . . . is reached by a trail running west from the Nipissing road. At 62 chains along this trail is a pit 11 by 13 feet and 5 feet to water. The material on the dump is mainly a garnet-magnetite rock [see analysis No. 6, table on page 30], and the country rock is a garnet-hornblende-feldspar rock. There is no rock exposed in place around the pit.

CONCESSION B, LOT 145

Not all the pits in this lot examined in 1941 with J. W. Edwards[2] were found in 1953.

One pit is on the south slope of a wooded outcrop hill about 200 feet north of an old beaver dam and 1,400 feet due west and 250 feet south of the junction of the old Nipissing and Rye roads. The pit is 9 by 20 feet, 10 feet deep at the north face, and 3 feet at the south. It exposes medium-grained, massive garnet-hornblende gneiss or garnet amphibolite and an irregular sill of white-to-pink, biotite-poor granite gneiss containing inclusions of biotite-hornblende gneiss. The dip is 30°–45°N. There is also a narrow irregular granite pegmatite dikelet. The only magnetite found was a few inches at the base of the pit on the north wall. On the dump from this pit there is coarsely disseminated magnetite some of which contains about 75 percent magnetite, but most of it would grade 25 percent or less. The lack of magnetite in the pit suggests only a very small pod of magnetite was present.

There is another pit about 200 feet north and 50 feet west of the above. It is 12 by 5 by 8 feet deep. The bottom is filled with debris, and it is surrounded and overgrown with trees. The pit exposes amphibolite, garnet-hornblende gneiss, and hornblende amphibolite. There is no magnetite exposed in the pit. On the small dump the rock contains medium-grained, disseminated magnetite and a minor amount of pyrite. The magnetite content may average 25 percent and occasionally reaches 50 percent.

The other occurrence noted in 1941[3] could not be found in 1953. It was described in 1941 as follows:

This showing consists of a pit 9 by 12 feet, partially filled with water, and stripping, a shallow trench on the strike of the pit, and a 23-foot cross-trench.

The rock in the trenches is a hornblende gneiss and a minor amount of disseminated magnetite. On the old dump, however, massive magnetite containing disseminated red garnet and some pyrite [see analysis No. 5, table on page 30] was found. Also on the dump was a rock made up of approximately equal amounts of hornblende, garnet, feldspar, and magnetite.

Limestone

The areas underlain by crystalline limestone are shown on the geological map. As noted previously (pages 14 and 15), most of the limestone is a tectonic breccia with numerous included fragments of hornblende gneiss, amphibolite, and pegmatite. The economic possibilities are therefore limited. In the days of the first settlers the limestone was quarried on lot 140, concession A, and burnt there for lime in a kiln. Lime from this kiln was used to build the original house on T. R. Russell's farm in 1880.[4] The remains of the old kiln may still be seen.

As the limestone disintegrates on weathering to a gravelly aggregate it is

[1] J. Satterly, *op. cit.*, p. 46.
[2] *Ibid.*, pp. 46, 47.
[3] *Ibid.*, p. 46. This pit is described in the 1941 report as being "18 chains by trail from the Nipissing road."
[4] T. R. Russell, personal communication.

frequently used locally to surface roads. Pits for this purpose were noted on the We-Na-Nak road, and on the Nipissing road just beyond the south boundary of the township.

Mica

Muscovite mica is the only mica of which any shipments have been made from the township, and these were apparently small. No large pegmatite dikes were found in the course of the field work. A little work was carried out in 1953 on an occurrence of biotite.

CONCESSION III, LOT 10

In 1914–16 Nicholas Hoffman worked a pegmatite dike in lot 10, concession III, for mica. George Hoffman, son of Nicholas, was unable to inform the author of the amount of mica shipped.

The pegmatite occurs in a narrow band of paragneiss bounded by migmatite. The pegmatite with mica on lot 3, concession V, is in a lens of paragneiss in migmatite.

A muscovite granite pegmatite has been explored by a trench, running N.30°E., and 100 feet long. The trench is 1–7 feet deep, the deep end being filled with 3 feet of water and debris. Material from the trench has been dumped on both sides covering dike contacts. The country rock is a fine-grained, banded, dark-to-light grey biotite paragneiss, striking N.30°E., and dipping 50°NW. The granite pegmatite is a sill about 5 feet thick. It appears to show a zoning with muscovite and a pink and white soda feldspar on the walls, and a salmon-pink potash feldspar in the middle. Glassy white quartz is present on the dump, but its position in the sill is obscure.

The muscovite books on the dump range from less than 1 inch to 3 inches across. A few highly squeezed books with diameters to 6 inches were found. There are no feldspar masses in the pegmatite larger than 1 foot across.

Records of the Department indicate that W. J. Hoffman shipped 25 pounds of mica valued at $2.00[1] in 1918.

CONCESSION V, LOT 3

A pegmatite dike on lot 3, concession V, just west of the road to Tough's sawmill on Deer Lake, was opened up originally for muscovite by J. Bell, and some additional work was performed by T. B. Tough in late 1941 for feldspar. The author examined the property on September 5, 1942. In 1953, the workings were largely covered with forest debris. The description that follows is based largely on the author's notes taken in 1942.

The work nearest the road consists of a stripping 200 feet long on a 20-foot wide pegmatite dike striking N.70°E., and dipping 60°S. At the east end of the stripping there is an open cut 20 by 35 by 4 feet deep. The country rock is a biotite paragneiss striking N.50°W., and dipping 50°W. The pegmatite is composed of muscovite books, glassy-grey quartz, and buff potash feldspar in masses 1–3 feet across. Much of the feldspar is cut by glassy-grey quartz stringers or is intergrown with quartz. It is doubtful that the feldspar would grade higher than No. 2. The mica books are small, mostly less than 2–3 inches in diameter.

About 60 feet west of the above stripping there is another stripping 200 feet long running S.45°W., which exposes irregular, narrow muscovite pegmatite dikes, 5–15 feet wide, cutting biotite paragneiss that strikes N.30°E. and dips 45°NW.

[1]Ont. Dept. Mines, files of the Statistician.

There are several small pits on these dikes. The feldspar is a white soda spar (oligoclase, An_{21}), veined brick-red. The largest masses are about 1 foot in diameter. Muscovite occurs in books up to 4 inches across. Allanite, in rod-shaped crystals, up to 3 inches in length, was noted in the pegmatite in a pit at the northeast end of this stripping.

T. B. Tough reports that Jack Bell shipped some mica from this showing, but the author has been unable to find any official record of this shipment.

CONCESSION B, LOT 137

In 1953, T. R. Russell put a few shallow test pits in to a very poorly exposed pegmatite dike containing biotite in lot 137, concession B, 650 feet north of the Fowke (Spring) Lake road in a hardwood forest.

The apparent width of the dike is 6 feet, it strikes north and dips vertically or nearly so. On the east wall the country rock is a silicified granite gneiss with inclusions of hornblende gneiss and crystalline limestone. A vertical edge on the west side of the exposure of pegmatite is assumed to be the west wall of the dike giving it a width of 6 feet. The dike does not show any segregation. It consists of masses of white glassy quartz up to 2 feet and pink potash feldspar up to 1 foot, but mostly less than 3 inches. Most of the spar carries some quartz, and would be No. 2 grade. Some soda spar and some biotite in books up to 3 inches across occur. The three test pits indicate an exposed length of 60 feet for the dike.

Molybdenum

CONCESSION II, LOT 18

A molybdenite occurrence in lot 18, concession II, was not as well exposed in 1953 as in 1941[1] since many of the pits were overgrown or covered with fallen trees. The occurrence is in a sandy field ½ mile south of the Williams farmhouse. It was explored in 1940 by seven pits scattered over a length of 250 feet. The only other exposure in the field is a patch of crystalline limestone and hornblende gneiss 125 feet north of these old workings. Amphibolite with garnet rock is exposed about 600 feet to the east in the woods bordering the field.

The pits expose a dark-green hornblende gneiss or amphibolite with bands and irregular masses of red garnet rock cut by a few stringers of granite pegmatite. Besides the massive garnet rock there are on the dumps minor amounts of a skarn composed of coarsely crystalline white calcite, red garnet, dark-green hornblende, pyroxene, and crystals of dark reddish-brown titanite. Only a few flakes of molybdenite were found in this skarn. Another skarn is a coarse aggregate of pyroxene rimmed with garnet, blue-grey scapolite, and small crystals of titanite.

The main pit is 10 by 15 by 4–5 feet deep, sunk in a shallower pit 37 feet in diameter. It exposes amphibolite containing irregular masses of red garnet rock of up to 10 by 20 feet in size. Molybdenite in small flakes or clusters of flakes is erratically distributed in the massive garnet rock, in schisted chloritized amphibolite, and more rarely, in the granite pegmatite stringers. Search in 1953 failed to discover any molybdenite in place in the other pits. There is no well-developed structure of any kind in the occurrence. No other occurrences of molybdenite were found in the other garnet rock exposures examined in the township. The occurrence is only of mineralogical interest.

[1] J. Satterly, *Mineral Occurrences in Parry Sound District*, Ont. Dept. Mines, Vol. LI, 1942, pt. 2, pp. 48, 49.

Rare-Element and Radioactive Minerals

Rare-element and radioactive minerals are of frequent occurrence in pegmatites in the Grenville subprovince. In Lount township a little allanite was found at an old mica and feldspar property, and a few other occurrences of allanite are recorded below.

CONCESSION A, LOT 126

On the dump beside an old pit in lot 126, concession A, sunk in exploration for magnetite, fragments of a hornblende syenite pegmatite were found. The pegmatite contains crystals of titanite up to ½ inch long and a radiocative mineral as grains or elongate crystals in feldspar surrounded by a ring of red colouration and showing "halo" cracks. The Provincial Assay Office identified this mineral as allanite.

CONCESSION V, LOT 5, AND CONCESSION VI, LOT 5

On lots 5, concessions V and VI, the country rock is a biotite-hornblende granite gneiss or migmatite. It is a light-coloured, medium-grained rock with the mafic minerals in streaks or lenticles, and the quartz and feldspars in lenses parallel to the gneissosity. The minerals present are oligoclase, microcline, quartz, biotite, and hornblende, with accessory apatite. A few scattered grains of a black rare-element mineral were noted at a number of places on these two lots. The mineral on each of these two lots was identified as allanite by the Provincial Assay Office. Grab samples of the gneiss containing allanite gave 0.002 percent and 0.005 percent U_3O_8 equivalent from lot 5, concession VI, and lot 5, concession V, respectively.

INDEX, PART 6

A PAGE

Access ... 3
Acknowledgments ... 2
Agriculture ... 6
Allanite ... 43
Amphibolite.
  Boudinage, photo ... 20
  Copper in ... 25, 26
  Granitization in ... 18
  Magnetite in ... 28–31
  Plutonic ... 15, 30
  Sedimentary ... 8–10
Analyses, magnetite ... 30
Anorthosite ... 16
Arkose ... 9
Augustine, L. M. ... 2

B

Banding ... 9
  In paragneiss, photos ... 11
Barnard, W. A. ... 3
Bartley, M. W. ... 4
Bedding.
  In amphibolite ... 9
    photo ... 11
  In quartzite ... 12
Bell, J. ... 41, 42
Biotite paragneiss ... 9, 10
  Banding in, photo ... 11
  Boudinage in, photo ... 23
  Drag-folded, photos ... 19, 21
  Granitization ... 17, 18
  Porphyroblasts in, photos ... 17, 21
Birds Eye Island.
  Rocks, notes and photos ... 17, 23, 24
Boudinage, notes and photo ... 23, 24
Boymar Gold Mines, Ltd. ... 26
Breccia, limestone ... 14, 15, 18
  Erosion in ... 6, 23
  Folding in ... 22
  Photos ... 4, 13, 14, 22
"Bummers Roost" ... 7

C

Commanda Creek, notes and photo ... 4–6
Copper ... 25, 26
Cramp Steel Co., Ltd. ... 27, 32, 34, 36
Crystal Island ... 13
Crystalline limestone ... 8, 14, 15
  Lime from ... 40
  Replaced by magnetite ... 30, 32, 33
  Sketch map ... 24
  See also Breccia, limestone.

D PAGE

Deer Lake ... 4, 6
Diabase dikes ... 5, 20
Drag-folding, photos ... 19, 21
Drainage ... 4–6
Drilling, plans of ... 35

E

Economic geology ... 25–43
Edwards, J. W. ... 32, 39, 40
Erosion ... 20
  Differential ... 6, 22, 23
    photo ... 13

F

Faulting ... 24
Feldspar ... 26, 41
Flowage, rock ... 14
Folding, notes and photos ... 19, 21–24
Forests ... 6
Formations, table of ... 8
Fowke, G. W. ... 32
Fowke Lake ... 3–5, 20
  Rocks ... 6, 9, 14, 16
    photos ... 13, 17, 23

G

Gabbro ... 15
  Scapolitized ... 33
  See also Metagabbro.
Garnet ... 27
Garnet amphibolite ... 26. 29
  In paragneiss, notes and photo ... 23, 24
  Intrusive origin ... 8
Garnet gneiss ... 10, 12
  Magnetite in ... 28, 30, 33, 34
  Photo ... 12
Garnet rock ... 36
  Copper in ... 25
  Magnetite in ... 28–31
  Molybdenite in ... 42
Geology, economic ... 25–43
Geology, general ... 7–21
Geology, structural ... 21–24
Glacial deposits ... 20, 21
Gneisses, hybrid ... 5, 17
Gneisses, sedimentary ... 8, 10
  See also Paragneiss.
Granitic rocks ... 16–20
Granitization ... 17, 18
Graphite ... 27
Gravel ... 27
Great Northern Iron and
    Smelting Co. ... 34, 36–38
Grenville rocks ... 7, 8

H

PAGE

Hammond Lake 5, 6
Hewitt, D. F. 2, 7, 14, 16
Historical notes 3, 7
Hoffman, N. 41
Hoffman, W. J. 41
Horizon markers 12, 21
Hornblende gneiss 15
  Copper in 25
  In limestone, photos 14, 22
  In paragneiss, photos 11, 21
  Magnetite in 30, 33
Hornblendite 16
Hybrid gneisses 5, 17

I

Iron 1, 27
  See also Magnetite.

L

Lake Algonquin, glacial 20
Lake of Many Islands 3, 4, 22
  Rocks 6, 20, 23
    photo 14
Limestone.
  See Crystalline limestone.

M

Maeck, C. 25
Maeck Lake 5
Magnetawan iron m. 32
Magnetite 2, 27
  Analyses 30
  Occurrences, reports on 31–40
    summarized 28–30
Maps, geological, coloured ..... *in pocket*
  Notes on 2
Maps, sketch.
  Drilling on McLean claims ..... *facing* 30
  Fault linears 24
May Lake 5
McLean, A. C. 26
  Iron claims, notes, plans, and sketch map 27, 30–35
McMarmac Red Lake Gold Mines, Ltd. 33
Metagabbro 8, 9
  Lithology 15, 16
Metasediments 8–15
Mica 41, 42
Migmatite 17–19
Moddle, D. A. 2
Molybdenite 42
Moore, R. G. 2

N

Natural resources 6
Nickel 25, 26
North Boundary Lake 5

P

Paragneiss 7–10
  See also Biotite paragneiss.
Pegmatite 15, 18, 26
  Allanite in 43
  Graphite in 27
  In paragneiss, notes and photo 11, 19, 20, 41

PAGE

Pegmatite—*Continued*
  Mica in 41
  Molybdenite in 43
Peridotite 16
Pickerel Lake. *See* Rye L.
Pickerel River 16
Pleistocene 20, 21
Plutonic rocks 8, 15–20
Porphyroblasts, notes and photos 12, 17, 18, 21, 23
Precambrian rocks 7–20
Pyrite 25, 26
Pyrrhotite 25, 26

Q

Quartz diabase 20
Quartzite 12

R

Radioactive minerals 43
Ragged Lake 5
Roads 3, 7
Russell, T. R. 2, 3, 7, 38
  Drilling on property 39
  Mica mining 42
Rye Lake 3, 5, 22
  Breccia, notes and photo 4, 6, 13, 14
  Drilling near, sketch map ..... *facing* 30
  Magnetite near 33

S

Sausage structure, notes and photo 23, 24
Scapolite 10, 15, 16, 33
Schmeler farm 25
Settlements, early 7
Shenango Furnace Co. 4
Skarn 15
  Copper in 25
  Magnetite in 28, 30
  Molybdenite in 42
Sohm farm 19
South Boundary Lake 3, 5, 6
South River 3
Spring Lake. *See* Fowke L.
Strickland Lake 5
Surveys.
  Geological 3
  Land 7
  Magnetic 1, 4, 27
Syenite pegmatite 20
  Allanite in 43
  Graphite in 27

T

Topography 4–6
Tough, T. B. 41, 42
Tough Lake 5, 6
  Drilling near, sketch map ..... *facing* 30
Tourists 6

V

Vanadium 31

W

Waterhouse, R. R. 2
We-Na-Nak Camp 2, 3, 6
Williams farm 36, 42

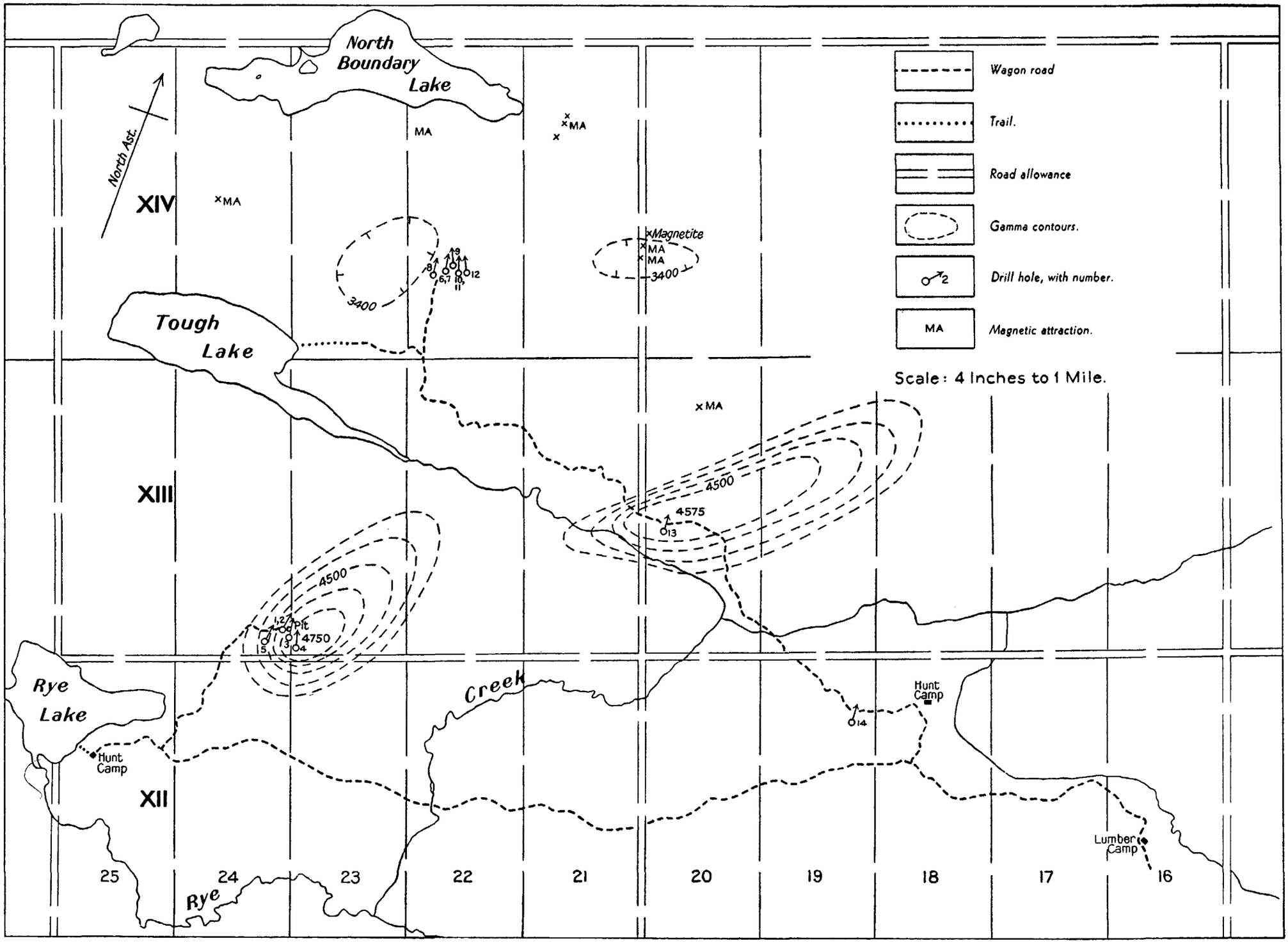


Figure 3—Sketch Map showing Location of Diamond-Drill Holes and Aeromagnetic Anomalies on Claims of A. C. McLean and Associates.





















Box #2



PROVINCE OF ONTARIO

DEPARTMENT OF MINES

HON. PHILIP T. KELLY, *Minister of Mines* H. C. RICKABY, *Deputy Minister*

M. E. HURST, *Provincial Geologist*

SIXTY-FOURTH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. LXIV, PART 7, 1955

Pleistocene Geology and Ground-Water Resources of the Township of North York, York County

By

A. K. WATT

PRINTED BY ORDER OF

THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO

Printed and Published by Baptist Johnston, Printer to the Queen's Most Excellent Majesty

1957

TABLE OF CONTENTS

Vol. LXIV, Part 7

	PAGE
Introduction	1
Scope of Report	2
Ground-Water Survey	2
Pleistocene Geology	3
Seismic Exploration	3
Acknowledgments	4
Literature	5
History of the Development and Utilization of Water for Municipal Purposes	6
Geography	7
Topography and Drainage	7
Climate	9
Population	10
General Geology	10
Bedrock	10
Overburden	11
General	11
Pleistocene Deposits	11
Illinoian Stage	12
Sangamon Interglacial Stage	13
The Toronto Formation	13
Wisconsin Glacial Stage	13
Till Deposits	13
Ground Moraine	13
Mechanical Analyses of Tills and Stratified Materials	15
Drumlins and Ridges	20
Direction of Ice Movement	22
Weathering	24
Patterns in the Till Surface	24
Glaciofluvial Deposits	25
Varved Clay and Silt	25
Stratified Sand and Gravel	25
Glaciolacustrine Deposits	25
Stratified Silt, Sand, and Gravel	25
Glacial Lakes	26
Lake Iroquois	26
Recent	26
Vertical Sections	27
Section A-A1	27
Section B-B1	27
Section C-C1	27
Section D-D1	28
Section E-E1	28
Section F-F1	28
Section G-G1	28
Section H-H1	28

	PAGE
General Geology—*Continued*	
Vertical Sections—*Continued*	
Section J-J1	29
Section K-K1	29
Section L-L1	29
Section M-M1	30
Section N-N1	30
Section O-O1	30
Section P-P1	31
Section Q-Q1	31
Former Drainage	31
Ground Water	32
Storage, Source, and Movement	32
Assembling Well Data	33
Occurrence of Ground Water in the Bedrock	33
Occurrence of Ground Water in the Overburden	33
Observation Wells	34
Observation Well No. 6	34
Observation Well No. 9	34
Observation Well No. 20	34
Observation Well No. 26	34
Quality	35
Chemical Analysis of Well Water	35
Residue on Evaporation	35
Calcium (Ca) and Magnesium (Mg)	36
Sodium (Na)	36
Sulphate (SO_4)	36
Chloride (Cl)	36
Silica (SiO_2)	36
Iron (Fe_2O_3) and Aluminium (Al_2O_3)	37
Alkalinity as $CaCO_3$	37
Hardness	37
Utilization	37
Domestic and Stock	37
Commercial and Industrial	38
Irrigation	38
Public Supply	38
Summary of Ground-Water Conditions	38
Appendix A—Water-Well Data for Wells Drilled in the Township of North York	41
Appendix B—Summary of Dug-Well Data, Township of North York	60
Index	63

ILLUSTRATIONS

	PAGE
Pumphouse on Sheppard Avenue West at Township Well No. 3	1
Ready to "shoot" during seismic survey operations on Steeles Avenue	3
Explosion of dynamite charge during seismic survey operations	4
Pit remaining after seismic "shot" in river valley	5
Till plain near Dufferin Street and Sheppard Avenue West	8
Dissected flanks of till uplands	9
Erratics from till in cut on highway No. 401	12
Pleistocene section on the Little Don River	14
Varved clay interbedded with till on Highway No. 400	15
Two Wisconsin tills on highway No. 400	21
Drumlin near Bathurst Street and Eglinton Avenue West	21
Glacial grooves or flutings in the till surface	22
Patterns in the till surface	23

MAPS, CHARTS, AND GRAPHS

FIGURE		PAGE
1	Key map showing the location of North York Township	2
2	Temperatures for Toronto, 1953	9
3	Precipitation for Toronto, 1953	10
4	Trilinear chart showing the results of mechanical analyses of till samples	20
5	Hydrographs of water levels in observation wells	*facing* 34

TABLES

	PAGE
I—Total Gallonage of Treated Water from North York Township Wells and Rivers	6
II—Classification of Geological Formations	11
III—Mechanical Analyses of Selected Samples of Till and Stratified Material	16
IV—Summary of Drilled-Well Data contained in Appendix A	*facing* 32
V—Chemical Analyses of Well Water, Township of North York	*facing* 32

COLOURED GEOLOGICAL MAPS AND SECTIONS
(In pocket at back of report)

Map No. 1955-6—Township of North York, County of York, Ontario, showing Pleistocene Geology. Scale, 1 inch to ½ mile.

Map No. 1955-7—Township of North York, County of York, Ontario, showing Water Wells and Bedrock Contours. Scale, 1 inch to ½ mile.

Vertical Sections showing the Pleistocene Stratigraphy in the Township of North York, County of York.

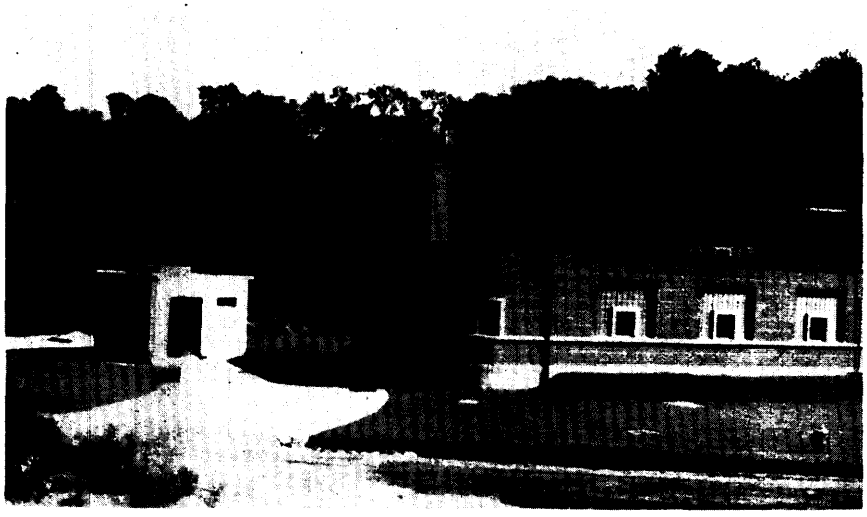
Pleistocene Geology and Ground-Water Resources of the Township of North York, York County

By A. K. Watt

INTRODUCTION

This is the first in a series of reports dealing with detailed ground-water investigations in townships where special ground-water problems exist. These reports supplement the hydrological data being assembled and published[1] from water-well drillers' records and observation-well measurements.

The township of North York lies directly north of the city of Toronto, in the county of York, and comprises about 70 square miles in the north-central part of the Metropolitan Toronto area. In 1922 it was incorporated as a municipality separate from the township of York.



Pump-house on Sheppard Avenue West, at township well No. 3 (No. 304 on map). The water is aerated, filtered, and softened in the water-treatment plant. The well site and pump are in the smaller building to the left.

In 1924 a waterworks system was installed. Water was obtained initially from the Little Don River,[2] and later from wells. However, it became necessary to purchase additional water from the adjoining municipalities to meet the expanding requirements of the township. From time to time test-drilling was

[1] A. K. Watt, *Ground Water in Ontario, 1947*, Ont. Dept. Mines, Vol. LX, 1951, pt. 11.
A. K. Watt, *Ground Water in Ontario, 1948, 1949, and 1950*, Ont. Dept. Mines, Bull. 145, 1953.
A. K. Watt, *Ground Water in Ontario, 1951 and 1952*, Ont. Dept. Mines, Bull. 152 (in preparation).

[2] Although the Don River and the Little Don River are better known locally as the West and East branches, respectively, of the Don River, this report follows the ruling of the Canadian Board on Geographic Names and uses the official names.

undertaken in search of new ground-water supplies, but results were not satisfactory. By the time Metropolitan Toronto took over the administration of the waterworks system it had been decided to abandon the search for additional wells and to consider Lake Ontario the ultimate source of supply.

The hydrological and geological data that have been assembled for North York are published in the hope that they will be of assistance to those who may have to utilize, or have knowledge of, ground water. The home owner who is not located near a municipal water main will be able to form some idea of ground-water conditions on his property from wells located nearby. Commercial and industrial firms planning to use ground water for cooling or other purposes will be interested in the quality of the water and places where the supply is likely to be abundant. If it is decided at a future date to hunt for additional ground-water supplies for municipal purposes, the information assembled in this publication could lead to considerable financial saving by indicating the approximate positions of the buried bedrock valleys, which contain the greatest reservoirs of ground water.

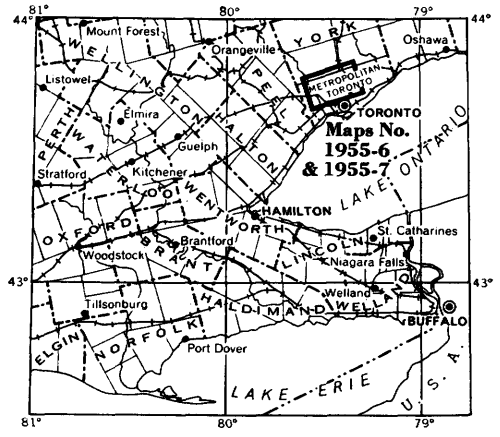


Figure 1 — Key map showing the location of North York township, county of York. Scale, 1 inch to 50 miles.

Scope of Report

GROUND-WATER SURVEY

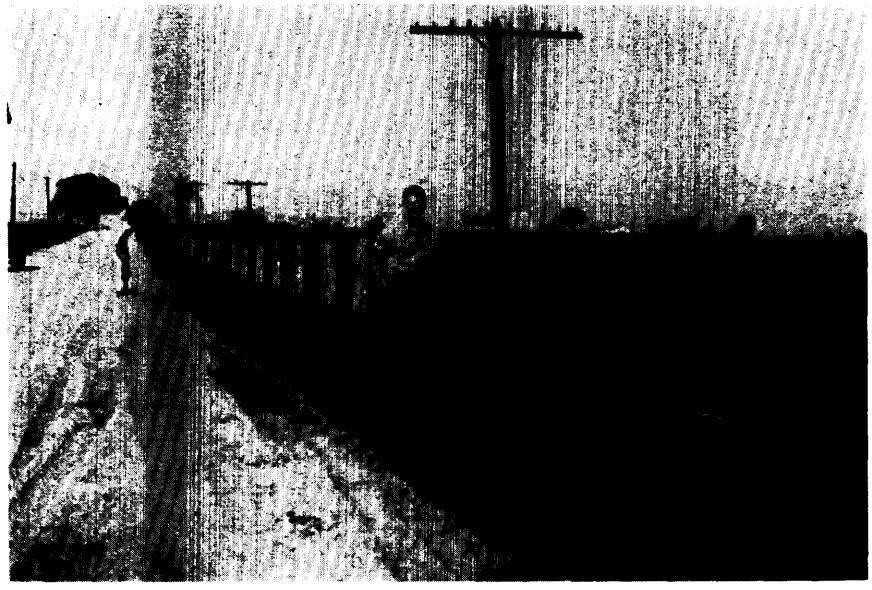
A detailed survey of the ground-water resources was commenced in North York during the summer of 1947. Occasional investigations have been made between then and 1953, mostly in connection with the examination of building and highway excavations, which yielded important information on the Pleistocene geology of the area.

Although a great deal of hydrological information was compiled in 1947, much of it was of a very general nature because the owners or tenants knew very little about their wells. Since 1947 more reliable well data have been added to the survey. These include logs of test holes that were drilled in search of additional municipal, ground-water supplies and information on private wells drilled since 1947. Records of these have been filed with the Ontario Department of Mines as required by legislation enacted in 1946. The test-hole data and the records filed with the Department supply most of the dependable data on ground-water conditions and depths to bedrock in the township.

The ground or surface elevations of the bedrock wells were levelled in by instrument and should not have a margin of error of more than a foot. Elevations of most of the remaining wells were obtained by means of a surveying aneroid and should be accurate, in most cases, to within five feet.

PLEISTOCENE GEOLOGY

A knowledge of the Pleistocene geology of the area was obtained by examining natural and man-made exposures in the area. Most of the roadside cuts and river sections were examined with pick and shovel to determine the sequence of tills and stratified deposits existing in the township. Foundation excavations for buildings rarely penetrated the upper till sheet, but excellent exposures were revealed in some of the main highway cuts and in most river sections. A hand auger was



Ready to "shoot" during the seismic survey. Wooden ties, used to prevent too much scattering of soil during the explosion, were later discarded. The plunger, used to set off the 5-pound dynamite charge is at the edge of the road in front of the figure in the background. The recording truck containing the instruments for registering the shock waves that pass through the overburden is on the same side of the road about 400 feet beyond the plunger.

employed to test depths of sand and silt in certain areas where exposures were lacking.

SEISMIC EXPLORATION

In 1947 also, a test was made of the refraction method of seismic exploration to ascertain whether or not it could be used satisfactorily to determine the thickness of overburden in the area. Another purpose of the survey was to see if an apparatus that could be handled by two men in areas not accessible by car could be devised for this type of geophysical work. This investigation was under the direction of J. H. Hodgson, and the author aided with advice on overburden and bedrock conditions.

The seismic results were only partially successful. There were two principal reasons for this. First, the shot-holes were bored manually with an auger to depths ranging from 5 to 10 feet. It was not too difficult to do this in the early part of the summer when the soil was still moist and fairly easy to bore. By August and

September, however, the augering process was slowed up considerably. A depth of 8 feet for the charge placement produced less satisfactory results than when deeper shot-holes were used. The manually prepared hole was, therefore, superseded in late summer by a powered drilling machine that drilled shot-holes 20 feet deep. The use of the drilling machine thus defeated one of the original purposes of the project.

In the second place, the thickness of overburden along Steeles Avenue East, where the seismic work was carried out, ranged from 100 to 400 feet. Many variations existed in the nature and thickness of the formations that made up this overburden. Some of the physical properties of the underlying shale bedrock were



At the moment of explosion on Steeles Avenue during seismic survey operations.

similar to those of the tough till and silt layers above it. Because of this, it was very difficult to use an average transmission velocity that could be relied upon. Many of the calculated depths to shale were corroborated satisfactorily from nearby drill-hole data. Sufficient error occurred in some of the other calculations, however, to warrant a greater refinement of method before it could be used with confidence in all parts of the township.

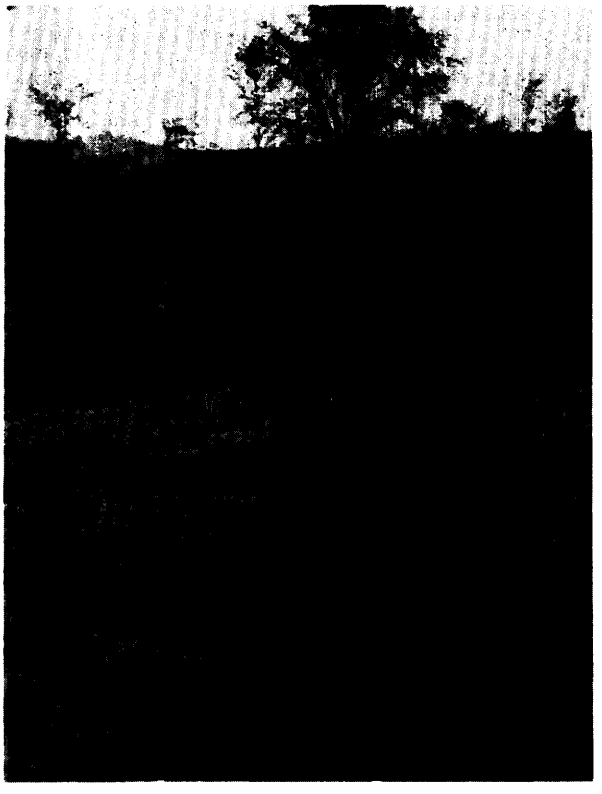
Acknowledgments

The township of North York shared the expense of the seismic survey investigations with the Ontario Department of Mines. The township engineer, G. H. Baker, the deputy engineer, E. L. Sanderson, and members of their staff, particularly I. A. Robertson and G. Shuter, co-operated willingly with the author by supplying engineering and waterworks data.

The author wishes to acknowledge the co-operation of the residents of the township who supplied information on their wells and the well drillers and drilling firms, chiefly International Water Supply, Limited, who supplied well-log data.

An expression of appreciation is due the following assistants who aided in the collection of ground-water data and in the mapping of the Pleistocene geology: S. A. Forman, E. P. Henderson, and W. A. Hiles in 1947; J. Cody and D. G. Colclough in 1952; and J. B. McClellan in 1953 and 1954.

Thanks are extended to the Provincial Assayer, D. A. Moddle, and his staff for the considerable amount of work involved in making the mechanical analyses of the soil samples and the chemical analyses of the water samples.



A pit in the river valley near the site of township well No. 4 (No. 396 on map) after an explosion during seismic investigation of the overburden.

Literature

Numerous reports are available dealing with the geology and, to a lesser extent, the ground water of the Toronto region, including the map area. The report by J. F. Caley is the only one dealing entirely with bedrock formations, and it contains an extensive bibliography of earlier reports on the Toronto and central Ontario region.

One or two of the publications dealing with the Pleistocene geology refer to features within the map area, or adjacent to it, but most describe the regional

picture, which is important in understanding the local behaviour of a continental glacier.

A selected list of publications follows:

J. F. CALEY, *Palaeozoic Geology of the Toronto-Hamilton Area, Ontario*, Geol. Surv. Can., Mem 224, 1940.
J. F. CALEY, T. H. CLARK, and E. B. OWEN, *Ground-Water Resources of Markham Township, York County, Ontario*, Geol. Surv. Can., Water Supply Paper No. 284.
L. J. CHAPMAN and D. F. PUTNAM, *The Physiography of Southern Ontario*, Ont. Research Foundation, 1951.
L. J. CHAPMAN and D. F. PUTNAM, *The Recession of the Wisconsin Glacier in Southern Ontario*, Trans. Royal Soc. Can., Third Series, Vol. XLIII, Sec. IV, 1949.
A. P. COLEMAN, *The Pleistocene of the Toronto Region*, Ont. Dept. Mines, Vol. XLI, 1932, pt. 7.
A. P. COLEMAN, *Lake Iroquois*, Ont. Dept. Mines, Vol. XLV, 1936, pt. 7.
H. N. HAINSTOCK, E. B. OWEN, and J. F. CALEY, *Ground-Water Resources of Vaughan Township, York County, Ontario*, Geol. Surv. Can., Water Supply Paper No. 287, 1940.
H. N. HAINSTOCK, E. B. OWEN, and J. F. CALEY, *Ground-Water Resources of Scarborough Township, York County, Ontario*, Geol. Surv. Can., Water Supply Paper No. 290, 1940.
F. B. TAYLOR, *The Moraine Systems of Southwestern Ontario*, Trans. Can. Inst., Vol. X, Univ. Toronto Press, 1913.
F. B. TAYLOR, *Moraines North of Toronto*, Ont. Dept. Mines, Appendix to Vol. XLI, 1932, pt. 7.

Some of the hydrological data contained in the ground-water reports by the author are repeated in the present report because they apply specifically to the North York area.

History of the Development and Utilization of Water for Municipal Purposes

The township of North York was incorporated on July 19, 1922, as a municipality separate from the township of York. Water was obtained from individual

TABLE I—TOTAL GALLONAGE OF TREATED WATER FROM NORTH YORK TOWNSHIP WELLS AND RIVERS

Year	Daily average pumpage of water treated at Oriole pumping station	Total annual pumpage of water at Oriole pumping station	Total annual pumpage of water from plants at Oriole, Sheppard Avenue West, and, Steeles Avenue East
	M gallons	M gallons	M gallons
1930	293	107,000	107,000
1931	348	127,000	127,000
1932	323	119,000	119,000
1933	400	148,000	148,000
1934	455	166,000	166,000
1935	392	143,000	143,000
1936	552	202,000	202,000
1937	480	176,000	176,000
1938	576	215,000	215,000
1939	644	236,000	236,000
1940	641	235,000	235,000
1941	719	262,000	262,000
1942	656	240,000	240,000
1943	676	247,000	247,000
1944	739	271,000	271,000
1945	826	301,000	301,000
1946	922	337,000	337,000
1947	1,053	384,000	384,000
1948	873	319,000	460,000
1949	1,324	483,000	674,000
1950	1,387	507,000	724,000
1951	1,474	538,000	728,000
1952	2,073	757,000	1,090,000
1953	1,791	654,000	1,105,000

wells or springs except in a few areas close to the city, which were on the Toronto waterworks system.

A waterworks plant located at Oriole on Sheppard Avenue East by the Little Don River was started in 1923 and completed in 1924. Water was obtained from the Little Don River. Treatment involved coagulation, filtration, and chlorination. In 1936 the first municipal well (No. 392 on map No. 1955-7, in back pocket) was developed on Leslie Street near Steeles Avenue East. Two softening units were installed, and treatment included softening of part of the water and aeration of the balance. A second well (No. 394), on Leslie Street north of Steeles Avenue East, was added in 1943.

By 1948 it was necessary to build a second pump-house on Sheppard Avenue West on the Don River, where a third well (No. 304) was developed. Two softening units were installed at this pump-house, and in the following year, 1949, three more softening units were added to the system, two at Oriole and one at the No. 2 pump-house on Sheppard Avenue West.

In 1950 complete aeration and filtration of township water was available. A fourth well (No. 396), drilled in Markham township, north of the second municipal well, was added to the system in 1952, with a separate treatment plant complete with aeration and filtration. The locations of the municipal wells are shown on map No. 1955-7 (back pocket).

Almost from the beginning, there was insufficient water available from the waterworks system to meet township requirements. From 1924 on, water was purchased from the town of Weston in increasing amounts each year, reaching a maximum of about 34,000,000 gallons in 1950. Since then the amount purchased has been reduced to almost nothing in 1954. Water was purchased also from York township, commencing in 1946, and from Scarborough township in 1953. Table I shows the gallonage of water treated at the Oriole pump-house from 1930 to 1953 and the total amount of water treated from all township sources, which includes the amount from the Sheppard Avenue West pump-house set up in 1948 and the Steeles Avenue East plant in 1952. The gallonage of water treated at Oriole includes river water, which made up the entire amount prior to 1936, and which has been used intermittently up to the present to augment the well supply.

GEOGRAPHY

Topography and Drainage

The surface of the township is a mostly flat to gently ridged and drumlinized till plain. The till has been modified by glaciolacustrine water in the final melting stages of the ice, resulting in a more level land surface than is usual in a till plain. However, in the areas where ridges, drumlins, and drumlin-like hills occur, variations in relief up to more than 50 feet are found. The ridges and drumlins run southeast-northwest revealing that the direction of final, glacial movement was locally northwestward from the basin now occupied by Lake Ontario.

Some of the ridges have the appearance of long, irregular drumlins, which are more or less oval hills shaped by the glacier, and these ridges might be termed "drumlinoid" features. Others have no closure of contour to justify the term drumlin but indicate the moulding effect of glacier ice on gradually rising ground. Several drumlins are present in the area, however, and the more typical of these are shown on the geological map (map No. 1955-6 in back pocket).

The township is dissected by three main rivers and their tributaries. The Little Don and Don rivers enter the township in the northeast and north-central parts of the area as relatively clear, shallow streams with occasional rapids and deep pools. The two rivers unite south of the township near its east boundary where the water is quite turbid with suspended silt and clay particles. Here the valleys reach a depth of 150 feet and are still youthful. Rapids usually occur where



A till plain near Dufferin Street and Sheppard Avenue West modified by glacial waters during their deposition to leave a more level ground surface than is usual in a till plain.

the streams are eroding till beds, and the pools are deeper and more frequent. Both the Don rivers flow in valleys cut entirely in the overburden with no bedrock exposures.

The Humber River forms the west boundary of the township as far south as the Town of Weston where the river has eroded a gorge in the underlying shales and limestones. Its valley occupies part of a lowland, broader than those in which the Don River system flows. The lowland is the result of a combination of geological processes that are not directly related to the present river watershed. Preglacial and interglacial drainage patterns and glacial and interglacial deposits combined to leave broad depressions in the land surface after the ice melted. Depressions of this nature are now occupied by the valleys of the three main rivers in the township.

Terraces exist on the valley walls, which indicates the rivers approached grade level at various times before finally eroding their channels to their present depth. Field studies indicate that the terraces are related to the levels of the glacial lakes that followed the melting of the Wisconsin glacier, and which occupied successively shallower basins until the present Lake Ontario was formed.

A well-pronounced shore line of glacial Lake Iroquois occurs in the vicinity of the valley re-entrants in the eastern and western parts of the township. Below this shore line stratified sands, silts, and clays form flat-lying areas except where cut by stream erosion. Other water lines, associated with the higher river terraces, are easily identified in certain areas.

Elevations above sea level on the flood plains of the Don River system range from 475 feet at the north boundary of the township to 300 feet at the south. On the Humber River there is a drop in elevation from about 440 feet at Steeles Avenue West to 375 feet at Weston. On the upland areas between the river valleys the land rises gradually from 425 feet in the vicinity of the Iroquois beach line to over 650 feet in the northern part of the area.



View of small drainage channels down the flanks of the upland east of Keele Street at Sheppard Avenue West. The dissection ends near the far side of the field in the foreground, which was covered by glacial water when the drainage channels were made.

Climate

The climate of North York is typical of the south-central areas of the Province that border Lake Ontario.

The average annual temperature at Toronto, based on a 70-year period is 45.9°F.[1] During 1953 the average temperature was 50.0°F.

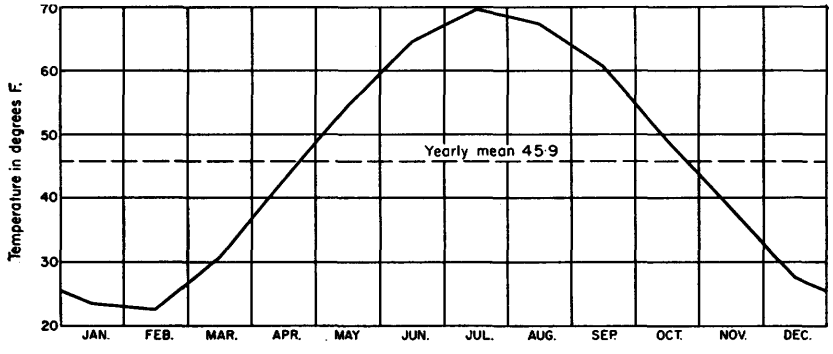


Figure 2 — Temperatures for Toronto, 1953. Information from the Annual Meteorological Summary, Toronto, Meteorological Division, Canadian Department of Transport.

[1] *Annual Meteorological Summary, Toronto, Ontario, 1953*, Can. Dept Transport, Meteorological Division.

The average monthly precipitation at Toronto remains remarkably uniform, between 2 and 3 inches. During a period of 105 years, the total annual precipitation averaged 32.05 inches. In 1953 the total precipitation was 27.25 or almost 5 inches below average.

Figures 2 and 3 show graphically the average temperature and precipitation for Toronto and the monthly minimum and maximum precipitation.

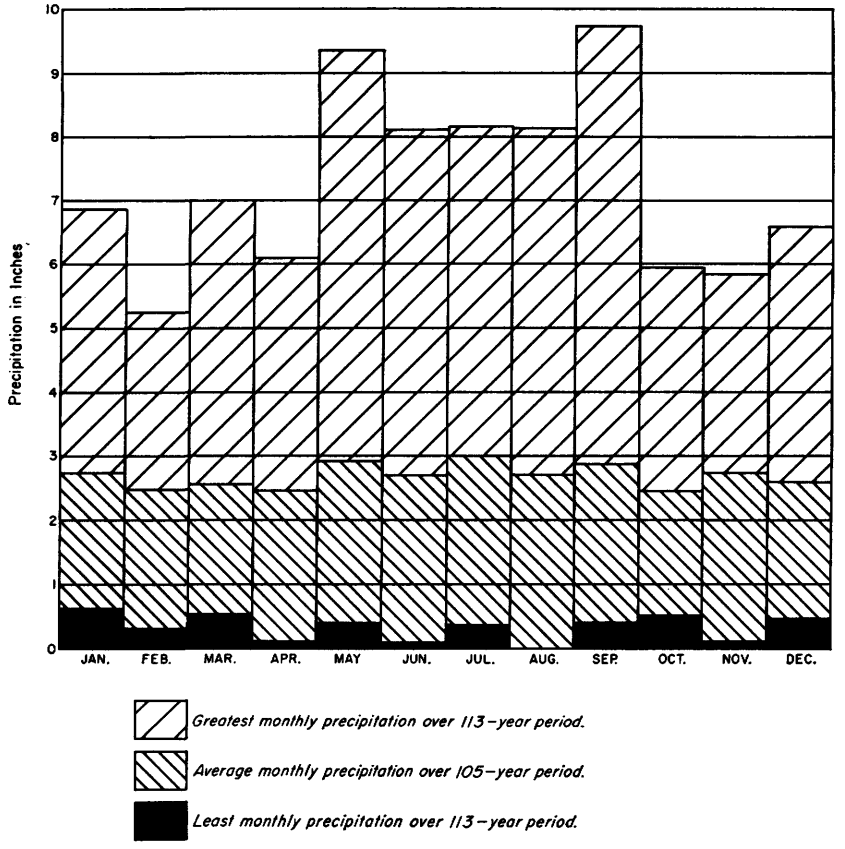


Figure 3 — Precipitation for Toronto, 1953. Information from the Annual Meteorological Summary, Meteorological Division, Canadian Department of Transport.

Population

In 1923, the first year after its incorporation, North York had a population of 6,303. The population increased steadily; by 1945 it had reached 26,432, an increase of approximately 20,000 in 23 years. By the end of 1953 the population had increased to 110,311, an increase of 84,000 in 8 years.

GENERAL GEOLOGY

Bedrock

Interbedded shale and limestone of the Dundas formation are exposed in the valley of the Humber River at Weston and farther upstream. Elsewhere in the township it is overlain by drift. The limestone and sandy limestone layers are

often discontinuous in length. They vary in thickness from one or two inches to more than a foot. Numerous fossils are present, particularly in the limestone layers. The formation is described, with a listing of the fossils, by Caley.[1]

The Dundas formation has a maximum thickness of several hundred feet. There is a regional dip to the southwest of about 25 feet to the mile. The formation is thinnest, therefore, in the eastern and northeastern parts of the township where possibly only 50 or 75 feet of the lowest part of the Dundas formation remains above the older shales of Collingwood and Gloucester age. Formations referred to in this report are classified in Table II.

TABLE II—CLASSIFICATION OF GEOLOGICAL FORMATIONS

Sequence	System	Series	Stage or Formation
Cenozoic	Quaternary	Recent	
		Pleistocene	Wisconsin Glacial Sangamon Interglacial Illinoian Glacial
Unconformity			
Paleozoic	Ordovician	Upper Ordovician	Dundas Collingwood and Gloucester

Overburden

GENERAL

Most of the overburden is composed of Pleistocene or glacial deposits, which were laid down under great thicknesses of ice or in the glacial rivers and lakes associated with them. The ice masses were continental glaciers having their beginnings in northern parts of Ontario, Quebec, or Labrador.

At least two separate times in the past million years a continental glacier has moved over southern Ontario. Coleman[2] indicates that there were three stages of glaciation and two interglacial stages in the Toronto region. Four stages of glaciation are recognized in parts of United States and Europe. In the township of North York and adjacent areas the author has found evidence of only two glaciations and one interglacial stage.

PLEISTOCENE DEPOSITS

The deposits from a continental glacier may be classified into two groups:

1. Those deposited by the ice itself, forming a till that is mainly unsorted by water action.
2. Those formed by meltwaters associated with the glacier, resulting in various types of stratified deposits.

Till, sometimes called boulder clay, is usually a mixture of clay, silt, sand, gravel, and stones of all sizes. It may be composed mostly, however, of any one of these materials. For example, a glacier that had advanced over an extensive

[1] J. F. Caley, *Palaeozoic Geology of the Toronto-Hamilton Area, Ontario*, Geol. Surv. Can., Mem. 224, 1940, pp. 15–18.

[2] A. P. Coleman, *The Pleistocene of the Toronto Region (Including the Toronto Interglacial Formation)*, Ont. Dept. Mines, Vol. XLI, 1932, pt. 7, p. 2.

sand plain would subsequently deposit a till that would be very sandy. At least four till sheets were recognized in the township. The lowest one was deposited during the Illinoian age, and the upper three during the latest, or Wisconsin age. The characteristics of each are described in more detail below.

The stratified materials, clay, silt, sand, and gravel of glacial origin, were deposited above, in front of, or beneath the ice masses when they were melting. Outwash sand and gravel deposited in meltwater streams flowing off the glacier are referred to as glaciofluvial deposits.

Stratified clays, silts, and sands which are formed in glacial lakes ponded between the glacier and higher land, are called glaciolacustrine deposits. These deposits often show varving, which means that there is a repetition of pairs of layers within the deposit. The sediment in a pair of layers may be composed of fine and coarse clay, clay and silt, or clay and sand. The separation of the fine and coarse parts in a varve is generally considered to be an annual phenomenon resulting from changes in temperature affecting the rate of melting of the glacier. Varved deposits in some places cover only a small area. Thick varved clays, containing numerous ice-rafted stones and blobs of till, which indicate the glacier



Boulders removed from a cut on highway No. 401 between Bayview Avenue and Leslie Street.

was not far away at the time the sediments were formed, are present in the township.

Because extensive glaciolacustrine deposits would be likely to precede and follow any major ice invasion of the area, their presence is helpful in determining boundaries between till sheets.

The Pleistocene deposits of the township are shown on map No. 1955-6 (back pocket).

Illinoian Stage

The lowest till sheet is exposed immediately above the bedrock that outcrops along the Humber River north of Weston. It is probably Illinoian till but is not differentiated from the younger Wisconsin till on map No. 1955-6. It appears as a stony, grey-blue till. In some spots it has weathered to a greenish colour or is composed mostly of greenish, weathered shale. It seldom exceeds two feet in thickness and is overlain by a buff-to-pinkish, tough, silty till, which is considered to be the lowest Wisconsin till in the area.

The Illinoian till contains numerous shale fragments and limestone slabs from the underlying Dundas formation, and pebbles and stones of the Precambrian rocks are also plentiful.

Sangamon Interglacial Stage

Following the melting away of the Illinoian glacier, a warm-climate period, as warm or warmer than that existing in the Toronto area today, lasted for thousands of years. Our knowledge of the climatic conditions is derived from a study of the fauna and flora contained in stratified beds laid down during part of this period. The beds constitute what is called the Toronto formation, which outcrops within the map area on both parts of the Don River system.

The Toronto Formation

The Toronto formation is subdivided into Don beds and Scarborough beds. Coleman[1] named the interglacial formation and its subdivisions; but he placed them in the Yarmouth Interglacial stage thereby implying that another interglacial stage existed between the time the Toronto beds were laid down and the present.

The lower Don beds do not outcrop in the township but are probably present, in places, below the Scarborough beds. The Scarborough beds are composed chiefly of stratified clays and silts with some fine-sand layers overlain by fine-to-medium, grey and brown sands. The beds are fossiliferous, containing peaty material, particularly in the lower clay and silt layers, with woody and fine shell remains occurring, in places, in the upper sandy part. A comprehensive list of the flora and fauna contained in the Toronto formation has been prepared by Coleman.[2]

Evidence of weathering, resulting in the development of soil, which would normally take place on the land surface during interglacial time, has not been observed in the township. The Wisconsin glacier has removed much, if not all, of the weathered Illinoian surface, but it is probable that exposures will be seen in the future that will reveal the remains of soil developed on the old land surface during this interglacial age.

Wisconsin Glacial Stage

Till Deposits

Ground Moraine.—Most of the surface of the township is ground moraine except for the areas dissected by the rivers and their tributaries. The uppermost material of the ground moraine is till. In many parts of the area, however, the till is overlain by, or interbedded with, a thin veneer of varved clays that were deposited during the final ablation of the ice in the waters ponded between the glacier and higher land to the north. Often the stratified nature of the veneer is difficult to recognize because so many ice-rafted stones, which give the clay mass a till-like appearance, are present. It is most easily discerned after a fresh vertical section has been made and allowed to partially dry for a day or two, at which time the varves are usually apparent.

On the coloured geological map (No. 1955-6, in back pocket) the veneer of stratified deposits over the till has not been shown as a separate map unit, partly because of the irregular occurrence of the clays, and partly because it is often interbedded with the till and cannot be readily separated from it for mapping.

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[1] A. P. Coleman, *op. cit.*, p. 2.
[2] *Ibid.*

Two, and possibly three, till sheets of Wisconsin age persist throughout the area separated by various thicknesses of stratified clays, silts, or sands. Occasionally, concentrations of boulders, called boulder pavements, mark the separation. In general, the lower Wisconsin till overlying the Toronto Inter-

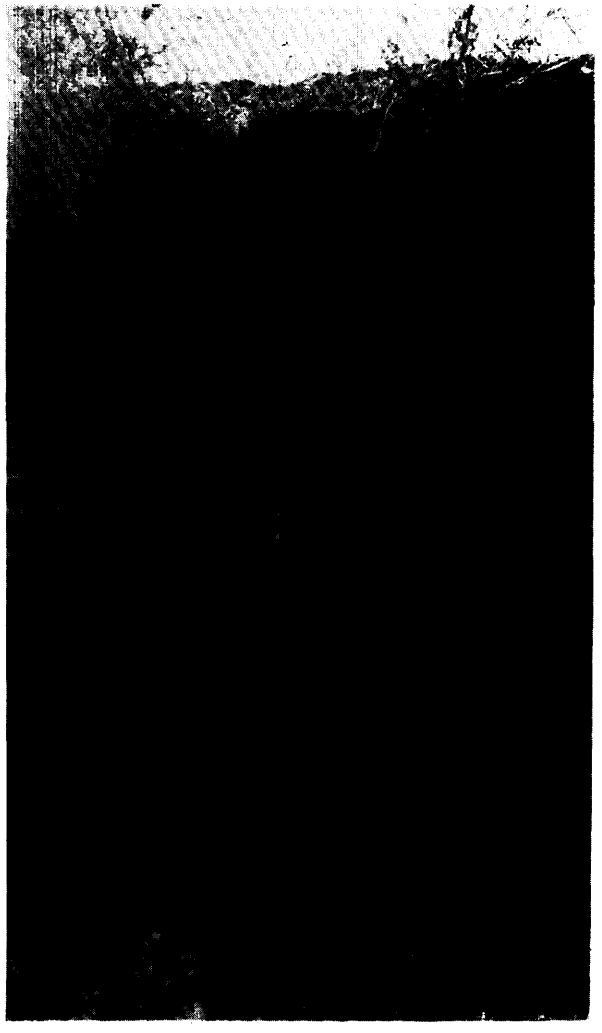


One of the many excellent Pleistocene sections on the Little Don River. This section is on the east side of the river, north of Lawrence Avenue East. The base of the section is made up of interglacial Scarborough clays. The stones are erosional remnants from the till formations making up most of the upper part of the section.

glacial beds is medium-grey, dense, calcareous, silty clay till, which dries to a light-grey, almost white, colour; the middle Wisconsin till is buff-to-grey, friable, calcareous, sandy till, and the upper till is a buff-to-brown, silty or sandy till. Variations in colour and lithology occur within a till sheet even at the same exposure. It is therefore difficult to recognize with certainty which Wisconsin till is present in an exposure if part of the complete section is lacking. Certain

characteristics of colour, weathering, and composition seem to recur with such regularity throughout the area, however, that the author believes a till sheet can often be identified on the basis of these observations.

Mechanical Analyses of Tills and Stratified Materials.—Mechanical analyses



Varved clays interbedded with till on the west side of highway No. 400, south of Steeles Avenue West. The base of the section is hard stony till.

were made of a great many till samples to determine whether or not the tills could be separated readily on the basis of the size of their constituent particles. Table III gives the results for a number of samples, some of which were selected to fit in with the vertical sections described below. It is doubtful whether much reliance can be placed on this method of distinguishing tills. Some interesting deductions seem apparent, however, although the number of samples taken was

TABLE III—MECHANICAL ANALYSES OF SELECTED SAMPLES OF TILL AND STRATIFIED MATERIAL

1. TILL

Sample No.	Reference, field notes	Description of material	Stratigraphic position	Location of sample	Percentage			
					Clay	Silt	Sand	Gravel
1	47-5-51-1	Massive, grey water-laid till	Upper Wisconsin	Humber River, 400 ft. N. of iron bridge on Weston-Thistletown road; E. bank; 12 ft. below top of 45-ft. exposure.	87	10	2	1
2	47-4-56-3	Brown, silty clay till	Upper Wisconsin	E. side of highway No. 400, 1,300 ft. S. of Sheppard Ave. W.; 6 ft. below top of 15-ft. exposure.	24	40	33	3
3	47-5-39-1	Grey, silty clay till	Upper Wisconsin	S. bank of Black Creek, 700 ft. S. of Lawrence Ave. W.; 2,900 ft. E. of Jane St.; 7 ft. below stratified silts and sands.	34	33	26	7
4	47-5-47-4	Yellow-brown, silty till	Upper Wisconsin	Sheppard Ave. W., 3,700 ft. W. of Keele St.; 800 ft. W. of Black Creek; 6 ft. below top of hill. (D-D1.)	28	40	24	8
5	47-5-30-1	Buff-yellow, silty till	Upper Wisconsin	Dufferin St., 1,000 ft. S. of Finch Ave. W.; base of 9-ft. exposure on W. side; stratified silts below. (G-G1.)	30	66	2	2
6	47-6-61-1	Grey, sandy till	Upper Wisconsin	Don River, 1,800 ft. W. of Bathurst St.	28	27	34	11
7	47-3-1-2	Brown, silty clay till	Upper Wisconsin	Don River, 1,800 ft. S. of Sheppard Ave. W.; E. bank; 8 ft. below top of 110-ft. exposure. (H-H1.)	25	38	30	7
8	47-3-1-1	Grey, silty clay till	Upper Wisconsin	Same exposure as above; 22 ft. below top. (H-H1.)	42	26	24	8
9	47-3-2-1	Grey, sandy till	Upper Wisconsin	Same exposure as above; 26 ft. below top; thin sand layer below. (H-H1.)	23	26	38	13
10	47-2-46-1	Brown, sandy till	Upper Wisconsin	Hogg's Hollow exposure, Don River; 400 ft. S. of Avenue Rd. bridge; 5 ft. below top of 110-ft. face. (H-H1.)	26	32	34	8
11	47-2-46-2	Grey, silty till	Upper Wisconsin	Same exposure as above; 12 ft. lower in section H-H1.	29	33	31	7

12	48–6–27–1	Brown, silty till	Upper Wisconsin	Tributary of Don River, 1,200 ft. N. of Eglinton Ave. E.; 1,000 ft. W. of C.N.R. tracks; 5 ft. below top of 75-ft. exposure. (K-K1.)	34	55	11	0
13	47–4–56–2	Grey, silty till	Middle Wisconsin	E. side of highway No. 400, 1,300 ft. S. of Sheppard Ave. W.; 8 ft. below top of 15-ft. exposure.	28	38	32	2
14	47–3–2–2	Dense grey, sandy till	Middle Wisconsin	Same exposure as sample No. 7 above; 36 ft. below top of section H-H1.	22	34	36	8
15	47–3–3–1	Brownish grey, sandy till	Middle Wisconsin(?)	Same exposure as sample No. 7 above; 50 ft. below top of section H-H1.	21	20	43	16
16	47–3–3–2	Grey, silty clay till	Middle Wisconsin	Same exposure as sample No. 7 above; 58 ft. below top of section H-H1.	56	27	15	2
17	47–2–46–3	Grey, silty till	Middle Wisconsin	Same exposure as sample No. 10 above; 29 ft. below top of 110-ft. exposure. (H-H1.)	26	36	31	7
18	47–2–46–4	Grey, sandy till	Middle Wisconsin	Same exposure as sample No. 10 above; 37 ft. below top of section H-H1.	21	30	40	9
19	47–3–3–3	Brownish grey, silty clay till	Lower Wisconsin	Same exposure as sample No. 7 above; 60 ft. below top; 10 ft. above thick, sandy beds. (H-H1.)	62	31	6	1
20	47–2–17–1	Grey, silty clay till	Lower Wisconsin	Little Don River, 75 ft. N. of Steeles Ave. E. at River level. (L-L1.)	44	46	8	2
21	48–6–1–1	Grey till	Lower Wisconsin	Don River, 1,300 ft. S. of bridge on Sunnybrook Hospital grounds; 50 ft. above river level. (K-K1.)	37	30	28	5
22	48–6–26–1	Dark-grey, silty clay till	Lower Wisconsin	In tributary of Don River, 2,700 ft. S. of Lawrence Ave. E.; 300 ft. E. of Leslie St. road allowance; 20-ft. exposure, 12 ft. above water level. (K-K1.)	46	37	17	0
23	47–1–49–2	Grey, sandy till	Lower Wisconsin	Don Valley brickyards, Toronto; directly overlying Toronto interglacial beds.	14	28	55	3
24	47–1–48–1	Blue-grey, sandy till	Illinoian	Don Valley brickyards, Toronto; directly overlying Dundas formation, SE. corner of pit.	29	19	22	30

TABLE III—MECHANICAL ANALYSES OF SELECTED SAMPLES OF TILL AND STRATIFIED MATERIAL—*Continued*

2. STRATIFIED CLAY AND SILT

Sample No.	Reference, field notes	Description of material	Stratigraphic position	Location of sample	Percentage			
					Clay	Silt	Sand	Gravel
25	47-5-57-1	Stratified clay and silt	Post-final Wisconsin advance; glacio-fluvial deposit	Finch Ave. W., 1,800 ft. W. of Main St.; 450 ft. W. of small creek; 4-ft. exposure. (B-B1.)	68	22	10	0
26	47-5-4-1	Varved clay and silt	Post-final Wisconsin advance; glacio-fluvial deposit	Wadsworth St., 550 ft. S. of Wilson Ave.; 6-ft. exposure, 3 ft. from top. (C-C1.)	72	26	2	0
27	47-5-47-1	Varved clay and silt	Wisconsin Interstage	Sheppard Ave. W., 250 ft. W. of Black Creek; 20 ft. above creek level. (D-D1.)	80	12	8	0
28	47-5-47-2	Varved clay and silt	Wisconsin Interstage	Same exposure as sample No. 27 above; 40 ft. above creek level. (D-D1.)	29	69	2	0
29	47-6-17-1	Scarborough beds	Sangamon Inter-glacial	Don River, 200 ft. N. of Eglinton Ave. E. (extended); W. bank; 35 ft. above water level, 5 ft. below top of formation. (K-K1.)	36	62	2	0
30	47-1-49-1	Scarborough beds	Sangamon Inter-glacial	Don Valley brickyards, Toronto; 3 ft. above Don beds, E. side of pit.	56	44	0	0

TABLE III—MECHANICAL ANALYSES OF SELECTED SAMPLES OF TILL AND STRATIFIED MATERIAL—*Continued*

3. STRATIFIED SILT, SAND, AND GRAVEL

Sample No.	Reference, field notes	Description of material	Stratigraphic position	Location of sample	Percentage				
					Very fine sand and silt	Fine sand	Medium sand	Coarse sand	Gravel
31	885–6	Deltaic sand	Post-final Wisconsin advance; glacio-fluvial deposit	Woodbridge Rd., 600 ft. N. of Finch Ave. W.; 9 ft. of sand, W. side of road. (B-B1.)	74	26	0	0	0
32	885–4	Fine sand	Wisconsin Interstage	Finch Ave. W., 1,500 ft. W. of Main St.; 6 ft. above stream level. (B-B1.)	74	25	1	0	0
33	885–1	Fine, cross-bedded sand	Wisconsin Interstage	Sheppard Ave. W., E. valley wall of Black Creek; 10 ft. above base of 30-ft. exposure. (D-D1.)	82	18	0	0	0
34	885–2	Fine, massive sand	Wisconsin Interstage	Same exposure as sample No. 33 above; 10 ft. higher in section D-D1.	96	3	1	0	0
35	885–7	Fine, cross-bedded sand	Wisconsin Interstage	Dufferin St., 1,400 ft. S. of Finch Ave. W.; 8 ft. above bed of small stream. (G-G1.)	8	54	34	4	0
36	885–10	Medium, yellow sand	Wisconsin Interstage	Steeles Ave. E., 600 ft. E. of Leslie St.; road level. (L-L1.)	5	38	47	8	2
37	885–13	Yellow-brown sand	Wisconsin Interstage	Bayview Ave. excavation of Can. Nat. Inst. for the Blind building; 10 ft. below land surface. (K-K1.)	43	55	2	0	0
38	885–11	Medium, yellow sand	Wisconsin Interstage	Lawrence Ave. E., between C.N.R. tracks and Little Don River; 30 ft. below top of 80-ft. exposure. (O-O1.)	17	48	20	13	2
39	885–9	Fine, yellow-brown sand	Glacial, pre-lower Wisconsin till	Same exposure as sample No. 10 above; 30 ft. above river level. (H-H1.)	22	47	20	7	4
40	885–8	Fine, cross-bedded sand	Sangamon Interglacial(?)	Same exposure as sample No. 10 above; 6 ft. above river level. (H-H1.)	83	17	0	0	0

small considering the wide variation possible within a till sheet at one exposure. A trilinear chart (Figure 4) shows the groupings of the tills according to their percentages of sand, silt, and clay.

The upper Wisconsin till is generally high in sand and low in clay; the middle Wisconsin till is even higher in sand with less silt content; and the lower Wisconsin till is high in clay and silt. The one Illinoian till sample shows a slightly higher clay content than the upper and middle Wisconsin tills and also a higher coarse fraction.

The stratified beds from which samples were taken are of glacial and inter-

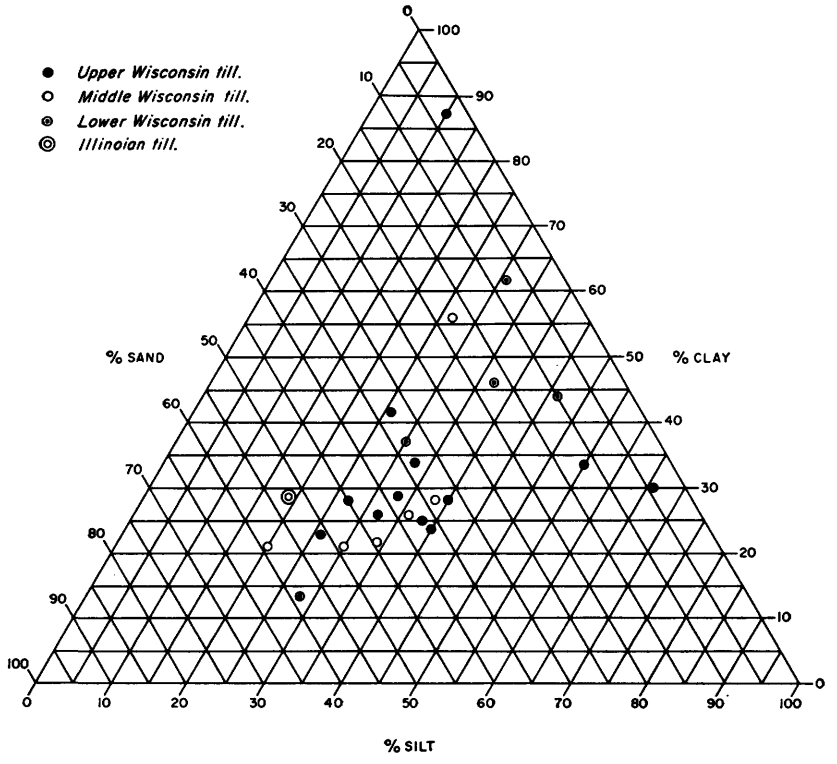


Figure 4 — Trilinear chart showing the results of mechanical analyses of till samples. The position of each sample on the chart is dependent on the percentages of clay, sand, and silt in it.

glacial origin. They will be described in detail below under Glaciofluvial Deposits and Glaciolacustrine Deposits. The locations from which most of the samples were taken are shown on the sheet of vertical sections in the pocket at the back of this report.

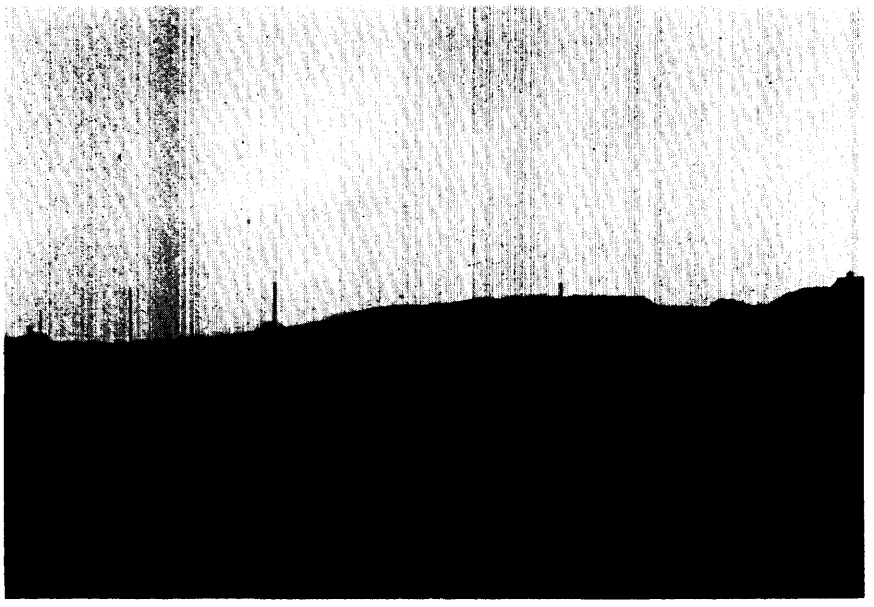
Drumlins and Ridges.—Closely associated with the ground-moraine areas are the drumlins and drumlin-like hills and ridges. The geological map (No. 1955-6, in back pocket) shows the positions of only the more regular, smooth-flanked hills of the typical, oval-shaped drumlins. The drumlins rise to a height of 20–50 feet above the surrounding land surface. They are aligned with their long axes in a northwest-southeast direction, indicating the moulding and scoring action of the Wisconsin glacier as it moved over the region out of what is now the Lake Ontario basin.



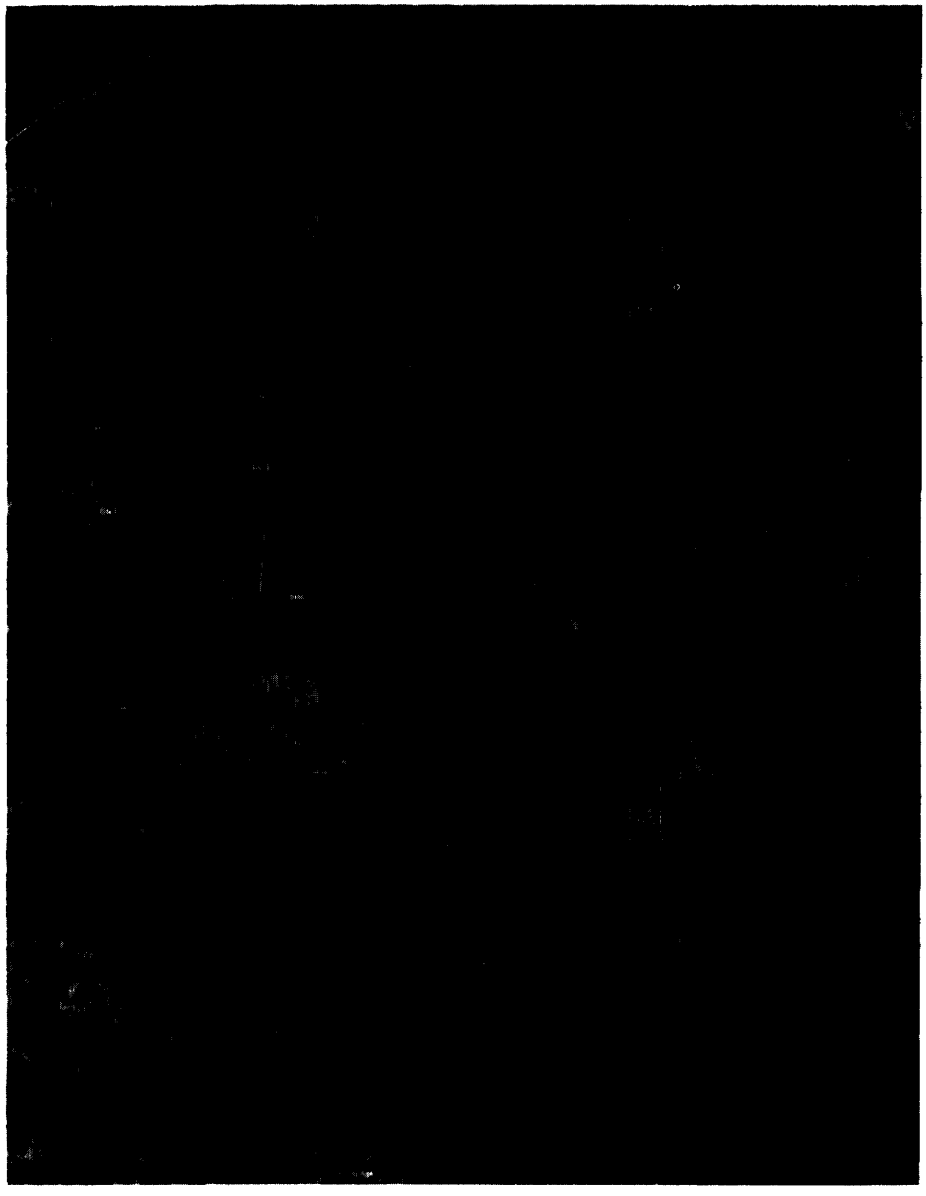
Two Wisconsin tills on highway No. 400, south of Sheppard Avenue West. The author is standing on top of the lower, silty till, which has an abrupt contact with the overlying, more sandy till containing numerous, irregular sandy lenses.

Gentle grooves or flutings, separating long ridges of land, trend in the same direction. Some of the ridges merge gradually with the gently rising land surface and, therefore, cannot correctly be termed drumlins.

Many elongated hills, too irregular in form to be classed as drumlins but



A drumlin near Bathurst Street and Eglinton Avenue West slightly modified by glacial waters. Sand and gravel have been removed intermittently from an interstage horizon under the till capping.

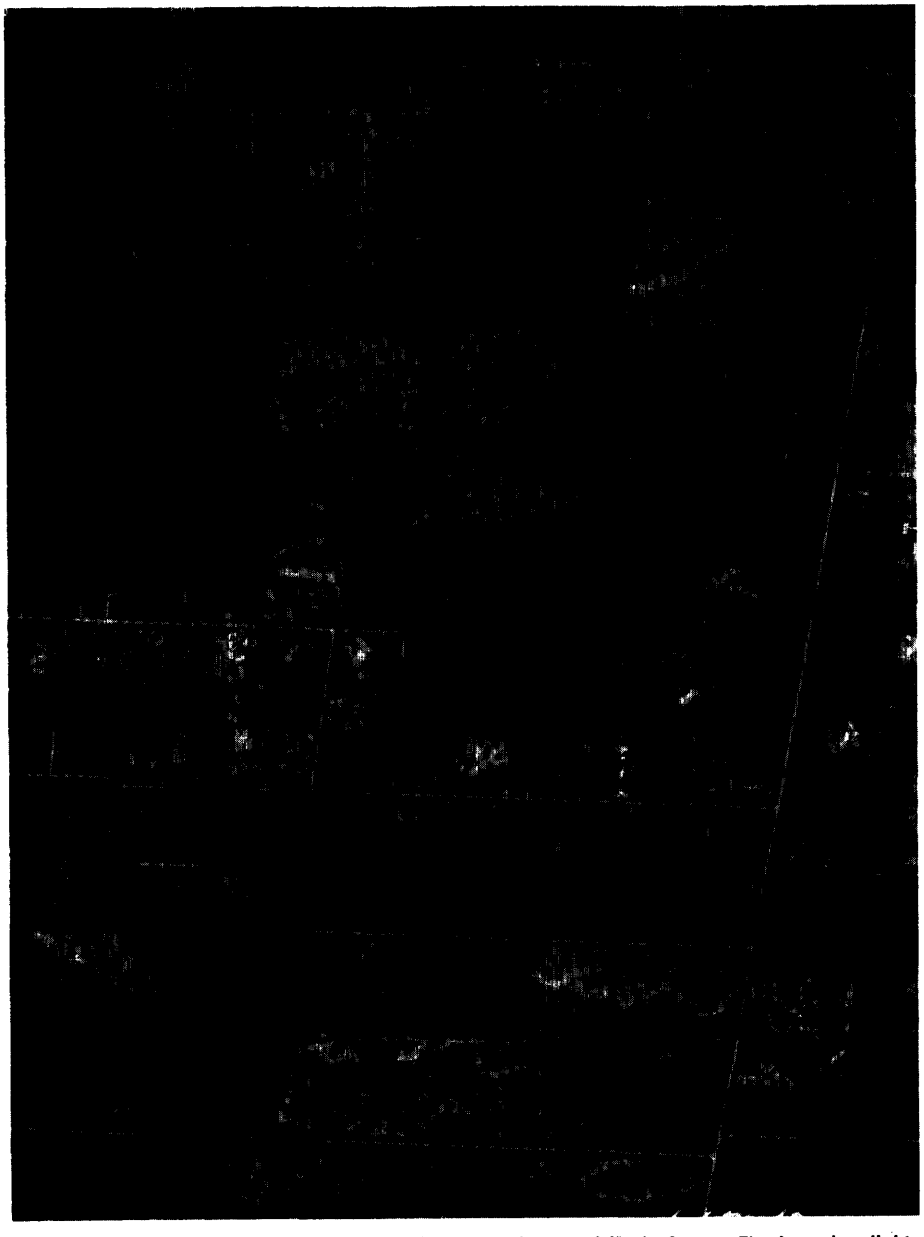


Glacial grooves or flutings trending northwestward in the till surface in the vicinity of Victoria Park Avenue and Lawrence Avenue East. They indicate the direction of the final glacial flow over the area.

exhibiting the same alignment and effects of ice shaping, are present in the township, particularly in the northeastern part. Some of these have been somewhat dissected by post-glacial river and lake waters, and therefore, their present appearance can best be described as "drumlinoid."

The upper material on all these forms is till, ranging in thickness from 4 to more than 30 feet.

Direction of Ice Movement.—From the northwest-southeast alignment of the drumlins and glacial groovings in the till surface it is clear that the Wisconsin



Patterns in the till surface south of Wilson Avenue and west of Keele Street. The irregular, light-coloured markings are the tops of ridges standing 3-10 feet above the rest of the ground surface. They result, probably, from the sloughing action of till material off stagnant lobes of ice under quiet, ponded-water conditions.

glacier moved over the township in a northwest direction out of the basin now occupied by Lake Ontario. It is quite apparent that no advance of continental ice covered the township area from any other direction after the formation of these features.

During the maximum thrust of the Wisconsin glacier, when the ice was much thicker, variations in local topography would have less effect on the flow of the ice

mass, and the direction of flow of the main glacier would predominate. Thus the striae on boulder pavements and boulders within the drift would be a more reliable indicator of the direction of flow of the glacier during its maximum thrust than the drumlins and flutings, which were formed under ice-lobe conditions during its ablation. Striae on boulder pavements, in and close to the map area, indicate that the directions from which the ice came at various times during the Wisconsin glaciation was N.16°E., N.70°E., E., and S.50°E.

Weathering.—The grey or blue-grey colour of the fresh till in the map area has been altered near the surface to a yellow or reddish-brown colour by oxidation. The oxidized zone usually extends to a depth of 10–12 feet below the surface of the ground, but occasionally is very much deeper.

Included in the weathering of the surface deposits is the leaching process whereby carbonates are removed from the soil by water action. Leaching has not penetrated as deeply as oxidation, and in most tills it has not gone lower than 2½–3 feet below the surface.

It is interesting to observe the effect of ground water on fresh till and stratified materials that are buried beneath the surface. The ground water, which percolates through lenses of sand and gravel, oxidizes the fresh till or stratified clay and silt above and below the sand lens. The presence of a brown till or clay below fresh material is usually an indication that a sandy layer, along which ground water is moving, is near. The fresh materials may be oxidized on both sides of such water-bearing zones in widths ranging from 1–2 inches to several feet.

Patterns in the Till Surface.—Deane[1] has described glacial features associated with the ground moraine in the Barrie-Orillia area, which he termed ice-block ridges. Somewhat similar forms are present throughout most of the township where there has been no modification of the original till surface by river or lake waters. The forms seem to be most pronounced in and along the flanks of broad, low valleys adjoining the till uplands. They are present to a lesser degree on the ground-moraine areas of the uplands but appear to be partially or completely masked by the veneer of clays described above, which was associated with the glacial lakes present in the area following the melting of the glacier. The patterns may be seen in the accompanying photograph. They have a variation in relief, usually from 3 to 10 feet. The white markings that show up on the photograph are the high parts of the ridges.

The reticulate shape of the till patterns and the fact that they seem more pronounced in and along the flanks of the valley areas would indicate that they were formed as a result of material, predominantly till, sloughing off a shrinking lobe of stagnant ice. The irregular folding of the material could conceivably take place during the ablation period when, with drift present on top of the ice, it became crowded into less and less space in the depression occupied by the lobe under water-saturation conditions. The linear arrangement of the series of folds may have been caused by some pattern of ice cracks or ridges developed on the surface of the stagnant ice mass. The explanation suggested here for the origin of the till patterns differs from the last of several suggestions given by Deane[2] in that isolated blocks of ice are not necessary for the phenomenon, but that such a pattern may result from the melting of drift-laden, glacier ice through a sloughing-off process in relatively quiet ponded water.

[1]R. E. Deane, *Pleistocene Geology of the Lake Simcoe District, Ontario*, Geol. Surv. Can., Mem. 256, 1940.
[2]*Ibid.*

Glaciofluvial Deposits

Varved Clay and Silt.—During periods of de-glaciation, when parts of the map area were free of ice, varved clay and silt were deposited in glacial lakes in front of the ice margin. The varved sediments were carried into the ponded waters by streams flowing from the ice-free areas to the north and by meltwater streams from the glacier itself to the south and east. Because the ice front was not stationary but flowed forward or melted back according to climatic changes, some of the varved-clay deposits were interlayered with till and represented only minor fluctuations in the ice-front position. Other varved-clay beds were associated with deposits of silt and sand, which were sufficiently thick and extensive to indicate a break in the Wisconsin glaciation of substage importance. Some of the varved sediments will be referred to later when descriptions of the vertical sections are given.

Following the final "retreat" of the Wisconsin glacier, deltaic deposits of varved clay and silt were built up into a succession of glacial lakes surrounding the ice lobe. When the level of the glacial lakes lowered, these deposits were left to occupy areas of what is now dry land. The clay and silt beds range in thickness from a few feet to more than 20 feet. They have been dissected in places by some of the existing rivers.

Varved-clay and silt deposits occur between Jane and Main streets in the area north of Weston and in the valley of the Little Don River.

Stratified Sand and Gravel.—Interbedded with the tills and varved sediments in the area are sand and gravel layers of various thicknesses. The size of the particles often varies greatly within the same exposure. This fact and the presence of interlayered till or blobs of till in the gravels suggest that the sediments were laid down in streams flowing at or close to the ice front. The thicknesses of the sand and gravel layers range from 1 to more than 20 feet.

Deposits of sand and minor amounts of gravel occur above the varved clays in the valleys of the Humber and Little Don rivers. These are deltaic in origin and indicate the approximate water levels of the glacial lakes that persisted for a sufficient length of time to allow the rivers to build up as much as 20 feet of sand in their estuaries.

The deposits are located north of Thistletown in concessions VI and VII, west of Yonge Street; between Mount Dennis and Weston; concession IV, west of Yonge Street; and in the vicinity of Oriole Station, concession III, east of Yonge Street.

Glaciolacustrine Deposits

Stratified Silt, Sand, and Gravel.—Interbedded with the tills and glaciofluvial stratified materials there are often found beds of silt, fine sand, and an occasional gravel layer, which indicate a lake rather than a river origin. The grain size is usually uniform and shows fine cross-bedding. These beds have a thickness of 25–30 feet in several places, suggesting uniform and widespread deposition such as might occur in the glacial waters that built up following the Sangamon Interglacial period and the various substages of Wisconsin glaciation. In a few places interstage sediments are present at the ground surface or are covered with postglacial sediments because the till capping had been removed by stream and lake erosion.

Glaciolacustrine sands and gravels occur above the till below the Lake Iroquois bluff in the southeast part of the township. They range in thickness from a few feet to more than 20 feet.

Glacial Lakes

The presence of shore cliffs and beach and lake deposits, occurring on what is now dry land high above the Lake Ontario water level, points to the succession of glacial lakes that existed throughout the area following the final melting of the Wisconsin glacier.

Some shore features are faint whereas others are well pronounced. The highest glacial lake level with extensive recognizable features existed at about 525 feet above sea level. River terraces on the Little Don River are correlated with this elevation and the glaciofluvial material described above; and tilly material interlayered with varved clay occurs in the valley below this elevation. Glaciofluvial clay, silt, and sand occur up to this elevation in the Humber Valley area. Concentrations of erratics occur in various places at this level. One of these is in the vicinity of Strathgowan Crescent, midway between Eglinton Avenue East and Lawrence Avenue East, on the township boundary, where the upper till has been entirely removed in places by water action.

At 465–75 feet above sea level, a moderately pronounced shore line has been cut in till in the eastern part of the Sunnybrook Hospital grounds. At this level also, a noticeable change in slope is observed on the sides of the broad depressions occupied by the Don and Humber rivers. Boulder-strewn terraces are present at this level in some of the rivers and their tributaries, notably the stream that flows into the Don River at Sunnybrook Hospital. A veneer of glaciofluvial sands and silts occurs at about this elevation in some parts of the east branch Little Don River.

Lake Iroquois.—The most pronounced shore line is that of glacial Lake Iroquois, which was named by Spencer[1] in 1889 and described in detail by Coleman.[2] The bluffs and beach deposits associated with this lake indicate that it existed for a very long time, perhaps hundreds of years. Coleman[3] described the lake as having a shore line as mature as that of Lake Ontario, which we know has existed for thousands of years. Within the map area, however, the shore line is somewhat modified, partly because it has been protected from the full erosive force of waves and currents by its position in embayments behind bars and spits that are south of the township.

The elevation of the Lake Iroquois shore line in the Weston area is 421 feet above sea level; between Don Mills Road and Victoria Park Avenue it is 433 feet above sea level, a difference of 12 feet in 9 miles. This is because the land throughout Ontario had been compressed by the glacier and rose differentially as the ice mass melted away.

Lake Iroquois sands and gravels are present in thicknesses up to 20 feet in the southeastern and southwestern parts of the township.

Only the shore line belonging to Lake Iroquois is shown on map No. 1955-6.

RECENT

In all the present river systems throughout the township silt, sand, and gravel, intermixed with various amounts of plant and animal remains, have been deposited on the valley floors. These deposits seldom exceed 10 feet in thickness and represent the remains of material eroded by the streams from the adjoining land areas; the rest of the material has been moved farther downstream or out into Lake Ontario. These recent deposits are periodically re-worked by flood-waters, which tend to level off the valley floors adjacent to the stream channels.

[1] J. W. W. Spencer, *The Iroquois Beach; a Chapter in the Geological History of Lake Ontario*, Proceedings and Trans. Royal Soc. Can., 1889, pp. 121–34; Amer. Jour. Science, Vol. XL, 1890, p. 446.

[2] A. P. Coleman, *Lake Iroquois*, Ont. Dept. Mines, Vol. XLV, 1936, pt. 7.

[3] A. P. Coleman, *The Last Million Years*, University of Toronto Press, 1941, p. 201.

Vertical Sections

River dissection has revealed outstanding exposures of Pleistocene stratigraphy in several parts of the township. Some of the stratified beds may have economic importance. In order to show the locations and thicknesses of formations constituting the upper part of the overburden, a series of vertical sections has been prepared. (See back pocket.) Map No. 1955-6 shows the locations of the sections, which are natural or man-made exposures, principally along or near the indicated lines of section. The surface profiles have been taken from topographic sheets issued by the Canadian Department of National Defence with occasional minor controls obtained by the author in the field or from the township engineer's office.

The circled numbers on the sections show the stratigraphic positions of samples of tills or stratified material that have been obtained from near that line of section. Mechanical analyses of these samples appear in Table III. (See page 16.)

SECTION A-A1

The line of section A-A1 runs eastward along Steeles Avenue West from the Humber River towards Main Street. The lower silty till is overlain by stratified clay and silt, which were probably the first sediments deposited in the glacial lake with shore-line features at about 525 feet above sea level. Overlying the stratified clay there is 10 feet of interbedded silt and fine sand, which changes gradually into sand, with some gravel, towards the top of the section.

SECTION B-B1

The line of section B-B1 runs eastward along Finch Avenue West from the Humber River to beyond Emery. The lower till in the small creek valley in the eastern part of the section is probably middle Wisconsin in age. It separates very-fine-to-fine sand, below, from coarser sands, above. Stratified silt overlies the coarse sand, and it changes to clay higher in the section. The clay merges into a material that contains many stones and has a till-like appearance in a weathered exposure, but it is definitely stratified in most of the upper part of the section. There are zones through it that are more till than modified till, and for that reason, a till zone is shown in the section. Such a deposit is common throughout the broad depression areas occupied at present by the Humber and Don rivers systems, and up which ice lobes of the Wisconsin glacier fluctuated in ponded water during the final re-advance.

SECTION C-C1

The line of section C-C1 runs northeastward from the Humber River at the north limits of the town of Weston, crossing Wilson Avenue near highway No. 400. The top of the Dundas formation is 20 feet above the river level at the Humber River, but near Wadsworth Street it begins to drop rapidly, revealing the presence of a buried valley to the east. The buff-to-pinkish silty till that overlies the bedrock is shown as Illinoian. It is only 2–3 feet thick in places and merges with a gravelly, stony till, which is probably Wisconsin. It is likely that the Illinoian drift is entirely lacking in places, particularly where the drift is shallow in the western part of the map area. A little farther upstream from the west end of this section, a boulder pavement was observed that separated the lower, gravelly Wisconsin till from an upper, light-grey, silty clay till. The lower part of the section shown near the Canadian Pacific railway tracks was partly compiled from well-log data.

SECTION D-D1

The line of section D-D1 runs from Jane Street eastward, crossing Sheppard Avenue West, to Keele Street. The presence of a valley in the bedrock was indicated by one test hole drilled near Black Creek. If this information is reliable, and a bedrock valley exists here, the valley walls will probably be considerably steeper than shown.

The lower, fine, cross-bedded sands east of Black Creek are similar in appearance to those on the Don River (section H-H1) just above water level, which may have been deposited in late Sangamon Interglacial time. The sequence of till and till-like stratified clay described in section B-B1 is present at the west end of the section above clearly stratified clay and silt.

SECTION E-E1

The line of section E-E1 runs eastward from Weston Road to Keele Street. The lower part of the section has been compiled from well-log data. The side of the buried bedrock valley that underlies Black Creek may be much steeper than shown here. The upper sands were in an embayment of Lake Iroquois behind bay-mouth bars that are present south of the map area.

SECTION F-F1

The line of section F-F1 runs from Caledonia Road along Tycos Drive and Hillmount Avenue eastward to Woodmount Avenue. The section was prepared by the author after an examination of samples taken in test-borings by the Raymond Concrete Pile Company, Limited, for a storm-sewer outlet tunnel to Black Creek.

SECTION G-G1

The line of section G-G1 runs northeastward from a small creek west of Dufferin Street and extends across Dufferin Street, Finch Avenue West, and the Don River. A combination of well-log data and field observations was used in preparing this section. The well numbers refer to Appendix A where the logs of wells are recorded.

The lower, silty, sandy till varies in thickness and composition where it was examined along the Don River valley. The sands and gravels, which are interlayered with the till in places near the water line, appear to be an ice-contact deposit. The upper till is thin near Dufferin Street and Finch Avenue West and is removed entirely by dissection a short distance to the east near the valley sides. It is the typical upper Wisconsin till, a brown, silty till with numerous pebbles and stones.

SECTION H-H1

The line of section H-H1 runs southeastward from Sheppard Avenue West near the Don River to Yonge Street, a short distance past highway No. 401. The entire sequence of interbedded till and stratified sands and silts was laid down during the Wisconsin glaciation, with the possible exception of fine, cross-bedded silts and sands at the base of the section, which may have been deposited late in the Sangamon Interglacial age.

At the east end of the section, 20 feet of dense, grey silt overlie sands of doubtful age. The silt is overlain by 27 feet of fine, yellow sand, which is coarser near the top. Between these uniformly bedded sands and the lower Wisconsin till there is 10 feet of mixed sand, gravel, and stones with an occasional layer of silt. The mixture is an ice-contact deposit that was laid down near the face of the advancing glacier on top of the quieter sediments deposited at a somewhat greater distance from the glacier.

The tills have been separated into three Wisconsin tills by stratified sands and gravels. Distinct lithological differences are evident in the field between the upper two tills. The separation between the middle and lower till in this section is more arbitrary. It would have been more certain that sample No. 19 (Table III, page 16) from the western part of the section, belonged to the lower Wisconsin till if it had been taken from the lowest two-foot layer of till directly over the sands. The tills show considerable variation in composition ranging from sandy to clay till. Irregular patterns of the fresh, grey till are the result of many interlayered sand and gravel lenses on both sides of which ground water has oxidized the till to a brown colour.

One boulder pavement is shown. There are indications in exposures along this section that others are present. The central part of the section is not completed because steepness of the exposure faces or slump prevented close inspection.

SECTION J-J1

The line of section J-J1 runs from Strathgowan Crescent northeastward across Lawrence Avenue and the Don River to the Post Road. The lower part of the section was compiled from test-hole data. The sands above the bedrock are probably the interglacial Don Beds. The Scarborough clay is exposed at river level and is overlain by sand that is interglacial, in part at least. In the lower part fossil shells occur in sand, which is probably correlated with the Scarborough interglacial sand at Scarborough Bluffs.

The thin veneer of sand above the upper till in some places, the concentration of erratics near Strathgowan Crescent, near which the upper till has been entirely removed by water action, and the faint strand lines in the vicinity of Park Lane and Post Road are further evidence of the glacial lake that stood at about the 525-foot level.

SECTION K-K1

The line of section K-K1 runs from Bayview Avenue eastward near the south boundary of the township to the Canadian National railway tracks. The Scarborough beds reach a maximum thickness of almost 50 feet on the west valley wall of the Don River. In the right-hand part of the section, on the east valley wall, the three Wisconsin tills are represented. The lowest and thickest till is a very dense, tough till, dark-grey to black when wet, and light-grey to white when dry.

Above a few feet of sand or sand and till layers, depending on the part of the section examined, there is a sandy, rather "schistose" till that is a typical middle Wisconsin till. Above it a poor boulder pavement marks the base of a dense, buff, silty clay till, which is characteristic of the uppermost Wisconsin till sheet.

The veneer of surface sand near Laird Drive is lacustrine sand associated with the glacial lake that existed at the 460- to 475-foot level. Lake Iroquois sand is at the surface at the right of the section.

SECTION L-L1

The line of section L-L1 runs from east of Bayview Avenue and extends northeastward to Steeles Avenue East, east of Leslie Street. The lower till is very sandy in some places without any noticeable clay or silt content. The stratified sands interlayered with the till are chiefly fine-to-medium. Gravel is confined to occasional lenses.

The upper till and stratified clay sequence in the central part of the section is similar to those in sections B-B1 and D-D1 where the till and varved-clay sequence is interlayered with thicker varved clay in many places. It is difficult

to see at a glance that the till-like material is really stratified, but if an exposure is prepared and allowed to partially dry the layering stands out. The upper veneer of clay with some sand, which occurs on both sides of the Little Don River, is at the 525-foot glacial lake level.

SECTION M-M1

The line of section M-M1 runs eastward from Bayview Avenue along Finch Avenue East to Leslie Street. The several tills that are noted in exposures in the small stream valley that crosses Bayview Avenue at the west end of this section and the interbedded, stratified clay, silt, and sand shown throughout the section are evidence of the fluctuating ice-front conditions in the central Ontario region that existed during the Wisconsin glaciation.

In the central part of the section the upper till is crudely stratified. It is actually a varved deposit, with the till varying in thickness from less than an inch to more than a foot and separated always by a thin layer of clay.

SECTION N-N1

The line of section N-N1 extends eastward from Bayview Avenue along highway No. 401 to a point midway between Leslie Street and Woodbine Avenue. The sequence of formations shown here was revealed during the construction of highway No. 401 east of Bayview Avenue. It shows clearly a feature of glacier movement not uncommon throughout the township—more or less horizontally bedded, stratified clay, silt, and sand are truncated by an upper till sheet generally conforming to the shape of the broad valley occupied by the Little Don River. The presence of stratified sediments of glacial origin on the valley floor and the presence of a bedrock valley in the area are evidence of the influence of preglacial topography on the final form of a glaciated area and indicate that the Don River system drains a broad valley area that was present immediately following the ablation of the Wisconsin glacier. It is probable that a lobe of ice occupied part of this basin when the varved clay and sand, present beneath the upper till in the section, were deposited.

The upper, brown, stony, clay till varies in thickness from about 10 feet at the top of the section to more than 20 feet lower down the valley wall. Above the lower, silty grey till are large varves of clay and silt up to 2 inches thick containing inclusions of broken varves and ice-rafted stones.

A number of abnormally large erratics was removed from the cut during the building of the highway. The sands above the till near Leslie Street are glacio-fluvial, associated with the 470-foot glacial lake level.

SECTION O-O1

The line of section O-O1 runs eastward from Don Mills Road along Lawrence Avenue East to Victoria Park Avenue. The interglacial Scarborough clays are present at the base of the section. They are overlain by sand and gravel that appears to be of glacial origin. The sand and gravel vary greatly in thickness within a few feet in the section; they are overlain by the lower Wisconsin till, which is typically dense, dark brown, and silty. Till with interlayered varved clay containing many stones and much till material is present at the upper part of the section adjacent to the river. The upper till is thin near Don Mills Road, and the underlying sand is exposed in places. Some of the till was probably removed by water associated with the 465- to 475-foot water plane.

Striae on a boulder embedded near the top of the lower till in the east valley wall of the Don River indicated ice movement along the line to be S.50°E.

SECTION P-P1

The line of section P-P1 runs eastward at the southeast township boundary across the Don and Little Don rivers. Not much is known of the lower formation between the two rivers. It is probable that the Scarborough beds are missing, down to the river level at least, throughout this entire section. They would probably be removed by glacial erosion as the ice moved into the area from an easterly-to-southeasterly direction.

Slump and lack of exposures on the banks of the Don River prevented as detailed an examination of the sequence of varved clay and till as was observed in the valley of the Little Don River where excellent sections are exposed from the township boundary to farther upstream. In the east (Little Don River) valley, the clays separating the till sheets have varves that often exceed 2 inches in thickness. Most of the varve is clay, signifying that the cool period was longer than the warm, melting period during which the silt part of the varve was laid down.

The upper sand was deposited in Lake Iroquois, which forms an embayment in the area. Farther to the east the actual shore line is cut in till. The lack of beach sand and gravel near it indicates that it was exposed to current and wave action, which concentrated the eroded materials in the lower areas to the west or the quieter waters a little farther north in the bay.

SECTION Q-Q1

The line of section Q-Q1 runs northward from the southeast township boundary almost to Lawrence Avenue East in a line intersected by the meanderings of the Little Don River. It is partly a composite section made up of exposures examined in river valleys and railway cuttings on both sides of the line of section. Excellent exposures indicate the fluctuating ice front under valley conditions.

The Scarborough interglacial clays in the northern part of the section reach a maximum height of 30 feet above river level. The thicknesses of varved sediments and tills vary greatly over short distances. A quarter of a mile west of point X on the section, the upper 40 feet are composed of varved clay and silt with interbedded sand layers.

Former Drainage

A knowledge of the positions of buried valleys eroded in bedrock by rivers of interglacial or preglacial time is of importance to those seeking large supplies of ground water. Most of the large-capacity wells in the Toronto area are located in such valleys.

Interglacial sediments such as the Don and Scarborough beds provide some information on the position and extent of ancient lakes and rivers. Additional information is available from well-drilling data from which map No. 1955-7 (back pocket) has been prepared. This map shows contours of the bedrock surface.

Three major valleys, coinciding to a large extent with existing river valleys, are indicated. It should be emphasized that the locations of the buried valleys as indicated by the contours, are only approximate, chiefly because the number of wells with reliable data on depths to bedrock is small. Other interpretations from available data are possible, although the positions of some of the contour lines were influenced by bedrock control data from outside the map area. The valleys are shown as forming more or less straight lines between control points whereas they would normally have meandering channels.

Some well data were of doubtful accuracy. The information in these instances was disregarded if it indicated a variation in bedrock elevation out of line with other data. It is possible that some of the data disregarded in this way indicated correct variation in bedrock-surface elevation such as the presence of tributary valleys to the main drainage system. An example of doubtful accuracy was well No. 374, listed in Appendix A and shown on map No. 1955-7, which, if correctly located, would indicate another bedrock valley of major importance in the vicinity of Black Creek and Sheppard Avenue West.

The valleys will probably be deeper than shown. The contours are as low as the lowest bedrock surface recorded in the drilling data, but these holes did not necessarily reach the lowest part of the buried valley at those locations. If drainage was southward, as is usually considered to be the case, all the valleys in the shale should show a deepening towards the south part of the map area.

In some parts of the course gorges with more or less vertical valley walls will likely be present. The contours at these locations would be close together.

The buried valleys will have tributaries, which are not shown. Two or more of the three valleys may actually join close to the map area, or they may all be tributaries to a larger, ancient river system that drained this part of Ontario prior to glaciation or during interglacial time. It is possible also that the valleys shown were not eroded contemporaneously but came into existence at different times during preglacial or interglacial stages.

GROUND WATER

Source, Storage, and Movement

Water in most wells and springs comes from precipitation. Some 14,500,000 gallons of water fall on a square mile of land surface for each inch of rainfall. The average annual precipitation in North York is 32 inches; therefore, more than 32,000,000,000 gallons of water fall annually on the township in the form of rain or snow. Much of this runs off directly into the river systems and does not become ground water. The extensive clay and till surface deposits are an important contributing factor to this initial run-off.

The sandy beds, occurring throughout most of the township, interlayered with till sheets, are favourable formations for the movement and storage of water that infiltrates the soil from the surface above, or moves laterally along, the sandy layers from higher, morainic land to the north. It is probable that the deep aquifers in the buried valleys of the township are largely recharged by precipitation in the area north of the township.

In digging or drilling a well, water may be encountered, in saturated sands and gravels, that does not rise in the well above the level at which it was first reached. Such ground water is unconfined, and the top of the water-saturated zone is called the water table. More than one water table may be present at the same location because clay or till layers may slow up ground-water infiltration sufficiently to build up perched saturated zones in sand or gravel lenses above unsaturated sand and gravel below. The lower saturated zones are generally the more permanent aquifers. Sometimes in a dug well, and usually in a drilled well, the water rises towards the surface, after being encountered. In most cases the level to which the water rises is not the same as the water table, but it indicates the amount of hydrostatic pressure built up under impermeable clay beds by ground water percolating from recharge areas farther away.

Assembling Well Data

At the time the detailed survey was made in 1947, water data were assembled on 854 wells in the township. The wells included a few driven and bored types but were mostly drilled or dug. Information on drilled wells only has been compiled in Appendix A to which has been added data on:

1) 58 wells drilled in the township since 1947, and existing municipal wells.
2) 84 test holes drilled for the township in search of additional, municipal ground-water supplies.
3) 2 North York municipal wells and 1 observation well located in the township of Markham.

Table IV summarizes the drilling data in Appendix A with the exception of the three wells located in Markham township. The locations of the drilled wells and test holes are shown on map No. 1955-7.

Few of the 84 test-holes show any well data other than logs. Water was probably encountered in most or all of them, but because the geological conditions were not favourable enough to indicate the possibility of a large-capacity municipal well, no water test was made.

The locations of dug wells have not been shown on map No. 1955-7. Their data have been summarized in Appendix B.

For information on ground-water conditions in the township, arranged by concession and lot, see:

1) Drilled-well data—Map No. 1955-7 and Appendix A.
2) Dug-well data—Appendix B.

Occurrence of Ground Water in the Bedrock

Only 19 wells in the township were reported to have obtained, or be obtaining, water from the bedrock. The shale and limestone of the underlying Dundas formation is not a good aquifer. This is particularly true of the eastern part of the township where water in the bedrock is usually too highly mineralized to be potable. In the western part of the township, where the overburden is thinner, a number of bedrock wells have obtained fresh water at depths 30–40 feet into the shale.

Large quantities of water are not available in the bedrock. The pumping rate rarely exceeds 5 gallons per minute, and the average is much less than that.

Occurrence of Ground Water in the Overburden

More than 90 percent of the wells in the township obtain water from the overburden. In most instances the ground water is found in the interstage or interglacial sand and gravel formations described above.

The quantity of water available from a well varies considerably. The chief factors affecting the yield are the permeability of the water-bearing formation penetrated by the well, the extent of the aquifer, and its recharge possibilities. The average domestic well yields an estimated 3–10 gallons a minute compared with capacities exceeding 1,000 gallons a minute in the larger-diameter, municipal wells developed in gravels of the bedrock valleys. The presence of fine sand or silt in a water-bearing formation often presents a development problem in regard to a proper screen for the well. A number of dug wells are reported to have dried up periodically in the summer months or during dry years. Drilled wells do not present this problem. Outside of silting or sanding up, drilled wells offer a more permanent supply except in some places where they are affected by the pumping of municipal wells.

Observation Wells

In addition to other factors, a knowledge of the variation in water level within a well is necessary in order to determine the amount of ground water available from a well. A continuous discharge is taking place from ground-water storage to streams and lakes. When recharge from precipitation exceeds this amount in any area, ground-water levels rise; when precipitation is below normal or is intercepted by vegetation, which happens during the summer months, ground-water levels fall. Normally, a seasonal fluctuation is present with ground-water levels at their highest in April or May and at their lowest in the autumn or early winter.

If the operation of a large-capacity well results in continued lowering of ground-water levels when a natural recharge condition is expected, it is a strong indication that the ground-water reservoir is being depleted more rapidly than it can be recharged by natural means. Under these conditions, if artificial recharge is not employed, or if the pumping rate is not reduced, the aquifer will be pumped dry.

Three wells in the township have been used as observation wells to study the trends of the ground-water levels. A fourth observation well is situated in Markham township midway between North York municipal wells Nos. 2 and 4. (Nos. 394 and 395 on map No. 1955-7.)

OBSERVATION WELL NO. 6

Markham township, concession III, lot 3. Well No. 395 in Appendix A and on map No. 1955-7. Casing diameter, 5 inches; depth, 139 feet; aquifer, sand and gravel. Weekly automatic recorder installed in 1951. Measuring point, top of instrument base, 1 foot above general flood-plain level. Charts changed by G. Shuter and W. Gourlay.

OBSERVATION WELL NO. 9

North York township, concession II W., lot 15, Dublin school, Sheppard Avenue West. Abandoned, drilled well. Well No. 141, in Appendix A. Diameter, 5 inches; depth, 169 feet; aquifer, sand and gravel. Measuring point, top of pipe 2.5 feet above land surface. Measurements made by I. A. Robertson. Discontinued in June, 1950.

OBSERVATION WELL NO. 20

North York township, concession III W., lot 9. Abandoned well owned by Kilmer van Nostrand, Limited, Wilson Avenue West. Well No. 164 in Appendix A. Diameter, 8 inches; depth 211 feet; aquifer, sand and gravel. Measuring point, top of nipple, 0.25 feet above land surface. Measurements made by I. A. Robertson.

OBSERVATION WELL NO. 26

North York township, concession IV W., lot 3. Abandoned well owned by Imperial Oxygen, Limited, Trethewey Drive. Near well No. 308 in Appendix A. Casing diameter, 5 inches, depth, 200 feet; aquifer, sand and gravel. Measuring point, top of casing, 6 feet above land surface of old gravel pit. Measurements made by J. Roy.

Hydrographs in Figure 5 show the fluctuations of the ground-water levels for different periods of time.

The water-level fluctuations in observation well No. 9 were not observed long enough to indicate the trend in ground-water levels at that locality. The other three wells, particularly Nos. 26 and 6, indicate a definite drop in pressure head. It is rather significant that these two wells are not far away from heavily pumped wells. Although the water level in observation well No. 20 remained about the same from 1947 to September, 1951, a slight trend downward is apparent over the next year and a half.

It will be noticed that the total variation in water levels in these four wells during the period of observation ranged from 2¼ feet for observation well No. 20, to 15 feet for observation well No. 26.

As mentioned above, the lower water levels in observation wells Nos. 26 and 6 are probably due to the pumping of nearby industrial and municipal wells, respectively. The downward trend can mean that the aquifers are losing water through pumping at a faster rate than can be recharged naturally; or it may indicate that less water is available for recharge than formerly. A change in the nature of the ground surface, for example the building of subdivisions with storm sewers, where meadow land formerly existed, would contribute to the lessening of natural recharge. A more important factor, with regard to the recharge, is precipitation, which has been 5 or 6 inches below average for the past three years. This fact will probably explain the trend downward in observation well No. 20, but will only partly explain the lowering of the water levels in Nos. 26 and 6.

Quality

Numerous cases of pollution occurring in dug wells were brought to the attention of the investigators at the time of the ground-water survey. The pollution probably resulted, in most cases, from surface water entering improperly finished wells. As a rule, even shallow dug wells will yield good quality water if they are sealed to prevent surface water and contaminated substances from entering the well at the top. No attempt was made on this survey to examine well water for the purpose of determining the amount of contamination.

Eighty-nine percent of the drilled wells, excluding the test-holes, were reported to have fresh water. Another 9 percent were not classified with regard to quality, but it is likely that most of them would also be fresh. Less than 2 percent were reported as being salty or mineralized. Attention is usually drawn to the hardness of the water and its iron content.

CHEMICAL ANALYSIS OF WELL WATER

Chemical analyses were made of water samples taken from eight wells that were selected as representative of the ground water at various depths in the township. The analyses were made by the Provincial Assay Office, Ontario Department of Mines, Toronto, and are shown in Table V.

The first four samples were taken from dug wells. The water in these wells did not necessarily come from aquifers at the bottom of the wells at the depths indicated, but could have entered the wells from one or more horizons above.

The following discussion of chemical constituents has been adapted from publications of the United States Geological Survey, the Geological Survey of Canada, and particularly a report by Thomas.[1]

RESIDUE ON EVAPORATION

Ground water dissolves soil and rock particles with which it comes in contact. The residue on evaporation will include both dissolved solids and suspended matter unless the water were free from turbidity. Water containing less than 500 parts per million of dissolved solids is preferred for most domestic uses. When it exceeds 1,000 parts per million it is generally unsatisfactory for most domestic uses. Sample Nos. 3, 4, and 8 had high residue upon evaporation. The wells from which samples Nos. 3, and 8 were taken had been abandoned prior to time of the survey, No. 8 because of its high salt content.

[1]J. F. J. Thomas, *Scope, Procedure, and Interpretation of Survey Studies*, "Industrial Water Resources of Canada," Water Survey Report No. 1, Can. Dept. Mines and Technical Survs., Mines Branch rept. No. 833, 1953.

CALCIUM (Ca) AND MAGNESIUM (Mg)

Calcium and magnesium are usually found in appreciable amounts in well water. Their presence is due to the action of carbon dioxide, in water, on limestone and dolomitic rock and on clay and other soil material containing calcium and magnesium. Calcium and magnesium are usually present as calcium and magnesium bicarbonates, sulphates, or chlorides, which are the main constituents causing hardness in well water.

SODIUM (Na)

Sodium is derived from a number of the rock-forming minerals and is common in most ground water in the form of sodium bicarbonate, sodium sulphate, and sodium chloride. Its presence in large quantities in the underlying shale bedrock suggests its origin in a brine solution, which has been associated with these rocks since their deposition in brackish seas millions of years ago. Water high in sodium salts may be undesirable because of the taste or its ability to react with other compounds or cause corrosion.

Sample No. 8 was taken from a well drilled into the bedrock where water high in sodium salts is generally found in the township. The well had been originally used for domestic and irrigation purposes but had to be abandoned when the salt content increased with the use of the water.

SULPHATE (SO_4)

Sulphate is formed in well water chiefly from the oxidation of iron sulphides such as pyrite, which are present in small quantities in the overburden and the bedrock. It is also associated with trade wastes and the bacterial action of other sulphur compounds.

It is important to determine the amount of sulphate in water since its combination with calcium and magnesium causes non-carbonate or "permanent" hardness in water, resulting in scaling in piping, boilers, and condensers. In sufficient quantities as sodium or magnesium sulphate it gives water a bitter taste and a laxative effect. The United States Public Health Service recommends 250 parts per million as the upper limit for the sulphate content of drinking water.

Two water samples were high in sulphate, No. 8, which had the highest salt content, and No. 3; both were from abandoned wells at the time the samples were taken.

CHLORIDE (Cl)

Chlorides occur in well water chiefly through the dissolving of chloride-containing rocks, from brine associated with the deposition of bedrock shale (as described under "Sodium" above) and from pollution. Chlorides greatly increase the corrosiveness of water and cause "permanent" hardness. In excess of 300 parts per million they give a salty taste to the water, and when present to the extent of 400 parts per million they render the water unfit for domestic uses. Only sample No. 8 had an objectionably high chloride content.

SILICA (SiO_2)

Silica may be dissolved by ground and surface water from most rocks. Its state in water is not definitely known, but it is generally considered to be present in a colloidal form. Silica has a detrimental effect on well water because it forms boiler scale and may act as a cementing agent for the softer carbonate scale. One well sample, No. 4, yielded water high in silica, but the others were within the normal range of silica content.

IRON (Fe_2O_3) AND ALUMINIUM (Al_2O_3)

The iron and aluminium constituents are reported together in Table V. Aluminium in small amounts has little known effect on water. Iron, on the other hand, is often a very troublesome constituent of well water. It contributes to the hardness of the water. When in excess of 0.1 or 0.2 parts per million, iron dissolved in well water will normally oxidize to a ferric oxide that precipitates as a brown sediment that stains fabrics and porcelain. Iron can be almost completely removed by aeration and filtration of the water.

Sample No. 1, the shallowest dug well, had the highest iron and aluminium content, 6 parts per million, which is double the amount permitted by the United States Public Health Service in drinking water standards.

ALKALINITY AS $CaCO_3$

In Table V this column shows figures of total alkalinity as $CaCo_3$. It is likely, however, that the carbonates in solution will be present in most cases entirely as bicarbonates. Ground water contains carbon dioxide in solution, which dissolves limestone and rock-forming minerals. This weathering process results in large amounts of carbonate being taken into solution as bicarbonates of calcium and magnesium. When the water is boiled the process is reversed, and the insoluble carbonates are precipitated out of solution and may form a scale on the sides of cooking utensils. The carbonate content of waters is discussed further under "Hardness" below.

HARDNESS

Hardness is caused chiefly by calcium and magnesium compounds that are dissolved in the water. Most of the bicarbonates of these minerals can be removed by boiling, and they are, therefore, spoken of as causing "temporary" or "carbonate" hardness. The hardness due to other compounds, such as chlorides and sulphates of calcium and magnesium cannot be removed by boiling, and it is called "permanent" or "non-carbonate" hardness. Thomas[1] gives the following classification of hardness of water:

Hardness of 1 to 60 p.p.m. as $CaCO_3$—soft water
Hardness of 61 to 120 p.p.m. as $CaCO_3$—medium hard water
Hardness of 121 to 180 p.p.m. as $CaCO_3$—hard water
Hardness greater than 180 p.p.m. as $CaCO_3$—very hard water

All the samples of well water but one were from medium to very hard. Individual softening units are desirable for domestic use when the hardness exceeds 120 parts per million. Certain commercial operations or industries that require that boiler scale be kept to a minimum would probably demand water softened to the medium hard range. Table V does not indicate the amount of carbonate or non-carbonate hardness but shows the total hardness expressed as parts per million $CaCO_3$ in terms of calcium and magnesium present.

Utilization

DOMESTIC AND STOCK

Out of 758 wells in service when the survey was made, 714, or 94 percent, were being used for domestic purposes or stock. It is very likely that many of these wells have now been abandoned because of increased municipal water service. Many farms had two or more wells one of which was often used exclusively for domestic purposes and the other for stock. Although more than 50

[1] J. F. J. Thomas, *op. cit.*, p. 50.

new wells have been drilled in the township since 1947, no record has been kept of the number of new wells that may have been dug since then, and which would be used mostly for domestic purposes or stock.

In some parts of the township, particularly in places near the east boundary where the overburden is mostly clay, there is a risk that drilled wells may be dry. If suitable water-bearing sands are known to occur at shallower depths in such an area, a dug well should be considered in the search for additional ground water.

COMMERCIAL AND INDUSTRIAL

Very little ground water was being used commercially or industrially. Two of the three commercial wells were for service stations, and the other was for an office building. Included in the industrial use was water supplied for the making of concrete blocks and to a chemical plant.

IRRIGATION

Twenty-three wells were used mainly for irrigation. The use of ground water for irrigation was increasing rapidly, and it is likely that numerous wells abandoned for domestic purposes when municipal water became available, are now being used for irrigation where fruit and vegetables are being grown in quantity.

PUBLIC SUPPLY

Under public supply, 11 wells are listed that were being used for municipal, school, or housing development purposes.

Of the 4 municipal wells 2 supply water to the town of Weston, and 2 to the township of North York. Weston had 2 more wells in Etobicoke township in the valley of the Humber River near Main Street. The township of North York, also, had two additional wells within the map area in Markham township near Leslie Street. The total daily pumpage of ground water from the 4 municipal wells within the township was about 2,000,000 gallons per day. This amount would be closer to 5,000,000 gallons a day if the pumpage from the other 4 municipal wells on the borders of the township were taken into account. Softening and iron-removal treatment of the water is necessary for all the municipal wells. A brief history of the development and utilization of municipal water for the township is given in the introduction.

Two of the public supply wells were being used by schools at the time of the survey in 1947. The two wells in use at the Connaught Laboratories Farm on Steeles Avenue West were included in this group. Four wells drilled for housing developments had a potential ground-water supply but were not in use at the time of writing this report.

Summary of Ground-Water Conditions

The source of ground water in the area is the precipitation that falls on the township and adjoining areas, particularly to the north. An inch of rainfall is equivalent to 14,500,000 gallons of water for each square mile of area. North York township has an average annual precipitation of 32 inches resulting in more than 32,000,000,000 gallons of water falling on the township each year. Much of this is available for ground-water recharge.

The interbedded shale and limestone of the Dundas formation underlie the drift throughout the township. It usually yields water high in mineral content except in the western part of the area. The overburden is made up of till and stratified material. The till is not suitable as an aquifer but is usually not too thick in any one place to prevent most dug or drilled wells from reaching water-bearing sand or gravel.

A sufficient supply of ground water is generally available for average domestic needs. If larger quantities are required for irrigation, golf courses, or industrial or commercial purposes, some sections of the township would prove unsatisfactory. The most likely locations for the high-capacity wells will be over the bedrock valleys shown on map No. 1955-6.

Information on 397 drilled wells and test holes is assembled in Appendix A and summarized in Table IV. Many of the wells reported in use at the time the data were collected may be abandoned at the present time because township water has been made available. The positions of drilled wells are shown on map No. 1955-7.

The quality of the ground water, although hard and often containing iron, is suitable for most domestic purposes. Water obtained from the bedrock in the eastern part of the area, or at much below the average depth in any part of the area, is likely to be highly mineralized.

More than 110,000 people in the township of North York depended upon ground water for their principal supply until 1950. From 1950 until the middle of 1954 about equal amounts of ground and surface waters have been used for municipal purposes. In addition, about 700 private wells have been in use in various parts of the township. No reliable information is available on the total amount of water pumped from the private wells, but the total pumpage from the 8 municipal wells in and immediately adjoining the township is close to 1,500,000,000 gallons annually.

APPENDIX A—WATER-WELL DATA FOR WELLS DRILLED IN THE TOWNSHIP OF NORTH YORK

Well No.	Type	Casing diameter	Depth[1]	Elevation, surface	Thickness of drift	Elevation, top of bedrock	Static level[2]	Aquifer	Use[3]	Quantity	Kind	Log and Remarks (Figures used in logs indicate depths, in feet, to which formations extend below surface.)
		inches	feet	feet a.s.l.	feet	feet a.s.l.	feet					
1	Drilled	2	*90*	635	.....	.....	.....	.....	D, S	Adequate	Fresh	
2	Dug, drilled	.....	*50*	569	.....	.....	.....	.....	D	"	"	
3	Drilled	2	*50*	560	.....	.....	.....	.....	S	"	Fresh, hard	
4	"	.....	*50*	556	.....	.....	.....	Drift	D, S	Good supply	.....	
5	"	.....	.....	525	.....	.....	.....	"	D, S	"	Fresh	
6	Dug, drilled	.....	*60*	508	.....	.....	12	"	D	Good supply	Fresh, hard	Dug, 40 ft.; drilled, 20 ft. Supplies five houses.
7	Drilled	.....	*200*	462	.....	.....	.....	.....	A	.....	.....	Gas at 150 ft. A dry well was drilled to a depth of 52 ft., 150 ft. west of well No. 7.
8	"	.....	.....	448	.....	.....	.....	.....	D, S	.....	.....	
9	Dug, drilled	.....	*42*	520	.....	.....	4	Drift	D	Adequate	Fresh, hard	Dug 30 ft., drilled 12 ft.
10	" "	.....	*42*	522	.....	.....	9	Gravel	D	"	Hard	Used by two houses.
11	" "	.....	.....	.....	.....	.....	5	"	D	"	Fresh, hard	Dug part, 31 ft. Well went dry in 1941 and was drilled deeper, now adequate.
12	" "	2	*120*	620	.....	.....	*15*	Sand	D, S	"	Fresh, with iron	
13	" "	.....	*66*	437	.....	.....	2	"	D	.....	.....	Dug 30 ft.; drilled 36 ft.
14	" "	42	*65*	438	.....	.....	2	"	D	.....	.....	New well, not yet in use.
15	" "	.....	*60*	412	.....	.....	.....	.....	D, S	Adequate	Fresh with iron	
16	Drilled	4	*125*	444	.....	.....	*60*	Gravel	D, S	"	" " "	
17	"	2	56	571	.....	.....	8	Drift	A	"	" " "	Not being used at present.
18	"	2	*85*	570	.....	.....	.....	"	D, S	"	" " "	
19	"	12	124	401	124	277	*95*	"	D, S	"	Fresh, hard	Fine sharp sand, clay, 50; hardpan, 70; clay, sand, 75; clay, sand, gravel, 90; fine sand, 95; fine gravel, 104; hardpan, 124; shale. Water at 82 and 94 ft.
20	"	3	*125*	575	.....	.....	.....	.....	D, S	Inadequate	" "	
21	"	.....	*125*	580	.....	.....	.....	.....	A	"	.....	Pumps only 1 pail at a time.
22	"	.....	*120*	579	.....	.....	80	.....	D, S	Adequate	Fresh, hard	
23	"	2	*200*	573	.....	.....	90	Sand	D, S	"	Fresh, with iron	80 ft. of clay on top, sand below.
24	"	3	*76*	577	.....	.....	.....	Sand, gravel	D, S	"	" " "	
25	"	4	*68*	575	.....	.....	*13*	Gravel	D, S	"	Fresh, hard	
26	"	4	*70*	598	.....	.....	.....	Sand	D, S	"	" "	
27	"	4	*160*	607	.....	.....	*40*	.....	D	"	" "	
28	Dug, drilled	2½	*100*	625	.....	.....	.....	Sand	D, S	"	Fresh, with iron	
29	Drilled	2	.....	585	.....	.....	.....	.....	D, S	"	Fresh, hard	
30	"	2	149	609	.....	.....	*109*	Quicksand	D, S	"	Fresh, with iron	
31	"	4	*190*	528	.....	.....	20	.....	D	"	" " "	
32	"	2	50	524	.....	.....	.....	Drift	A	"	" " "	Owner now uses township water.
33	"	2	*73*	551	.....	.....	.....	Sand	D	"	" " "	
34	"	1½	*186*	541	.....	.....	*30*	Gravel	D, S	"	" " "	
35	"	2	*134*	550	.....	.....	59	Fine sand	D, S	"	" " "	
36	Dug, drilled	2	*87*	529	.....	.....	40	" "	D, S	"	" " "	Dug, 30 ft.; drilled, 57 ft.
37	Drilled	.....	.....	512	.....	.....	.....	.....	D, S	"	Fresh, hard	
38	"	2	85	512	.....	.....	.....	Gravel	D	"	" "	Occasionally runs low.
39	"	2	.....	514	.....	.....	.....	Drift	S	"	.....	
40	"	4	84	533	.....	.....	.....	Sand	D, S	Inadequate	Fresh, hard	Well is plugged, pumps sand and mud.
41	"	2	100	514	.....	.....	*14*	"	D, S	Excellent supply	" "	

[1] Well depths were measured except those printed in italics, which were depths reported by the owner.
[2] The static level is the distance from the surface of the ground to the top of the water in the well when it is not being pumped. Static levels were measured except those printed in italics, which were levels reported by the owner.
[3] Symbols designating Use are: A—abandoned; C—commercial; D—domestic; In—industrial; Ir—irrigation; P—public supply; S—stock; T—test hole.

APPENDIX A—WATER-WELL DATA FOR WELLS DRILLED IN THE TOWNSHIP OF NORTH YORK—*Continued*

Well No.	Type	Casing diameter	Depth[1]	Elevation, surface	Thickness of drift	Elevation, top of bedrock	Static level[2]	Aquifer	Use[3]	Quantity	Kind	Log and Remarks (Figures used in logs indicate depths, in feet, to which formations extend below surface.)
		inches	feet	feet a.s.l.	feet	feet a.s.l.	feet					
42	Drilled	2	72	498	.....	.....	.....	Sand	D, S	Adequate	Fresh, with iron	
43	"	2	60	487	.....	.....	.....	Drift	D, S	"	Fresh, hard	
44	"	6	60	484	.....	.....	.....	Sand	D, S	Inadequate	" "	Used with township water.
45	"	4	86	577	.....	.....	60	"	D	2 g.p.m.	" "	
46	"	4	228	518	218	300	80	Bedrock	S	"	" "	
47	"	4	165	502	.....	.....	.....	Sand, gravel	D, S	"	Fresh, with iron	
48	"	4	96	458	.....	.....	4	Gravel	D	"	" " "	
49	"	4	147	498	.....	.....	29	Sand	D	"	" " "	Red clay, 15; blue clay, 31; coarse sand, hard, blue clay, stones, 81; sand, 147. Some water at 61.
50	"	4	120	447	.....	.....	20	"	D, S	"	Fresh, hard	
51	Dug, drilled	4	120	474	.....	.....	.....	Quicksand	D, S	"	Fresh, with iron	Dug, 45 ft.; drilled, 75 ft.
52	Drilled	2	85	448	.....	.....	10	Quicksand, gravel	A	"	" " "	Owner uses township water.
53	"	12	94	417	.....	.....	25	Quicksand	Ir	"	Fresh	
54	"	2	120	442	.....	.....	.....	Sand	D, S	"	Fresh, hard	
55	Dug, drilled	48	120	459	.....	.....	4	Drift	D	"	Fresh, with iron	Dug, 28 ft.; drilled, 92 ft.
56	Drilled	6	121	478	.....	.....	.....	Sand	D, S	"	" " "	Iron content so high water is unfit for drinking.
57	"	.....	100	476	.....	.....	.....	.....	D, S	Never dry	Fresh, hard	
58	"	4	120	467	.....	.....	30	Drift	D, S	Adequate	Fresh, with iron	
59	"	4	127	475	.....	.....	107	Sand	D, S	"	" " "	Can be pumped dry in ½ hour.
60	"	2	113	553	.....	.....	.....	"	D, S	"	Fresh, hard	
61	"	4	165	473	.....	.....	4	"	D	"	Fresh, with iron	
62	"	2	48	476	.....	.....	12	Drift	D	"	Fresh, hard	
63	"	2	127	556	.....	.....	77	Sand	D, S	"	Fresh, with iron	
64	"	.....	148	541	.....	.....	.....	.....	D	"	" " "	
65	"	2	147	554	.....	.....	.....	.....	D, S	"	Fresh	
66	"	4	160	493	.....	.....	.....	Drift	D, S	"	Fresh, hard	
67	"	.....	120	560	.....	.....	.....	Sand	D, S	"	Fresh, soft	
68	Dug, drilled	.....	.....	461	.....	.....	.....	Drift	D	"	Fresh, with iron	
69	Drilled	2	128	467	128	339	.....	.....	A	"	" " "	
70	"	2	175	577	.....	.....	30	Fine sand	D, S	"	Fresh, hard	
71	"	4	160	620	.....	.....	.....	Drift	A	"	Fresh, with iron	
72	Dug, drilled	2	195	629	.....	.....	130	Gravel	S	"	" " "	Dug, 90 ft.; drilled, 105 ft.
73	Drilled	.....	125	589	.....	.....	.....	Sand	A	.....	.....	
74	Dug, drilled	.....	42	469	.....	.....	.....	.....	.....	.....	.....	Dug, 27 ft.; drilled, 42 ft. Dry hole.
75	Drilled	.....	182	629	.....	.....	.....	Drift	D	Adequate	Fresh, with iron	
76	"	.....	135	623	.....	.....	.....	"	D	"	" " "	
77	"	2	180	629	.....	.....	120	Coarse sand	D, S	"	" " "	
78	Dug, drilled	2	93	636	.....	.....	8	Sand	D	"	" " "	Dug, 35 ft.; drilled, 58 ft.
79	Drilled	2	112	633	.....	.....	.....	.....	.....	.....	.....	Dry hole.
80	Dug, drilled	.....	68	634	.....	.....	7	Drift	D	.....	.....	Dug, 18 ft.; drilled, 45. ft.
81	Drilled	2	125	611	.....	.....	105	Sand	D, S	Adequate	Fresh, hard	
82	"	2	82	612	.....	.....	62	Gravel	D, S	"	Fresh, with iron	
83	"	2	125	612	.....	.....	75	Sand	D, S	"	" " "	
84	Dug, drilled	.....	125	621	.....	.....	.....	.....	D	"	" " "	Dug, 10; drilled, 115 ft.
85	Drilled	2	161	620	.....	.....	.....	Sand	D, S	"	" " "	Water at 30 ft. Too much sand.
86	"	2	90	569	.....	.....	30	"	D	"	" " "	Water at 50 ft. Too much sand.
87	"	2	170	626	.....	.....	.....	"	D, S	"	" " "	
88	"	2	100	606	.....	.....	.....	Drift	D, S	"	" " "	

89	"	2	*97*	577	97	480	.....	"	D	"	" " "		Owner believes well ends in bedrock.
90	"	2	*126*	632	.....	.....	.....	Gravel	D	"	Fresh, hard		
91	"	.....	*150*	603	.....	.....	.....	Drift	D, Ir	"	Fresh, soft		
92	"	2	.....	596	.....	.....	.....	"	D	"	Fresh, with iron		
93	Dug, drilled	2	*103*	600	.....	.....	*70*	Quicksand	A	"	" " "		Dug, 78 ft.; drilled, 25 ft. Well now plugged with quicksand.
94	" "	.....	110	592	.....	.....	5	Drift	D	"	" " "		Dug, 26 ft.; drilled, 84 ft.
95	Drilled	2	*140*	624	.....	.....	.....	"	D, S	"	" " "		
96	"	.....	.....	623	.....	.....	.....	"	D, S	"	" " "		
97	"	2	*145*	622	.....	.....	.....	Gravel	D	"	" " "		
98	"	.....	*180*	624	.....	.....	.....	Sand	D, S	"	" " "		
99	"	.....	100	626	.....	.....	.....	Drift	D, S	"	" " "		
100	"	.....	.....	632	.....	.....	.....	"	D	"	" " "		
101	"	2	*160*	620	.....	.....	*140*	Sand	D, S	"	" " "		
102	"	2	*200*	617	.....	.....	.....	Drift	D	"	" " "		
103	"	4	.....	617	.....	.....	.....	.....	D, S	.....	.....		
104	"	2	*130*	619	.....	.....	.....	Sand	D	Adequate	Fresh, hard		
105	"	2	*145*	619	.....	.....	*100*	"	D	"	Fresh, with iron		
106	"	2	*106*	617	.....	.....	.....	"	D, S	"	" " "		
107	"	2	.....	621	.....	.....	.....	"	D	"	" " "		
108	"	2	*100*	616	.....	.....	.....	"	D	"	" " "		
109	"	2	.....	621	.....	.....	.....	"	D	"	" " "		
110	"	14	141	609	.....	.....	36	Gravel	P	160 g.p.m.	" " "		Fill, 1; topsoil, 2; sand clay, boulders, 20; sand, silt, 30; clay, boulders, 54; hardpan, 59; clay, 101; clay, streaks of sand, 112; fine sand, some silt, 122; sand, silt, some gravel, 141; clay, gravel.
111	"	14	134	594	.....	.....	38	Gravel	P	100 g.p.m.	" " "		Fill, 8; sandy clay, 13; blue clay, 20; blue clay, gravel, 23; sand, silt, 31; hard clay, gravel, sand, 42; blue clay, 90; clay, silt, 95; sand, silt, 98; sand, 113; sand, fine gravel, 122; sand, silt, 132; clay, sand, gravel, 134. Water must be chlorinated.
112	"	.....	*175*	618	.....	.....	.....	Drift	D	Adequate	" " "		
113	"	2	*85*	630	.....	.....	*15*	Gravel	S	"	" " "		
114	"	2½	*90*	602	.....	.....	.....	Drift	D	"	" " "		
115	"	2	*175*	610	.....	.....	.....	Sand	D	"	Fresh, hard		
116	"	4	*178*	645	.....	.....	*108*	Quicksand	D, S	"	Fresh, with iron		
117	"	.....	*188*	628	.....	.....	.....	Drift	D	"	Fresh, hard		
118	"	2½	*98*	635	.....	.....	*30*	Sand	D	"	Fresh, with iron		
119	"	4	*110*	607	.....	.....	50–60	"	D	"	" " "		12 ft. of till, then sand with streaks of gravel to bottom.
120	"	5	*105*	550	.....	.....	*10*	.....	D, Ir	"	" " "		
121	"	1½	*160*	631	.....	.....	*140*	Drift	A	Inadequate	.....		Can be pumped dry in 10 minutes.
122	"	2½	*135*	567	.....	.....	.....	Sand, gravel	D	Adequate	Fresh, with iron		
123	"	2½	*135*	571	.....	.....	.....	" "	D	"	" " "		
124	"	.....	*150*	610	.....	.....	.....	Drift	D	"	" " "		
125	"	2½	.....	620	.....	.....	.....	"	D, S	"	Fresh, hard		
126	Dug, drilled	.....	*180*	632	.....	.....	.....	"	D, S	"	Fresh, with iron		Supplies 60 head of cattle.
127	Drilled	2	*130*	606	.....	.....	.....	"	D, S	"	" " "		
128	"	2½	*182*	642	.....	.....	.....	"	D	"	" " "		
129	Dug, drilled	.....	*78*	639	.....	.....	.....	"	D, S	"	" " "		Dug, 65 ft.; drilled, 13 ft.
130	Drilled	4	*180*	636	.....	.....	.....	"	D	"	" " "		
131	"	2	*75*	640	.....	.....	.....	Sand	D	"	" " "		

[1]Well depths were measured except those printed in italics, which were depths reported by the owner.

[2]The static level is the distance from the surface of the ground to the top of the water in the well when it is not being pumped. Static levels were measured except those printed in italics, which were levels reported by the owner.

[3]Symbols designating Use are: A—abandoned; C—commercial; D—domestic; In—industrial; Ir—irrigation; P—public supply; S—stock; T—test hole.

APPENDIX A—WATER-WELL DATA FOR WELLS DRILLED IN THE TOWNSHIP OF NORTH YORK—*Continued*

Well No.	Type	Casing diameter	Depth[1]	Elevation, surface	Thickness of drift	Elevation, top of bedrock	Static level[2]	Aquifer	Use[3]	Quantity	Kind	Log and Remarks (Figures used in logs indicate depths, in feet, to which formations extend below surface.)
		inches	feet	feet a.s.l.	feet	feet a.s.l.	feet					
132	Drilled	2	*75*	644	.....	.....	.....	Sand	D	Adequate	Fresh, with iron	
133	"	4	*180*	618	.....	.....	*50*	Sand, gravel	D	"	" " "	
134	"	4	*140*	608	.....	.....	.....	Sand	D	"	" " "	Water is turbid.
135	"	5	100	616	.....	.....	40	Gravel	D	"	Fresh, hard	
136	"	.....	125	630	.....	.....	*20*	Drift	A	"	.....	Yellow clay, 40; dry sand, 55; gravel, 69; hardpan, 84; blue clay, 125.
137	"	5	204	522	.....	.....	.....	Sand	D, S	"	Fresh, hard	
138	"	6	*90*	529	.....	.....	.....	"	D, S	"	" "	
139	"	4	*90*	529	.....	.....	.....	"	D, S	"	" "	
140	"	2	*160*	503	.....	.....	.....	"	D, S	"	" "	
141	"	4	169	631	.....	.....	.....	"	A	.....	Fresh	Dublin School well; used as observation well until abandoned.
142	"	5	*150*	624	.....	.....	60	"	D	Adequate	Fresh, hard	
143	Dug, drilled	.....	*90*	596	.....	.....	5	Drift	.....	.....	" "	Dug, 29 ft.; drilled, 61 ft.
144	Drilled	2	*90*	605	.....	.....	.....	Sand	D, S	Adequate	Fresh, with iron	
145	Dug, drilled	2	*180*	595	.....	.....	*30*	Drift	D, S	"	Fresh, hard	
146	Drilled	2	*178*	651	.....	.....	60	Sand	D, S	"	" "	
147	Dug, drilled	2½	*180*	607	.....	.....	.....	Drift	D, S	"	Fresh, with iron	Dug, 80 ft.; drilled, 100 ft.
148	Drilled	3	*180*	657	.....	.....	*120*	Quicksand	S	"	Fresh, hard	
149	"	2	*160*	666	.....	.....	*60*	"	D, S	"	" "	
150	"	5	*120*	577	.....	.....	.....	Drift	S	"	Fresh, with iron	
151	"	4	*196*	623	196	427	*96*	"	D, S	"	Fresh, hard	
152	"	2	130	626	.....	.....	.....	Sand	D, S	"	" "	
153	"	2	*235*	612	.....	.....	.....	"	D, S	"	Fresh, with iron	
154	"	2	*180*	577	.....	.....	.....	Drift	D	"	" " "	
155	"	2	*120*	574	.....	.....	*60*	Sand	D	"	" " "	
156	"	2	*175*	574	.....	.....	.....	Drift	D, S	"	" " "	
157	"	5	*184*	597	187	410	*120*	"	D, S	"	" " "	
158	"	2	*180*	611	180	431	*140*	"	D, S	"	" " "	
159	"	4	178	615	.....	.....	*160*	Gravel	D, S	"	Fresh, hard	
160	"	2	*178*	616	.....	.....	*160*	"	D, S	"	Fresh, with iron	
161	Dug, drilled	2½	*140*	611	.....	.....	*45*	Drift	D	"	" " "	Dug, 80 ft.; drilled, 60 ft.
162	Drilled	6	*177*	608	.....	.....	*117*	Gravel	D, S	"	" " "	
163	"	.....	*180*	591	.....	.....	.....	Sand	D	"	Fresh, hard	
164	"	8	*211*	610	.....	.....	125	Sand, gravel	A	.....	Fresh, with iron	Observation well No. 20.
165	"	2	*135*	606	.....	.....	*95*	Gravel	D, S	Adequate	" "	
166	"	2	*170*	615	.....	.....	*40*	Quicksand	D, In	"	Fresh, hard	
167	Dug, drilled	2½	*105*	583	.....	.....	4	Drift	D	"	" "	Dug, 80 ft.; drilled, 25 ft.
168	Drilled	4	*88*	622	.....	.....	.....	"	D, S	"	Fresh, with iron	
169	"	.....	*130*	612	.....	.....	30	Sand, gravel	D, S	"	" " "	
170	"	.....	.....	.....	.....	.....	.....	.....	D, S	.....	" " "	Water level low in summer.
171	"	2	*135*	589	.....	.....	.....	Gravel	D, S	Adequate	" " "	
172	"	4	*105*	479	.....	.....	25	Fine, sand	D, S	"	" " "	
173	"	4	*130*	598	.....	.....	50	Sand, gravel	D	3 g.p.m.	Mineral	Tests show high mineral content.
174	"	5	125	584	.....	.....	*65*	Fine, gravel	D	Adequate	Fresh, hard	Clay, hardpan, 100; fine sand, gravel, 125.
175	"	2	*110*	562	.....	.....	80	"	D, S	"	Fresh, with iron	
176	"	2½	104	579	.....	.....	2	Drift	A	.....	.....	
177	Dug, drilled	.....	*175*	567	.....	.....	.....	"	D	Inadequate	Hard	Dug, 27 ft.; drilled, 148 ft. Often dry.
178	Drilled	4	*80*	509	.....	.....	.....	Gravel	D	.....	Fresh, with iron	
179	"	4	.....	505	.....	.....	.....	Drift	D, S	Adequate	Fresh, hard	
180	Dug, drilled	3	112	500	.....	.....	41	"	A	.....	.....	

181	Drilled	2	*70*	438	.....	.....	.....	Fine sand	D	Adequate	Fresh, with iron	
182	"	4	*80*	444	.....	.....	*25-30*	Sand	A	Good supply	Fresh, hard	
183	Dug, drilled	5	*145*	420	.....	.....	*30*	Sand, gravel	D, S	Adequate	" "	Dug, 35 ft.; drilled, 110 ft.
184	Drilled	.....	*138*	440	.....	.....	.....	.....	D	"	" "	
185	"	4	*116*	413	116	297	31	Drift	A	.....	.....	
186	"	2	140	537	.....	.....	38	"	A	Adequate	Fresh	Never dry.
187	"	2	*150*	450	.....	.....	.....	.....	A	.....	.....	
188	"	.....	77	419	70	349	.....	.....	T	.....	.....	Weston test hole No. 7. Grey clay, 7; blue clay, 42; sandy clay, 60; clay boulders, 70; shale, 77.
189	"	4	75	454	.....	.....	.....	Sand	Ir	Adequate	Fresh, hard	Seldom used.
190	"	4	*125*	504	125	377	*73*	Bedrock	D	"	Fresh, with iron	
191	"	4	*214*	440	200	240	*30*	"	D	"	" " "	
192	"	.....	*100*	449	.....	.....	.....	Drift	D, S	"	Fresh, hard	
193	"	4	*100*	450	.....	.....	.....	"	D, S	"	" "	
194	"	5	*110*	450	70	380	*15*	Bedrock	D	"	" "	
195	"	4	*80*	451	.....	.....	*18*	.....	D	"	Fresh, with iron	
196	"	4	*60*	449	.....	.....	.....	.....	D	"	" "	
197	"	4	*80*	450	.....	.....	*15*	.....	D, S	"	" " "	
198	"	4	75	455	.....	.....	*20*	.....	D	"	Fresh, hard	
199	Dug, drilled	.....	*8*	453	.....	.....	18	.....	D, S	"	" "	Dug, 28 ft.; drilled 20 ft.
200	" "	.....	*40*	450	.....	.....	15	.....	D	"	.....	Dug, 30 ft.; drilled 10 ft.
201	" "	.....	.....	454	.....	.....	.....	.....	D	.....	Fresh, hard	Dry in a dry season.
202	" "	.....	*24*	450	.....	.....	.....	.....	D, S	Adequate	" "	
203	Drilled	4	*55*	408	.....	.....	.....	Sand	D, S	"	" "	
204	"	.....	*81*	455	.....	.....	.....	.....	D, S	"	" "	
205	"	.....	*50*	451	.....	.....	.....	.....	D	"	" "	
206	"	.....	*80*	452	.....	.....	*9*	.....	D	"	Fresh, with iron	
207	"	4	*80*	451	.....	.....	.....	.....	.....	"	Salty, hard	Not used for drinking.
208	"	.....	*42*	452	36	416	.....	Bedrock	D	"	Fresh, hard	
209	"	4	62	446	40	406	.....	"	D, S	"	" "	
210	Dug, drilled	.....	*35*	451	.....	.....	*15*	.....	D	"	" "	Dug, 17 ft.; drilled, 18 ft.
211	Drilled	4	*80*	451	60	391	*15*	Bedrock	D	"	Fresh, soft	
212	"	4	*135*	441	.....	.....	.....	"	D	"	Fresh, with iron	
213	"	4	*201*	432	.....	.....	*100*	"	D	"	Fresh, hard	
214	"	4	*100*	446	.....	.....	*30*	Gravel	D, S	"	" "	
215	"	5	*78*	539	78	461	*30*	Drift	D	"	Fresh, with iron	
216	"	5	*68*	534	.....	.....	*20*	Gravel	S	"	" " "	
217	"	5	*105*	504	.....	.....	25½	"	A	.....	.....	
218	"	.....	.....	503	.....	.....	.....	.....	P	.....	Fresh	
219	"	5	*167*	582	.....	.....	*102*	Gravel	S	Adequate	Fresh, with iron	
220	"	.....	*135*	502	.....	.....	.....	.....	D, S	"	Fresh, hard	
221	Dug, drilled	5	*245*	491	135	356	.....	Bedrock	D	"	" "	Dug, 35 ft.; drilled 210 ft.
222	Drilled	.....	*112*	484	.....	.....	*47*	Gravel	D	"	Fresh, soft	Often dry until deepened 2 ft. to 112 ft. in 1947.
223	"	4¼	*107*	474	.....	.....	*30*	"	D, S	"	Fresh, hard	
224	"	.....	*92*	460	.....	.....	.....	Drift	D	"	" "	
225	"	4	*80*	466	.....	.....	*80*	"	A	.....	.....	Well has gone dry.
226	"	4	*80*	464	.....	.....	.....	"	.....	Inadequate	.....	Reported to have gone dry after Weston well pumped.
227	"	4	*80*	424	.....	.....	.....	Gravel	D	Adequate	Fresh, with iron	
228	"	4	*86*	449	.....	.....	59	"	D	.....	Fresh, hard	Water low in dry weather.
229	"	.....	*100*	477	.....	.....	90½	"	A	.....	.....	Reported to have gone dry after Weston well pumped.

[1] Well depths were measured except those printed in italics, which were depths reported by the owner.

[2] The static level is the distance from the surface of the ground to the top of the water in the well when it is not being pumped. Static levels were measured except those printed in italics, which were levels reported by the owner.

[3] Symbols designating Use are: A—abandoned; C—commercial; D—domestic; In—industrial; Ir—irrigation; P—public supply; S—stock; T—test hole.

APPENDIX A—WATER-WELL DATA FOR WELLS DRILLED IN THE TOWNSHIP OF NORTH YORK—*Continued*

Well No.	Type	Casing diameter	Depth[1]	Elevation, surface	Thickness of drift	Elevation, top of bedrock	Static level[2]	Aquifer	Use[3]	Quantity	Kind	Log and Remarks (Figures used in logs indicate depths, in feet, to which formations extend below surface.)
		inches	feet	feet a.s.l.	feet	feet a.s.l.	feet					
230	Drilled	5	*100*	465	.....	.....	.....	Drift	A	.....	Fresh	Reported to have gone dry after Weston well pumped.
231	"	5	85	465	.....	.....	.....	Gravel	A	.....	"	Reported to have gone dry after Weston well pumped.
232	"	4	87	461	114	347	*75*	Drift	S	Adequate	Fresh, hard	
233	"	4	90	463	.....	.....	.....	.....	A	.....	.....	
234	"	4	71	458	.....	.....	.....	Gravel	A	.....	.....	Reported to have gone dry after Weston well pumped.
235	"	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	[No information available.]
236	"	4	.....	464	.....	.....	.....	.....	A	.....	.....	
237	"	6	130	504	100	404	*90*	Bedrock	A	Adequate	Salt, with iron	Water became more salty with use.
238	"	5	*115*	487	.....	.....	.....	.....	D, S	"	Fresh, hard	Slightly salty water.
239	"	5	*98*	492	.....	.....	.....	Fine gravel	A	Inadequate	.....	
240	"	5	*185*	448	.....	.....	65	Gravel	D	Adequate	Fresh, hard	
241	"	2	*200*	442	.....	.....	.....	Bedrock	D	Inadequate	Fresh, with iron	Supplies 1 pail of water per hour.
242	"	2	*62*	436	.....	.....	.....	.....	D	Adequate	Fresh, hard	
243	"	2½	.....	425	.....	.....	.....	.....	D	"	" "	
244	"	.....	*150*	444	.....	.....	.....	Gravel	A	.....	.....	
245	"	4	*150*	410	.....	.....	.....	Drift	A	.....	.....	
246	"	2	147	630	.....	.....	*20*	Sand	D	Adequate	Fresh, with iron	Yellow clay, 40; dry sand, 55; gravel, 69; hardpan, 84; blue clay, 125; quicksand, 141; water sand, 147.
247	"	2	111	575	.....	.....	*30*	"	Ir	"	" " "	Loam, gravel, 5; dry sand, 20; oil sand, 22; sand, gravel, clay, 31; blue clay, 71; quicksand, 97; fine, water sand, 105; coarse water sand, 111.
248	"	4	*120*	575	.....	.....	*30*	"	Ir	"	" " "	Dry sand, 23; sand, gravel, 48; blue clay, 63; quicksand, 109; water sand, gravel, 120.
249	"	5	89	460	.....	.....	30	Gravel	S	10 g.p.m.	Fresh, hard	Yellow clay, 40; fine silty sand, 75; coarse sand, 87; gravel, 89.
250	"	2	180	574	.....	.....	80	Sand	D	4 g.p.m.	" "	Dug, 30; blue clay, 40; hardpan, sand, 85; quicksand, 175; water sand, 180.
251	"	2	135	574	.....	.....	15	"	D	3 g.p.m.	" "	Yellow clay, 10; blue clay, 60; hardpan, sand, 105; quicksand, 125; water sand, 135.
252	"	2	97	598	.....	.....	50	"	D	3 g.p.m.	" "	Yellow clay, 22; grey sand, 60; blue clay, 90; grey, quicksand, 97.
253	"	2	135	578	.....	.....	90	"	D	2–3 g.p.m.	Fresh, with iron	Brown clay, 2; hardpan, clay, 100; soft, white clay, 122; fine sand, coarse at bottom, 135.
254	"	2	89	527	.....	.....	41	"	D	3 g.p.m.	Fresh, hard	Brown clay, 12; blue clay, 21; gravel, hardpan, 22½; blue clay, 41; brown sand, hardpan, 46; quicksand, 85; water sand, 89.
255	"	.....	208	567	.....	.....	65	"	D	10 g.p.m.	" "	Yellow clay, 40; blue clay, 90; fine sand, 130; blue clay, 190; fine sand, 200; coarse sand, 207; gravel, 208.
256	"	6	200	529	198	331	.....	.....	A	.....	.....	Blue clay, 50; fine sand, 198; blue shale, 200. Dry hole.
257	"	6	252	556	231	325	60	Bedrock	S	10 g.p.m.	Mineral, salt	Till, 231; limestone, 252.
258	"	2	64	571	.....	.....	6	Drift	C	3 g.p.m.	Fresh, hard	Clay and stone, 64.
259	"	2	105	637	.....	.....	45	Sand	S	5 g.p.m.	" "	Brown clay, 2; brown hardpan, sand, 82; blue hardpan, sand, 96; water sand, 105.
260	"	5	152	624	.....	.....	50	Sand, gravel	D	8 g.p.m.	Fresh, soft	Topsoil, 3; brown sand, clay, boulders, 35; brown sand, little clay, 60; quicksand, 80; blue clay, 148; sand, gravel, 152.

261	"	5	148	614	.....	.....	60	" "	D	8 g.p.m.	" "	Topsoil, 4; brown clay, 20; blue clay, 90; quicksand, 110; blue clay, 142; sand, gravel, 148.
262	"	2	92	635	.....	.....	47	Sand	D	4 g.p.m.	Fresh, hard	Brown clay, 4; brown hardpan, sand, 70; cemented gravel, 87; water sand, 92.
263	"	2	85	637	.....	.....	50	Gravel	D	4 g.p.m.	" "	Brown clay, 2; cemented gravel, 72; quicksand, 80; gravel, 85.
264	"	2	85	629	.....	.....	25	Sand	D	3 g.p.m.	" "	Yellow clay, 20; sand, 50; hardpan, sand, 80; water sand, 85.
265	"	2	136	611	.....	.....	96	"	D	2½ g.p.m.	" "	Yellow clay, 15; blue clay, 100; hardpan, sand, 115; quicksand, 130; water sand, 136.
266	"	2	127	637	127	510	.....	.....	A	.....	.....	Dug, 33; blue clay, 127; shale. Dry hole.
267	"	4	36	637	.....	.....	9	Gravel	D	1½ g.p.m.	Fresh, soft	Yellow clay, 14; silt, 15; sand, 35; gravel, 36.
268	"	4	36	637	.....	.....	.....	"	D	Adequate	.....	Yellow clay, 13; silt, 15; sand, 35; gravel, 36. Never dry.
269	"	6	190	648	.....	.....	90	Sand, gravel	D	5 g.p.m.	Fresh, hard	Clay, 20; till, 60; sand, clay, 95; sand, fine gravel, 98; hard, blue clay, 160; fine sand, 165; hard, grey clay, 178; sand, gravel, 190.
270	"	2	108	641	.....	.....	58	Sand	D	3 g.p.m.	" "	Clay, 15; sand, 105; water sand, 108.
271	"	5	168	637	.....	.....	65	"	D	15 g.p.m.	Fresh, soft	Topsoil, 2; red quicksand, 35; clay, sand, 145; fine, black, water sand, 168.
272	"	2	72	637	.....	.....	27	"	S	3 g.p.m.	Fresh, hard	Yellow clay, 10; sand, gravel, 60; water sand, 72.
273	"	4	100	514	70	444	30	Drift	D	Adequate	Fresh	Soft, muddy, blue sand, 10; hardpan, rock, 70; grey shale, 100.
274	"	4	138	618	.....	.....	90	Sand, gravel	D	3 g.p.m.	Fresh, hard	Yellow clay, 12; blue clay, large boulder, 19; blue clay, 101; quicksand, silt, 130; blue clay, gravel, 131½; coarse sand, fine gravel, 135; water sand, fine gravel, 138.
275	"	2	125	648	.....	.....	90	Sand	A	Inadequate	" "	Clay, 120; fine sand, 125.
276	"	2	88	565	.....	.....	38	"	D	2 g.p.m.	" "	Yellow clay, 10; blue clay, 50; sand, 70; blue clay, 80; water sand, 88.
277	"	2	159	546	.....	.....	49	"	D	1 g.p.m.	" "	Yellow clay, 8; blue clay, 98; gravel, sand, 108; sand, 159.
278	"	4	162	650	.....	.....	82	Sand, gravel	D	5 g.p.m.	" "	Topsoil, red sand, 15; clay, 60; fine sand, 157; coarse sand, fine sand, gravel, 162.
279	"	4	132	610	.....	.....	80	" "	D	5 g.p.m.	Fresh, soft	Topsoil, 3; brown clay, 20; blue clay, 90; hard clay, sand, 120; sand, gravel, 132.
280	"	2	78	561	.....	.....	43	Sand	D	5 g.p.m.	Fresh, hard	Yellow clay, 15; blue clay, 25; hardpan, 40; quicksand, 60; medium sand, 75; water sand, 78.
281	"	4	216	419	200	219	.....	.....	A	.....	.....	Dug, 30; soft, blue clay, 200; blue shale, 216. Dry hole.
282	"	4	97	487	66	421	92	Bedrock	D	1 g.p.m.	Fresh, hard	Topsoil, 3; brown clay, 18; soft, blue clay, 50; running sand, little gravel, 66; shale, 97.
283	"	5	100	487	55	432	13	"	D	1½ g.p.m.	Fresh, with iron, sulphur	Brown topsoil, brown clay, 18; blue clay, 35; hardpan, 55; blue shale, 100.
284	"	4	90	487	48	439	10	"	D	3 g.p.m.	Mineral, hard	Topsoil, 4; brown clay, 19; blue clay, 30; boulders, hard, blue clay, 48; blue shale, 90.
285	"	6	96	498	76	422	10	"	D	1 g.p.m.	Fresh, hard	Brown clay, 10; blue, muddy sand, 30; hardpan, 40; layers of shale, hardpan, 2–3 ft. thick, 76; blue shale, 96.
286	Dug, drilled	4	128	565	.....	.....	40	Gravel	D	5 g.p.m.	Fresh, soft	Dug, 30; muddy sand, 70; blue clay, 120; red, muddy sand, 124; blue clay, 127; gravel, 128.

[1]Well depths were measured except those printed in italics, which were depths reported by the owner.
[2]The static level is the distance from the surface of the ground to the top of the water in the well when it is not being pumped. Static levels were measured except those printed in italics, which were levels reported by the owner.
[3]Symbols designating Use are: A—abandoned; C—commercial; D—domestic; In—industrial; Ir—irrigation; P—public supply; S—stock; T—test hole.

APPENDIX A—WATER-WELL DATA FOR WELLS DRILLED IN THE TOWNSHIP OF NORTH YORK—*Continued*

Well No.	Type	Casing diameter	Depth	Elevation, surface	Thickness of drift	Elevation, top of bedrock	Static level	Aquifer	Use[1]	Quantity	Kind	Log and Remarks (Figures used in logs indicate depths, in feet, to which formations extend below surface.)
		inches	feet	feet a.s.l.	feet	feet a.s.l.	feet					
287	Drilled	4	151	583	.....	.....	70	Sand	S	.....	Fresh	Blue clay, 90; fine, white sand, 120; coarse sand with fine shells and fossils, 151.
288	"	5⅝	113	475	110	365	45	Bedrock	D	3 g.p.m.	Fresh, hard	Brown clay, 18; blue clay, boulders, 73; fine sand, pebbles, 110; shale, 113.
289	"	4	172	480	.....	.....	30	Gravel	D	15 g.p.m.	" "	Sand, 4; soft blue clay, 164; medium gravel, 172.
290	"	8	385	556	285	271	.....	.....	.....	.....	.....	Fill, 10; blue hardpan, 25; till, 60; grey sand, 285; grey shale, 375; rock, 385. Dry hole.
291	"	6	168	592	.....	.....	100	Sand	A	.....	Fresh, cloudy	Grey clay, boulders, 60; blue clay, 100; fine, grey quicksand, 168.
292	"	2	120	637	.....	.....	.....	.....	A	.....	.....	Yellow clay, 10; sand, 60; quicksand, 75; hard, blue clay, 120. Pipe seized; well abandoned.
293	"	2	85	629	.....	.....	35	Gravel	D	6 g.p.m.	Fresh, hard	Loam, 2; blue clay, 44; cemented gravel, 74; quicksand, 80; water gravel, 85.
294	"	2	115	620	.....	.....	50	Sand	D	3 g.p.m.	" "	Brown and blue clay, 90; white, stream sand and fine, water sand, 115.
295	"	7½	235	581	232	349	30	Drift	C	.....	.....	Sandy clay, 17; blue clay, sand, gravel, 232; shale, 235.
296	"	6	124	510	.....	.....	60	Gravel	P	7 g.p.m.	Fresh	Brown sand, 15; grey sand, 100; gravel, 124.
297	"	4	135	546	135	411	31	Drift	P	32 g.p.m.	Fresh, hard	Winston Park development; capped well. Topsoil, 1; brown clay, 2; clay, gravel, boulders, 3; sandy clay, hard gravel, 33; silty sand, some gravel, 61; blue clay, boulders, 68; silty sand, some clay, 87; blue clay, silt, 119; gravel, sand, boulders, shale, blue and red clay, 129; shale or cemented gravel, 135.
298	"	4	332	488	330	150	4	"	P	150 g.p.m.	" "	Winston Park development; capped well. Topsoil, 1; brown, sandy clay, gravel, 3; blue clay, gravel, 13; blue clay, boulders, 14; silty clay, fine sand, 26; blue clay, 32; blue clay, boulders, some sand, gravel, 51; cemented sand and gravel with soft streaks, 63; blue clay, sand, gravel, boulders, 68; boulders, gravel, sand, streaks of clay, 106; sandy clay, gravel, 109; cemented sand, gravel, red clay, 124; blue clay, sand, gravel, 144; cemented sand, gravel, 146; blue clay, sand, gravel, 161; sandy clay, gravel, 304; cemented sand, gravel, boulders, streaks of shale, 330; probably shale, 332.
299	"	2	89	521	84	437	8½	"	P	16 g.p.m.	" "	Sorbora and Snider development; capped well. Topsoil, 1; brown clay, gravel, boulders, 4; blue clay, 12; silt, streaks of clay, 25; sand, silt, 56; gravel, sand, boulders, 62; silty clay, gravel, 84; soft, shale, 89.

300	"	2	87½	524	79	445	6½	"	P	10 g.p.m.	" "	Sorbora and Snider development. Capped well. Topsoil, 1; brown, sandy clay, 4; blue clay, 6; silty sand, fine sand, 71; boulders or shale streaks, 72; blue clay, streaks of gravel, sand and shale, 79; soft shale, 87½.
301	"	5	230	631	175	456	80	Bedrock	C	5 g.p.m.	" "	Topsoil, 2; brown clay, 15; blue clay, 40; hardpan, 110; blue clay, 130; hard, blue, dead sand, 175; blue shale, 230.
302	"	.....	170	559	170	389	.....	.....	.....	.....	.....	Clay, sand, hardpan, 60; clay, boulders, 75; sand, 85; clay, sand, hardpan, 145; fine sand, 150; clay, sand, little gravel, 170; shale. Dry hole.
303	"	18	153	484	.....	.....	12	Sand and gravel	Ir	300 g.p.m.	Fresh	Soil, 1; sand, clay, boulders, 7; sand, gravel, 14; sandy clay, sandy gravel, 153.
304	"	26	150	484	150	334	2	" "	P	1,085 g.p.m.	Fresh, hard	Township well No. 3. Soil, sand, gravel, clay, 59; cemented gravel, clay, 83; sand, gravel, clay, 132; sand, gravel, 150; shale.
305	"	4	113	530	93	437	30	Drift	A	1 g.p.m.	Fresh, soft	Yellow clay, 10; blue clay, 40; sand, silt, 55; blue clay, 63½; gravel, 65; soft, blue clay, 93; shale, 113. Well filled in.
306	"	4	87	535	70	465	15	Bedrock	A	2 g.p.m.	Fresh, hard	Yellow clay, 23; blue clay, 50; silt, 70; shale, 87. Well filled in.
307	"	5	137	576	.....	.....	65	Sand	In	5 g.p.m.	Fresh, soft	Yellow clay, 11; blue clay, 52; fine sand, 136; coarse sand, 137.
308	"	5	200	403	190	213	35	Drift	In	60 g.p.m.	Fresh, with iron, sulphur	Loam, sand, gravel, 35; clay, hardpan, 190; hardpan, gravel, shale, 200.
309	"	5½	72	430	69½	360	4	"	T	8 g.p.m.	Fresh	Weston test hole No. 4–50. Topsoil, 4; gravel, 7; sandy clay, hard clay, 60; boulders, 62; clay, 64; coarse gravel, some clay, 66; hardpan, 67; fine gravel, sand, 69½; shale, 72.
310	"	5½	69	432	.....	.....	Flows	Gravel	T	.....	"	Weston test hole No. 3–50. Clay, 2; sand, 4; gravel, 6; clay, few boulders, 36; hard, blue clay, 41; clay, 62; boulders, 64; clay, sand, 66; gravel, 69.
311	"	7½	265	553	265	288	.....	.....	T	.....	"	Township test hole No. 4–51. Sandy clay, 8; brown sand, shells, 17; dirty sand, fine gravel, 39; blue clay, 48; sandy clay, gravel, 82; fine sand, fine gravel, 96; clay, sand, gravel, 107; dirty sand, gravel, shale streaks, 265; shale, 265.
312	"	5½	332	481	319 (?)	162	.....	.....	T	.....	.....	Township test hole No. 3–50. Brown, sandy clay, gravel, 7; hard blue clay, 13; sandy, blue clay, gravel, shale, 229; cemented sand, gravel, 234; sand, gravel, clay, boulders, 286; cemented sand, gravel, streaks of sandy clay, 315; hard clay, soft shale, 319; soft shale or clay, 332.
313	"	5½	331	451	327(?)	124	.....	.....	T	.....	.....	Township test hole No. 1–50. Topsoil, 2; sandy clay, shells, 5; sand, gravel, clay, boulders, hard cemented streaks, 327; sand, clay, cemented gravel or shale, 331.
314	"	5½	378	521	372	149	.....	.....	T	.....	.....	Township test hole No. 2–50. Topsoil, 3; gravel, sand, 5; blue clay, 14; blue clay, gravel, cemented sand, 296; hard, sandy, blue clay, 372; blue-black shale, 378.

[1]Symbols designating Use are: A—abandoned; C—commercial; D—domestic; In—industrial; Ir—irrigation; P—public supply; S—stock; T—test hole.

APPENDIX A—WATER-WELL DATA FOR WELLS DRILLED IN THE TOWNSHIP OF NORTH YORK—*Continued*

Well No.	Type	Casing diameter	Depth	Elevation, surface	Thickness of drift	Elevation, top of bedrock	Static level	Aquifer	Use[1]	Quantity	Kind	Log and Remarks (Figures used in logs indicate depths, in feet, to which formations extend below surface.)
		inches	feet	feet a.s.l.	feet	feet a.s.l.	feet					
315	Drilled	5½	268	571	.....	.....	.....	.....	T	.....	.....	Township test hole No. 3–51. Brown clay, sand, gravel, 15; blue clay, streaks of sand and gravel, 255; cemented sand, 268.
316	"	5½	196	520	.....	.....	.....	.....	T	.....	.....	Township test hole No. 2–51. Topsoil, 2; brown clay, sand, gravel, 141; cemented sand and gravel, 146; blue clay, sand and gravel streaks, 178; cemented sand and gravel, 196.
317	"	5½	203	528	189	339	.....	.....	T	.....	.....	Township test hole No. 4–50. Brown clay, wood, 3; blue clay, 13; fine, silty sand, gravel, 56; blue clay, sand, gravel, 68; fine sand, gravel, boulders, 189; soft, blue shale, 203.
318	"	5½	195	518	186	332	.....	.....	T	.....	.....	Township test hole No. 1–51. Brown clay, wood, 4; brown clay, sand, gravel, 8; blue clay, 13; blue clay, sand, gravel, boulders, 99; sandy clay, gravel, 186; shale, 195.
319	"	.....	107	418	.....	.....	.....	.....	T	.....	.....	Township test hole No. 1–40. Fine sand, 7; clay, sand, boulders, 48; hardpan, clay, sand, 58; sandy clay, 61; hardpan, 63; boulders, sand, gravel, 72; tough clay, 89; fine sand, 98; clay, 102; blue clay, 107.
320	"	.....	103	416	101	315	.....	.....	T	.....	.....	Township test hole No. 2–40. Yellow sand, 7; hardpan, 8; sandy clay, sand, gravel, clay, 26; quicksand, 35; sandy clay, 39; sand, clay, boulders, 46; gravel, 50; clay, 71; sandy clay, boulders, 76; tough clay, 80; fine sand, 82; tough clay, 85; hardpan, 86; gravel, 98; tough clay, 101; shale, 103.
321	"	.....	209	447	209	238	.....	.....	T	.....	.....	Township test hole No. 3–40. Sandy clay, boulders, 18; tough clay, sandy, clay, 81; gravel, 86; tough clay, 95; hardpan, clay, boulders, 190; sand, 194; sandy clay, clay, 209; shale.
322	"	.....	173	487	172	315	.....	.....	T	.....	.....	Township test hole No. 1-41. Fill, 3; peat, 8; fine sand, 18; sandy clay, 23; gravel, boulders, 40; clay, 48; sand, gravel, 57; sandy clay, 67; blue clay, 84; sand, gravel, hardpan, 142; tough clay, 150; sand, gravel, 165; clay, boulders, 172; shale, 173.
323	"	.....	160	481	.....	.....	.....	.....	T	.....	.....	Township test hole No. 2–41. Sand, 6; sand, gravel, clay streaks, 22; fine sand, clay streaks, 52; sand, boulders, 60; sand, clay streaks, 160.
324	"	.....	134	487	.....	.....	.....	.....	T	.....	.....	Township test hole No. 3–41. Fine sand, 5; boulders, 8; sand, boulders, gravel, 39; gravel, clay, 52; cemented gravel, 74; tough clay, 82; blue clay, gravel, 117; hardpan, 119; gravel, boulder, 134.
325	"	.....	161	485	156	329	.....	.....	T	.....	.....	Township test hole No. 4–41. Sandy clay, 3; sand, gravel, 20; sandy clay, tough clay, blue clay, 145; tough clay, boulders, 156; shale, 161.

326	"	.....	129	488	.....	.....	.....	.....	T	.....	.....	Township test hole No. 5–41. Topsoil, 3; fine sand, 8; gravel, 18; gravel, clay, 49; tough clay, 54; blue clay, 98; sand, gravel, 110; clay, 113; sand, gravel, boulders, 129.
327	"	.....	166	486	166	320	.....	.....	T	.....	.....	Township test hole No. 6–41. Topsoil, 1; sandy clay, 3; sand, gravel, 11; blue clay, gravel, 63; gravel, 66; gravel, blue clay, 86; tough clay, 100; gravel, clay streaks, 110; fine sand, clay, 166; rock.
328	"	.....	275	483	.....	.....	.....	.....	T	.....	.....	Township test hole No. 1–42. Topsoil, 4; sand, gravel, 12; clay, gravel, boulders, 53; clay, 60; clay, boulders, sand and gravel streaks, 102; sand, gravel, clay streaks, 127; clay, sand and gravel streaks, 154; clay, gravel, 172; hardpan, 174; hardpan, clay, gravel, streaks, 221; clay, gravel, 242; sand, gravel, clay, 275.
329	"	.....	175	482	.....	.....	.....	.....	T	.....	.....	Township test hole No. 2–42. Soil, 1; sandy clay, gravel, boulders, 16; clay, gravel, boulders, 49; clay, 95; sand, gravel, clay, 115; hardpan, 121; clay, gravel, hardpan, streaks, 175.
330	"	.....	165	480	.....	.....	.....	.....	T	.....	.....	Township test hole No. 3–42. Soil, clay, 1; sand, gravel, 10; sandy clay, clay, 96; clay, sand, gravel streaks, 130; hardpan, 131; clay, sand, gravel, streaks of hardpan, 165.
331	"	.....	153	486	.....	.....	.....	.....	T	.....	.....	Township test hole No. 4–42. Soil, 2; clay, sandy clay, 129; sand, gravel, 149; clay, 153; clay, hardpan streaks, 153.
332	"	.....	150	486	.....	.....	.....	.....	T	.....	.....	Township test hole No. 5–42. Soil, 1; clay, 3; sand, gravel, 10; clay, gravel, 15; clay, sandy clay, boulders, 110; clay, sand and gravel streaks, 115; sand, gravel, clay streaks, 141; hard clay, 150.
333	"	.....	174	486	.....	.....	.....	.....	T	.....	.....	Township test hole No. 6–42. Soil, 2; sand, gravel, 13; clay, boulders, 28; sandy clay, clay, 113; clay, sand and gravel streaks, 126; sand, gravel, hardpan streaks, 131; sand and gravel streaks, 145; clay, boulders, streaks of sand and gravel, 164; sand, gravel, 172; hardpan, 174.
334	"	.....	174	486	.....	.....	.....	.....	T	.....	.....	Township test hole No. 7–42. Soil, 5; sand, gravel, boulders, 12; sandy clay, 33; sand, 39; sandy clay, clay, 125; clay, sand and gravel streaks, 130; clay, 134; sand, gravel, hardpan streaks, clay streaks, 155; clay, hardpan streaks, 174.
335	"	.....	174	486	.....	.....	.....	.....	T	.....	.....	Township test hole No. 8–42. Soil, 2; sandy clay, sand, gravel, clay, 143; hardpan, 144; sand, gravel, 147; clay, 161; sand, gravel, hardpan streaks, boulders, 174.
336	"	.....	149	483	.....	.....	.....	.....	T	.....	.....	Township test hole No. 9–42. Soil, 7; clay, gravel, 10; clay, sandy clay, boulders, 118; clay, hardpan streaks, 149.
337	"	.....	165	486	.....	.....	.....	.....	T	.....	.....	Township test hole No. 10–42. Soil, sand, gravel, 9; clay, gravel boulders, 28; sandy clay, clay, 102; sand, gravel, clay, 160; clay, gravel, boulders, 165.

[1]Symbols designating Use are: A—abandoned; C—commercial; D—domestic; In—industrial; Ir—irrigation; P—public supply; S—stock; T—test hole.

APPENDIX A—WATER-WELL DATA FOR WELLS DRILLED IN THE TOWNSHIP OF NORTH YORK—*Continued*

Well No.	Type	Casing diameter	Depth	Elevation, surface	Thickness of drift	Elevation, top of bedrock	Static level	Aquifer	Use[1]	Quantity	Kind	Log and Remarks (Figures used in logs indicate depths, in feet, to which formations extend below surface.)
		inches	feet	feet a.s.l.	feet	feet a.s.l.	feet					
338	Drilled	.....	163	486	.....	.....	.....	.....	T	.....	.....	Township test hole No. 11–42. Soil, sand, 5; clay, gravel, 9; clay, sandy clay, 90; sand, gravel, clay, streaks of hardpan, 163; hardpan.
339	"	.....	153	486	.....	.....	.....	.....	T	.....	.....	Township test hole No. 12–42. Soil, 3; clay, sand, gravel, 11; sandy clay, 28; clay boulders, 53; sandy clay, clay, gravel streaks, 115; sand, gravel, some clay, 117; hardpan, 122; sand, gravel, hardpan streaks, 139; clay, gravel, boulders, 153.
340	"	.....	128	409	.....	.....	.....	.....	.....	.....	.....	Township test hole No. 1–44. Sand, gravel, 17; blue clay, 24; sand, gravel, 26; tough clay, 75; sand, gravel, 78; clay, some sand, gravel, 83; cemented gravel, 93; blue clay, 109; sand, gravel, some clay, 122; tough clay, 126; clay, cemented gravel, 128.
341	"	.....	133	407	133	274	.....	.....	T	.....	.....	Township test hole No. 2–44. Sand, gravel, some clay, 30; clay, 34; sand, gravel, 37; tough clay, clay, boulders, 110; cemented gravel, 118; tough clay, 125; cemented gravel, 128; tough clay, 131; hardpan, 133; rock.
342	"	.....	179	465	.....	.....	.....	.....	T	.....	.....	Township test hole No. 1–46. Soil, 1; sand, 3; clay, gravel, 8; clay, sand and gravel streaks, 117; dirty gravel, silt streaks, 137; clay, gravel, 179.
343	"	.....	187	458	.....	.....	.....	.....	T	.....	.....	Township test hole No. 2–46. Soil, 1; sandy clay, tough clay streaks, 74; sandy clay, 77; soft clay, gravel, 99; tough clay, clay, gravel streaks, 187.
344	"	.....	52	447	42	405	.....	.....	T	.....	.....	Township test hole No. 3–46. Sand, 8; clay, gravel, 16; fine, dirty sand, 27; sandy clay, gravel, 34; hard clay, gravel, 42; shale, 52.
345	"	.....	179	505	.....	.....	.....	.....	T	.....	.....	Township test hole No. 5–46. Sand, coarse gravel, 9; soft clay, boulders, 28; sand, gravel, silty streaks, 46; blue clay, 53; coarse gravel, clay, 78; fine gravel, 81; hard clay, 93; hardpan, 108; clay, boulders, 114; hard clay, hardpan streaks, 179.
346	"	.....	176	504	.....	.....	.....	.....	T	.....	.....	Township test hole No. 6–46. Fine, dirty sand, 16; clay, 21; sand, gravel, silt streaks, 36; gravel, clay, 38; sand, some coarse gravel, 62; clay, gravel and hardpan streaks, boulders, 176.
347	"	.....	178	533	176	357	.....	.....	T	.....	.....	Township test hole No. 12-46. Clay, boulders, 16; hard, sandy clay, 27; clay, gravel, boulders, 61; fine, hard-packed sand, 119; hard-packed silt, clay streaks, 132; clay, cemented sand streaks, 176; shale, 178.

348	"	.....	167	545	.....	.....	.....	.....	T	.....	.....	Township test hole No. 13–46. Topsoil, 1; sand, 7; coarse gravel, 18; cemented sand, 34; clay, gravel, 59; packed sand, hard streaks, 102; clay, gravel, 109; hard sand, fine gravel, 121; silty sand, cemented streaks, 136; cemented sand, 148; clay, gravel, 167.
349		.....	196	544	192	352	.....	.....	T	.....	.....	Township test hole No. 1–47. Topsoil, 1; dirty sand, 6; clay, boulders, 22; coarse gravel, sand, 36; clay, gravel, 80; hard-packed sand, clay streaks, 113; clay, gravel, boulders, 120; tough clay, 134; hard sand, silt streaks, 182; clay, 192; shale, 196.
350	"	.....	163	516	.....	.....	.....	.....	T	.....	.....	Township test hole No. 2–47. Clay, 10; clay, gravel, 21; sandy clay, 40; dirty sand, clay streaks, 102; tough clay, sand streaks, 132; loose dirty sand, cemented streaks, 139; cemented sand, 163.
351	"	5⅜	251	567	247	320	.....	.....	T	.....	.....	Maclean-Hunter Pub. Co., Ltd. test hole No. 1–46. Topsoil, 1; clay, gravel, 21; sandy clay, clay, 74; clay, silt, sand, 99; sandy clay, hard, silty sand streaks, 160; hard-packed sand, 240; cemented sand, 247; shale, 251.
352	"	5⅜	253	567	249	318	.....	.....	T	.....	.....	Maclean-Hunter Pub. Co., Ltd. test hole No. 2–46. Topsoil, 1; sandy clay, 14; clay, shale streaks, 94; sandy clay, 119; hard-packed, fine sand, 249; shale, 253.
353	"	5⅜	252	567	249	318	.....	.....	T	.....	.....	Maclean-Hunter Pub. Co., Ltd. test hole No. 3–46. Topsoil, 1; clay, 11; hard, sandy clay, gravel, 23; hardpacked sand, clay, 61; tough clay, fine gravel, 127; hardpacked sand, clay, 249; shale, 252.
354	"	5⅜	254	567	250	317	.....	.....	T	.....	.....	Maclean-Hunter Pub. Co., Ltd. test hole No. 4–46. Topsoil, 1; clay, shale-like streaks, 26; clay, sand and clay streaks, 79; clay, cemented sand streaks, 117; cemented sand, clay streaks, 250; shale, 254.
355	"	5⅜	123	583	.....	.....	.....	.....	T	.....	.....	Maclean-Hunter Pub. Co., Ltd. test hole No. 5–46. Topsoil, 1; hard clay, shale streaks, 34; coarse sand, little clay, 41; hard, sandy clay, 74; hardpacked sand, 123.
356	"	5⅜	49	454	46	408	.....	.....	T	.....	.....	Oakdale Golf Course Test hole No. 1–46. Topsoil, 2; coarse gravel, 5; sandy clay, gravel, 20; clay, gravel, boulders, 44; clay, boulders, 46; shale, 49.
357	"	.....	40	453	38	415	.....	.....	T	.....	.....	Oakdale Golf Course test hole No. 2–46. Topsoil, 1; dirty sand, 9; gravel, 11; clay, gravel, boulders, 38; shale, 40.
358	"	5⅜	41	456	38	414	.....	.....	T	.....	.....	Oakdale Golf Course test hole No. 3–46. Topsoil, 1; sandy clay, 7; clay, gravel, 38; shale, 41.
359	"	5⅜	39	460	36	424	.....	.....	T	.....	.....	Oakdale Golf Course test hole No. 4–46. Topsoil, 2; clay, 12; hard clay, gravel, 36; shale, 39.

[1]Symbols designating Use are: A—abandoned; C—commercial; D—domestic; In—industrial; Ir—irrigation; P—public supply; S—stock; T—test hole.

APPENDIX A—WATER-WELL DATA FOR WELLS DRILLED IN THE TOWNSHIP OF NORTH YORK—*Continued*

Well No.	Type	Casing diameter	Depth	Elevation, surface	Thickness of drift	Elevation, top of bedrock	Static level	Aquifer	Use[1]	Quantity	Kind	Log and Remarks (Figures used in logs indicate depths, in feet, to which formations extend below surface.)
		inches	feet	feet a.s.l.	feet	feet a.s.l.	feet					
360	Drilled	5⅜	39	461	36	425	.....	.....	T	.....	.....	Oakdale Golf Course test hole No. 5–46. Topsoil, 1; clay, 12; sandy clay, 25; clay, gravel, 36; shale, 39.
361	"	5⅜	40	463	36	427	.....	.....	T	.....	.....	Oakdale Golf Course test hole No. 6–46. Topsoil, 1; clay, 16; sandy clay, 29; clay, gravel, 36; shale, 40.
362	"	5	161	479	151	328	.....	.....	T	.....	.....	York Downs Golf Course Test hole No. 1–45. Coarse gravel, sand, 21; blue clay, 99; clay, gravel, 145; blue clay, gravel, 147; blue clay, 151; shale, 161.
363	"	5	155	480	155	325	.....	.....	T	.....	.....	York Downs Golf Course test hole No. 2–45. Brown sand, 4; coarse gravel, 19; clay, gravel, 58; soft, blue clay, 107; soft, blue clay, fine sand, gravel, 155; shale, 155.
364	"	5	30	480	.....	.....	.....	.....	T	.....	.....	York Downs Golf Course test hole No. 3–45. Sandy loam, boulders, 7; sand, gravel, boulders, clay, 23; sandy clay, boulders, 30.
365	"	5	153	480	153	327	.....	.....	T	.....	.....	York Downs Golf Course test hole No. 3A–45. Sandy loam, boulders, 7; gravel, boulders, clay, 23; clay, sand, boulders, 75; sand, gravel, clay, 153; rock.
366	"	5	146	468	146	322	.....	.....	T	.....	.....	York Downs Golf Course test hole No 4–45. Gravel, boulders, 9; fine, silty sand, 14; blue clay, 35 tough clay, sand, 136; gravel, boulders. clay, 146; rock.
367	"	5	271	591	.....	.....	.....	.....	T	.....	.....	York Downs Golf Course test hole No. 5–45. Topsoil, 1; clay, gravel, boulders, hardpan streaks, 105; packed, sandy clay, 145; clay, gravel, sand streaks, 205; packed, sandy clay, 227; clay, gravel, 252; packed, sandy clay, 271.
368	"	5	155	472	155	317	.....	.....	T	.....	.....	York Downs Golf Course test hole No. 6–45. Topsoil, 1; sand, 6; sand, gravel, 13; clay, 65; clay, gravel, boulders, 105; sandy clay, clay, gravel, 155; rock.
369	"	5	150	484	.....	.....	....	.....	T	.....	.....	York Downs Golf Course test hole No. 7–45. Topsoil, sand, 5; sand, gravel, boulders, 20; clay, 83; hard, sandy clay, hardpan streaks, 115; clay, sand streaks, 133; fine sand, gravel, 150.
370	"	.....	71	454	61	393	.....	.....	T	.....	.....	Weston test hole No. 1. Topsoil, 1; clay, 6; sand, 11; blue clay, boulders, 20; hardpan, 26; clay, gravel, 48; hard clay, 61; shale, 71.
371	"	.....	64	481	60	421	.....	.....	T	.....	.....	Weston test hole No. 2. Clay, 16; sand, gravel, 26; clay, 34; sand, gravel, 50; clay, gravel, 60; shale, 64.
372	"	.....	35	464	30	434	.....	.....	T	.....	.....	Weston test hole No. 3. Sand, 1; sandy clay, 4; clay, boulders, 9; blue clay, 30; shale, 35.

373	"	.....	54	465	50	415	.....	.....	T	.....	.....	Weston test hole No. 4. Sandy clay, 4; clay, sand, 14; sand, gravel, 30; gravel, 36; clay, gravel, 50; shale, 54.
374	"	.....	195	503	195	308	.....	.....	T	.....	.....	Weston test hole No. 5. Sandy clay, clay, 69; fine sand, 99; clay, sand, gravel, 150; gravel, sand, 195; shale.
375	"	.....	64	416	55	361	.....	.....	T	.....	.....	Weston test hole No. 6. Gravel, sand, 27; tough clay, 40; gravel, sand, 44; clay, boulders, 55; shale, 64.
376	"	.....	61	480	.....	.....	.....	.....	T	.....	.....	Weston test hole No. 8. Sandy clay, 10; sand, gravel, 13; clay, 15; sand, gravel, 33; tough clay, 41; gravel, clay, 48; gravel, sand, 61.
377	"	.....	43	471	33	438	.....	.....	T	.....	.....	Weston test hole No. 9. Clay, 8; grey sand, gravel, 27; clay, boulders, 33; shale, 43.
378	"	.....	36	478	32	446	.....	.....	T	.....	.....	Weston test hole No. 10. Clay, 29; tough clay, boulders, 32; blue shale, 36.
379	"	.....	41	471	38	433	.....	.....	T	.....	.....	Weston test hole No. 11. Sand, gravel, 1; tough clay, 22; fine sand, 27; tough clay, 30; sand, gravel, 32; tough clay, 38; shale, 41.
380	"	.....	57	451	56	395	.....	.....	T	.....	.....	Weston test hole No. 12. Blue clay, 17; sand clay, 37; hardpan, 39; hard-packed, grey sand, 47; clay, 51; sand, gravel, 53; clay, boulders, 56; shale, 57.
381	"	.....	97	418	97	321	.....	.....	T	.....	.....	Township test hole No. 3–30. Subsoil, 5; sand, clay, 67; sand, 76; fine sand, clay, gravel, 82; clay, 90; shale, 92; bluestone, 93; clay, 94; shale, 97.
382	"	.....	117	481	113	368	.....	.....	T	.....	.....	Township test hole No. 1–31. Sand, 10; quicksand, gravel, 25; quicksand, 80; quicksand, gravel, 110; shale, 113.
383	"	.....	96	437	95	342	.....	.....	T	.....	.....	Weston test hole No. 15. Sandy clay, 9; sand, gravel, boulders, 39; sand, gravel, some clay, 45; clay, 80; clay, boulders, 95; shale, 96.
384	"	.....	18	497	13	484	.....	.....	T	.....	.....	Weston test hole No. 38–32. Sand, gravel, boulders, 11; sand, boulders, 13; shale, 18. Location of this well uncertain.
385	"	.....	210	410	.....	.....	.....	.....	T	.....	.....	Weston test hole No. 34–32. Dry quicksand, 37; quicksand, gravel, 54; dry quicksand, gravel, 108; sand, gravel, 113; sand, gravel, clay, 124; quicksand, gravel, 176; quicksand, gravel, clay, 210.
386	"	.....	73	398	73	325	.....	.....	A	.....	.....	A second abandoned well is 3 ft. south of this well; wells drilled in 1931; pumped for a few months, then abandoned; pumped again in 1941 and 1945; both wells now capped. Quicksand, gravel, 73; limestone.
387	"	.....	98	514	98	416	.....	Gravel	P	500 g.p.m.	Fresh, with iron	Site of municipal well; Weston test hole No. 40–32. Clay, sand, gravel, 55; quicksand, gravel, sand, 96; hardpan, 98; shale.
388	"	.....	96	509	93	416	.....	.....	T	.....	.....	Weston test hole No. 1–38. Clay, 5; coarse sand, 29; hardpan, 59; gravel, clay, 78; coarse sand, 93; shale, 96.
389	"	.....	115	514	115	399	.....	.....	T	.....	.....	Weston test hole No. 2–38. Clay, 5; coarse sand, 47; hardpan, 62; gravel, clay, 82; gravel, 88; fine sand, 115; shale.

[1]Symbols designating Use are: A—abandoned; C—commercial; D—domestic; In—industrial; Ir—irrigation; P—public supply; S—stock; T—test hole.

APPENDIX A—WATER-WELL DATA FOR WELLS DRILLED IN THE TOWNSHIP OF NORTH YORK—*Continued*

Well No.	Type	Casing diameter	Depth	Elevation, surface	Thickness of drift	Elevation, top of bedrock	Static level	Aquifer	Use[1]	Quantity	Kind	Log and Remarks (Figures used in logs indicate depths, in feet, to which formations extend below surface.)
		inches	feet	feet a.s.l.	feet	feet a.s.l.	feet					
390	Drilled	.....	123	509	122	387	.....	.....	T	.....	.....	Weston, test hole No. 3–38. Sand, 5; sand, clay, 10; fine sand, 33; hardpan, 59; clay, gravel, 64; sand, gravel, clay, 78; coarse sand, 88; gravel, sand, clay, 93; coarse sand, 98; clay, 122; shale, 123.
391	"	.....	140	516	139	377	.....	Gravel	P	500 g.p.m.	Fresh, with iron	Site of municipal well. Weston test hole No. 4–38. Clay, 20; clay, fine sand, 74; hardpan, 95; clay, some gravel, 139; shale, 140.
392	"	.....	174	486	174	.....	.....	.....	P	.....	.....	Site of township well No. 1. Sand, 11; fine sand, gravel, 15; quicksand, gravel, 30; quicksand, 35; quicksand, fine sand, gravel, sand, 147; quicksand, little gravel, 174. Water flowed originally at 40 gallons per minute.
393	"	.....	.....	378	100	278	.....	.....	T	.....	.....	Overburden, 100; shale.
394	"	.....	166	512	.....	.....	.....	Drift	P	.....	.....	Site of township well No. 2. Sandy clay, 5; sand, gravel, boulders, 9; clay, 12; clay, gravel, boulders, 23; clay, gravel, 52; hardpan, 59; clay, gravel, 81; clay, 85; clay, gravel, 108; clay, 111; sand, gravel, 148; fine sand, silt, gravel streaks, 156; fine sand, clay streaks, 166.
395	"	5	139	512	139	373	.....	"	.....	75 g.p.m.	Fresh	Sand, clay, 8; coarse sand, gravel, 14; pea gravel, coarse sand, 63; coarse sand, fine gravel, 70; dirty sand, 74; sand, gravel-packed streaks, 100; pea gravel, sand, 115; packed gravel, sand, 125; tough clay, gravel, 139; shale. Used as observation well.
396	"	.....	.....	.....	.....	.....	.....	.....	P	.....	.....	Site of township well No. 4.
397	"	2	354	587	354	233	.....	.....	T	.....	.....	Drilled to test thickness of drift for seismic survey.

[1]Symbols designating Use are: A—abandoned; C—commercial; D—domestic; In—industrial; Ir—irrigation; P—public supply; S—stock; T—test hole.

APPENDIX B—SUMMARY OF DUG-WELL DATA, TOWNSHIP OF NORTH YORK

Location	Dug wells	Depth of well		Quantity of water			Use			
		Average	Range	Never dry, adequate supply	Occasionally dry, inadequate supply	Not indicated	Domestic and stock	Irrigation	Not indicated	Dry or abandoned at time of survey
	number	feet	feet	number	number	number	number	number	number	number
EAST OF YONGE STREET:										
Concession I:										
Lot 1	1	59				1				1
Lot 3	3	9	6–12	3			2	1		
Lot 4	1	9½		1						1
Lot 11	2	25	24–26	1		1				2
Lot 12	1	26		1						1
Lot 13	1	11				1				1
Lot 16	3	26	21–36	3			2			1
Lot 19	2	33	22–45	1		1	1			1
Lot 20	1	26		1			1			
Lot 21	2	25			2		2			
Lot 23	1	11			1					1
Lot 24	1	30				1				1
Lot 25	2	34	33–36		2		2			
Concession II:										
Lot 4	1	5		1			1			
Lot 5	2	23	20–26			2				2
Lot 8	2	35	23–48	2			2			
Lot 10	2	42	–42		1	1	1			1
Lot 11	2	21	11–31	1		1	1			1
Lot 12	2	38	32–45	1	1		2			
Lot 13	2	36	36–37	1		1				2
Lot 15	1	28				1				1
Lot 16	7	24	12–35	7			4	2		1
Lot 17	1	45		1			1			
Lot 18	3	37	22–45	2		1	2	1		
Lot 19	1	47		1			1			
Lot 20	10	20	8–36	7		3	7			3
Lot 21	3	11	9–13	2		1	3			
Lot 22	3	19	16–25	2		1	3			
Lot 23	4	27	22–36	4			3			1
Lot 24	1	40			1		1			
Lot 25	2	33	16–51	1		1				2

APPENDIX B—SUMMARY OF DUG-WELL DATA, TOWNSHIP OF NORTH YORK—*Continued*

Location	Dug wells	Depth of well		Quantity of water			Use			
		Average	Range	Never dry, adequate supply	Occasionally dry, inadequate supply	Not indicated	Domestic and stock	Irrigation	Not indicated	Dry or abandoned at time of survey
	number	feet	feet	number	number	number	number	number	number	number
Concession III:										
Lot 1	4	22	11–35	2		2	4			
Lot 2	1	30		1			1			
Lot 5	4	26	16–43	1	2	1	4			
Lot 6	4	33	24–53	4			4			
Lot 7	6	24	11–48	1		5	4		2	
Lot 8	8	30	12–57	3	3	2	7			1
Lot 9	3	29	7–51	3			3			
Lot 10	6	11	9–14	4	1	1	5			1
Lot 11	4	16	8–22	4			3	1		
Lot 12	3	38	11–83	2		1	2			1
Lot 13	4	22	12–42	2		2	2			2
Lot 14	1	19		1			1			
Lot 15	1	42				1	1			
Lot 17	1	32				1				1
Lot 18	1	47			1		1			
Lot 19	1	40				1	1			
Lot 20	2	24	22–26	1		1	2			
Lot 21	1	20		1			1			
Lot 22	2	49	18–80	1	1		2			
Lot 23	2	61	42–80	2			2			
Lot 24	1	28		1			1			
Lot 25	3	28	21–40	1	2		2			1
Concession IV:										
Lot 1	5	32	15–50	1	2	2	5			
Lot 2	4	31	18–60			4	4			
Lot 3	5	23	13–55	1		4	4			1
Lot 4	6	19	12–26	5		1	6			
Lot 5	9	25	9–50	4		5	7			2
Lot 6	1	48				1	1			
Lot 8	3	37	32–45	2	1		3			
Lot 9	1			1			1			
Lot 10	2	48	20–75	1		1	2			
Lot 11	3	25	7–34	2		1	3			
Lot 12	3	53	40–70			3	2			1
Lot 14	2	52	50–54	1		1	2			

Lot 15	6	29	11–45	4	1	1	6			
Lot 16	3	34	30–41	2		1	2			1
Lot 17	5	31	13–52	2		3	5			
Lot 18	2	31	29–32	1		1	2			
Lot 19	3	29	14–50			3	2			1
Lot 20	4	28	18–32	1		3	4			
Lot 21	1	26			1		1			
Lot 22	1	11				1				1
Lot 23	1	10				1	1			
Lot 24	4	14	6–22			4	3			1
FROM LAKE ONTARIO:										
Concession III:										
Lot 3	7	32	15–75	4		3	7			
Lot 4	5	23	19–27	4	1		5			
Lot 5	8	36	20–51	6		2	7			1
Lot 8	1	80			1		1			
Lot 9	2	30	25–35	1		1	1			1
Lot 10	1	17		1			1			
WEST OF YONGE STREET:										
Concession I:										
Lot 9	1	50		1			1			
Lot 11	2	40	38–42	2			1			1
Lot 15	1	35			1		1			
Lot 16	4	31	25–35	3		1	3		1	
Lot 17	1	18		1			1			
Lot 19	4	25	17–37	1	2	1	3			1
Lot 20	1	15			1		1			
Lot 21	3	36	34–38	2	1		1			2
Lot 22	2	48	30–65	2			2			
Lot 23	4	16	8–24	1	1	2	3			1
Lot 24	9	14	6–22	5	1	3	6	1		2
Lot 25	1	22			1		1			
Concession II:										
Lot 5	1	94				1				1
Lot 6	2	40		2			1			1
Lot 7	1	60		1						1
Lot 10	1	16		1			1			
Lot 11	2	15	13–17	1		1				2
Lot 12	1	36		1			1			
Lot 13	3	29	6–68	2	1		1	2		
Lot 14	1	34		1			1			
Lot 15	10	32	10–60	6	1	3	9			1
Lot 16	3	18	5–28	1		2	2			1
Lot 17	3	50	34–66	1	1	1	1			2

APPENDIX B—SUMMARY OF DUG-WELL DATA, TOWNSHIP OF NORTH YORK—*Continued*

Location	Dug wells	Depth of well		Quantity of water			Use			
		Average	Range	Never dry, adequate supply	Occasionally dry, inadequate supply	Not indicated	Domestic and stock	Irrigation	Not indicated	Dry or abandoned at time of survey
	number	feet	feet	number	number	number	number	number	number	number
Lot 19	1	25	.....	.....	.....	1	.....	.....	.....	1
Lot 22	1	26	.....	1	.....	.....	1	.....	.....	.....
Lot 23	1	36	.....	1	.....	.....	1	.....	.....	.....
Lot 25	2	.....	?–120	2	.....	.....	2	.....	.....	.....
Concession III:										
Lot 3	1	68	.....	.....	.....	1	.....	.....	.....	1
Lot 5	2	65	40–90	.....	.....	2	.....	.....	1	1
Lot 6	1	80	.....	1	.....	.....	1	.....	.....	.....
Lot 9	1	29	.....	1	.....	.....	.....	1	.....	.....
Lot 10	1	27	.....	1	.....	.....	1	.....	.....	.....
Lot 11	5	15	10–22	2	1	2	2	.....	.....	3
Lot 12	2	20	10–30	1	1	.....	1	.....	.....	1
Lot 14	2	29	28–30	2	.....	.....	1	1	.....	.....
Lot 16	1	19	.....	.....	1	.....	.....	.....	.....	1
Lot 18	1	39	.....	1	.....	.....	1	.....	.....	.....
Lot 19	1	18	.....	1	.....	.....	1	.....	.....	.....
Lot 20	5	24	20–30	4	1	.....	5	.....	.....	.....
Lot 21	6	28	22–35	1	4	1	5	.....	.....	1
Lot 22	2	30	14–45	1	1	.....	1	.....	.....	1
Lot 23	1	24	.....	.....	1	.....	1	.....	.....	.....
Lot 24	4	23	18–26	4	.....	.....	4	.....	.....	.....
Lot 25	6	27	11–40	4	.....	2	3	1	.....	2
Concession IV:										
Lot 3	1	44	.....	1	.....	.....	1	.....	.....	.....
Lot 4	1	19	.....	1	.....	.....	1	.....	.....	.....
Lot 5	19	16	10–41	14	.....	5	14	.....	.....	5
Lot 7	26	18	6–43	16	2	8	18	3	.....	5
Lot 8	4	24	18–36	3	.....	1	2	1	.....	1
Lot 9	5	16	9–26	3	.....	2	4	.....	.....	1
Lot 10	10	17	6–30	6	.....	4	6	.....	.....	4
Lot 11	6	34	16–51	5	.....	1	5	.....	.....	1
Lot 12	1	22	.....	1	.....	.....	1	.....	.....	.....
Lot 13	2	28	25–30	1	1	.....	2	.....	.....	.....
Lot 15	1	30	.....	1	.....	.....	1	.....	.....	.....

Lot 16	2	21		1		1	2			
Lot 17	1	17			1		1			
Lot 18	1	16		1			1			
Lot 19	1	16				1	1			
Lot 20	1	22		1			1			
Lot 21	3	47	15–95	2		1	3			
Lot 22	2	26		1	1		2			
Lot 24	1	18		1			1			
Lot 25	3	43	28–60	3			3			
Concession V:										
Lot 4	5	14	9–17	4		1	4			1
Lot 8	10	29	18–40	9		1	10			
Lot 9	8	38	20–69	6	1	1	7			1
Lot 10	6	18	13–28	4		2	3	1		2
Lot 12	1	21		1			1			
Lot 13	2	25	18–32	1	1		2			
Lot 14	1	14		1			1			
Lot 16	4	28	14–38	2	1	1	4			
Lot 17	3	10	5–12			3	3			
Lot 19	1	5		1			1			
Lot 20	3	30	26–34	2		1	1			2
Lot 21	2	30	26–33	2			2			
Lot 22	6	19	8–22	5	1		6			
Lot 23	5	16	10–28	3		2	4		1	
Lot 24	4	19	14–28	2		2	2		2	
Lot 25	4	25	8–53	2	1	1	3		1	
Concession VI:										
Lot 10	1	12				1				1
Lot 15	1			1			1			
Lot 18	1	20				1	1			
Lot 19	2	25	18–32	2			2			
Lot 20	2	12		1		1	2			
Lot 21	3	13	6–21	2	1		3			
Lot 22	3	15	13–17	3			3			
Lot 23	6	17	7–22	3		3	3			3
Lot 24	5	18	14–22	2		3	2			3
Lot 25	6	21	13–28	4		2	6			
Concession VII:										
Lot 22	2	19	15–22	1		1	1			1
Lot 23	10	15	11–19	8	1	1	10			
Lot 24	57	14	7–27	50	1	6	51		2	4
Lot 25	8	12	8–16	7		1	7			1
Total	602			377	59	166	471	16	6	109

INDEX, PART 7

A PAGE

Acknowledgments 4, 5
Analyses, chemical.
  Notes on 35–37
  Table of ..... *facing* 32
Analyses, mechanical 16–20
Aquifers 32, 33, 38, 41–49

B

Baker, G. H. 4
Beaches 9, 26
Bedrock 10, 11
  Contours, map showing ..... *in pocket*
  Valleys in 28, 30, 31
  Water in 2, 33
Bibliography 5, 6
Black Creek.
  Bedrock valley 28, 32
  Till, mechanical analysis 16
Boulder clay. *See* Till.
Boulder pavements 14, 24, 29

C

Caley, J. F. 5, 6
Chemical analyses 35–37
  Table ..... *facing* 32
Clays. *See* Stratified deposits; Varved clay.
Climate 9, 10
  Interglacial 13
Cody, J. 5
Colclough, D. G. 5
Collingwood formation 11

D

Deane, R. D. 24
Deltaic deposits 25
  Mechanical analysis 19
Don beds 13, 29, 31
Don River 8, 9
  E. branch. *See* Little Don R.
  Interglacial deposits 29
    mechanical analyses 16–18
    till 27, 28
  Water supplies from 7
Drainage 7–9
  Preglacial 8, 31, 32
Drumlins 7
  Notes and photo 20–22
Dundas formation 10, 11
  Water in 33, 38
Dug wells. *See* Wells.

E

Elevations 9
  Glacial lakes 26

F

Forman, S. A. 5

G PAGE

Geology, general 10–26
Geophysical surveys, notes and photo .. 3, 4
Glacial deposits 11–24
  See also Stratified deposits; Till.
Glacial lakes 8, 24, 26
  See also Lake Iroquois.
Glaciation 7, 11, 20–24
Glaciofluvial deposits 12, 25, 26
  Mechanical analyses 18, 19
Glaciolacustrine deposits 12, 25, 26
  See also Lake Iroquois.
Gloucester formation 11
Gourlay, W. 34
Grooves, glacial 21, 22
Ground water 32–39
  Oxidation by 24
  Survey, notes on 2

H

Hardness in water 37
Henderson, E. P. 5
Highway 400.
  Tills, analysis 16, 17
    photo 21
  Varved clay, photo 15
Highway 401 ..... 12, 30
Hiles, W. A. 5
Historical notes 1, 6, 7
Hodgson, J. H. 3
Humber River 8–10, 27
  Sand and gravel 25, 26
  Till 12, 16, 27

I

Ice-block ridges 24
Illinoian till 11–13
  Mechanical analyses 17
  Sections. *See* Sections.
Industrial water 2, 38, 39
Interglacial deposits 11–13, 31
  Ground water in 33
  Mechanical analyses 17, 18
International Water Supply Co., Ltd. .. 5
Iron oxide 37
Irrigation, water for 38, 39

L

Lake Iroquois 28, 29, 31
  Beach, elevation 9
  Shore line 8, 26
Little Don River 8
  Sections on 30, 31
    photo 14
  Terraces 26
  Till, mechanical analysis 17
  Varved clay 25
  Water supply from 1, 7
Logs of wells 49–56

M PAGE

Maclean-Hunter test holes 53
McClellan, J. B. 5
Maps.
Pleistocene geology ..... *in pocket*
Water wells and bedrock ..... *in pocket*
Markham tp. 7, 33, 38
Observation well 34
Mineralized water 33, 36, 37
Moddle, D. A. 5
Moraine, ground 13

O

Oakdale Golf Course 53, 54
Observation wells 34, 35
Oriole waterworks 7, 8
Overburden.
Description and photos 11–26
Ground water in 33
Sections 27–31
Seismic survey in 4
Oxidation by ground water 24

P

Pleistocene deposits 3
Stratigraphy 11–26
sections ..... *in pocket*
notes on 27–31
Pollution in wells 35
Population 10
Precipitation 10, 32, 38
Pumpage 6, 7, 38, 39

R

Recent deposits 26
Robertson, I. A. 4, 34
Roy, J. 34

S

Sand and gravel 25, 26
See also Stratified deposits.
Sanderson, E. L. 4
Sangamon interglacial deposits 13
Mechanical analyses 18, 19
See also Don beds; Scarborough beds.
Scarborough beds 29–31
Description 13
Mechanical analysis 18
Photo 14
Scarborough tp. 7
Sections, vertical ..... *in pocket*
Notes on 27–31
Seismic exploration, notes and photos .. 3, 4
Shales. *See* Dundas formation.
Shuter, G. 4, 34
Silt. *See* Stratified deposits.
Sorbora and Snider wells 48, 49
Stratified deposits.
Description 12–14, 25
Mechanical analyses 18–20
Sections, graphic ..... *in pocket*
notes on 27–31
Striae, glacial 24, 30

T PAGE

Terraces 8, 26
Test holes 2, 33
Logs 45, 49–56
Thomas, J. F. J. 35
Till.
Description and photos 11–15
Mechanical analyses 15–17, 20
Plain, notes and photo 7, 8
Sections in 27–31
Surface, patterns in, notes and photo . 23, 24
Weathering in 24
Topography 7–9
Toronto, climate 9, 10
Toronto formation 13
See also Don beds; Scarborough beds.
Treatment of water 7

U

Utilization of water 37, 38

V

Valleys 8, 10
Deposits in 26
Preglacial 28, 30
ground water in 2, 33
Varved clays 12, 13, 25
In sections 29–31
Photo 15
Varving 12

W

Water table 32
Waterworks plants.
Notes and statistics 1, 6, 7
Pump-house, photo 1
Weathering 24
Interglacial 13
Wells.
Drilled 32, 41–56
data summary ..... *facing* 32
Dug 32, 57–61
pollution in 35
Municipal 7, 33, 38
locations. *See* map No. 1955–7 *in pocket*
logs 49, 55, 56
pumpage from 38
Observation 34, 35
Water from, analyses of ..... *facing* 32
notes on 35–37
Water levels in 34, 35
Yields 33, 34
Weston 8, 10
Test holes 38
logs 45, 49, 54–56
Water purchased from 7
Winston Park well 48
Wisconsin glacier 8, 13, 25, 27
Deposits, notes and mechanical analyses 11–20
sections in. *See* Sections.
tills, differences in 29
photo 21
Movement of 20, 22–24

Y

Yarmouth interglacial stage 13
York Downs Golf Course 54
York tp., water from 7

TABLE IV—SUMMARY OF DRILLED-WELL DATA CONTAINED IN APPENDIX A

Insert to face page 32

Location	Total wells	Type of well		Water-bearing formation			Kind of water				Use of water							Dry
		Dug and drilled	Drilled	Overburden	Bedrock	Not indicated	Fresh	Salt	Mineral	Not indicated	Domestic and stock	Public supply	Commercial	Industrial	Irrigation	Test hole	Abandoned	
	number	number	number	number	number	number	number	number	number	number	number	number	number	number	number	number	number	number
East of Yonge Street:																		
Concession I	13	1	12	5			5				3					8	2	
Concession II	43	2	41	19		2	21				21					22		
Concession III	42	4	38	28	1	4	29			4	29	1			1	8	2	1
Concession IV	22	2	20	10	1	6	13	1		3	12		2			4	3	1
From Lake Ontario:																		
Concession III	7	4	3	3		3	4			2	5						1	1
West of Yonge Street:																		
Concession I	18	2	16	10			9			1	7	1			1	8	1	
Concession II	72	6	66	63		3	62			4	58	2			4	5	4	1
Concession III	31	2	29	29	1		28			2	26		1	1			3	1
Concession IV	56	3	53	38	1	3	38		1	3	30	3		1	1	14	7	
Concession V	68	9	59	27	12	15	48	1	1	4	44	2		1		12	7	2
Concession VI	20	1	19	11	3	5	12	2		5	7	1				3	8	
Concession VII	2		2	2			2				1	1						
Total	394	36	358	245	19	41	271	4	2	28	243	11	3	3	7	84	38	7

TABLE V—CHEMICAL ANALYSES OF WELL WATER, TOWNSHIP OF NORTH YORK

Sample No.	Well No.(1)	Location		Depth	Aquifer	Date sample taken	Residue on evaporation (parts per million)	Constituents(2) as analysed (parts per million)								Hardness as $CaCO_3$ (parts per million)		
		Con.	Lot					Ca	Mg	Na(3)	SO_4	Cl	SiO_2	Fe_2O_3 and Al_2O_3	Alkalinity as $CaCO_3$	Ca	Mg	Total
				feet														
1	.....	IV E.	20	18	Overburden	Sept. 19, 1950	413	57	7	79	20	10	15	6	310	143	29	172
2	.....	III E.	11	22	Overburden	Sept. 19, 1950	320	25	10	85	9	12	3	trace	262	63	41	104
3	.....	II W.	15	50	Overburden	Sept. 12, 1950	926	94	43	102	229	46	17	0	328	235	176	411
4	.....	III E.	6	52½	Overburden	Sept. 19, 1950	720	8	1	157	4	36	41	trace	310	20	4	24
5	48	III E.	14	96	Overburden	Sept. 19, 1950	337	46	8	82	2	10	6	2	312	115	33	148
6	119	II W.	20	110	Overburden	Sept. 12, 1950	388	40	15	82	60	12	10	0	252	100	62	162
7	31	III E.	25	190	Overburden	Sept. 19, 1950	286	44	15	78	4	6	18	trace	333	110	62	172
8	237	VI W.	23	130	Bedrock	Sept. 12, 1950	56,310	355	72	21,200	534	33,120	0	0	29	888	295	1,183

(1)Number refers to well listed in Appendix A and shown on map No. 1955-7.
(2)Constituents are reported as number of parts by weight of the constituent per one million parts by weight of water.
(3)Na is calculated.

To accompany Ontario Department of Mines report, Vol. LXIV, part 7, 1955.

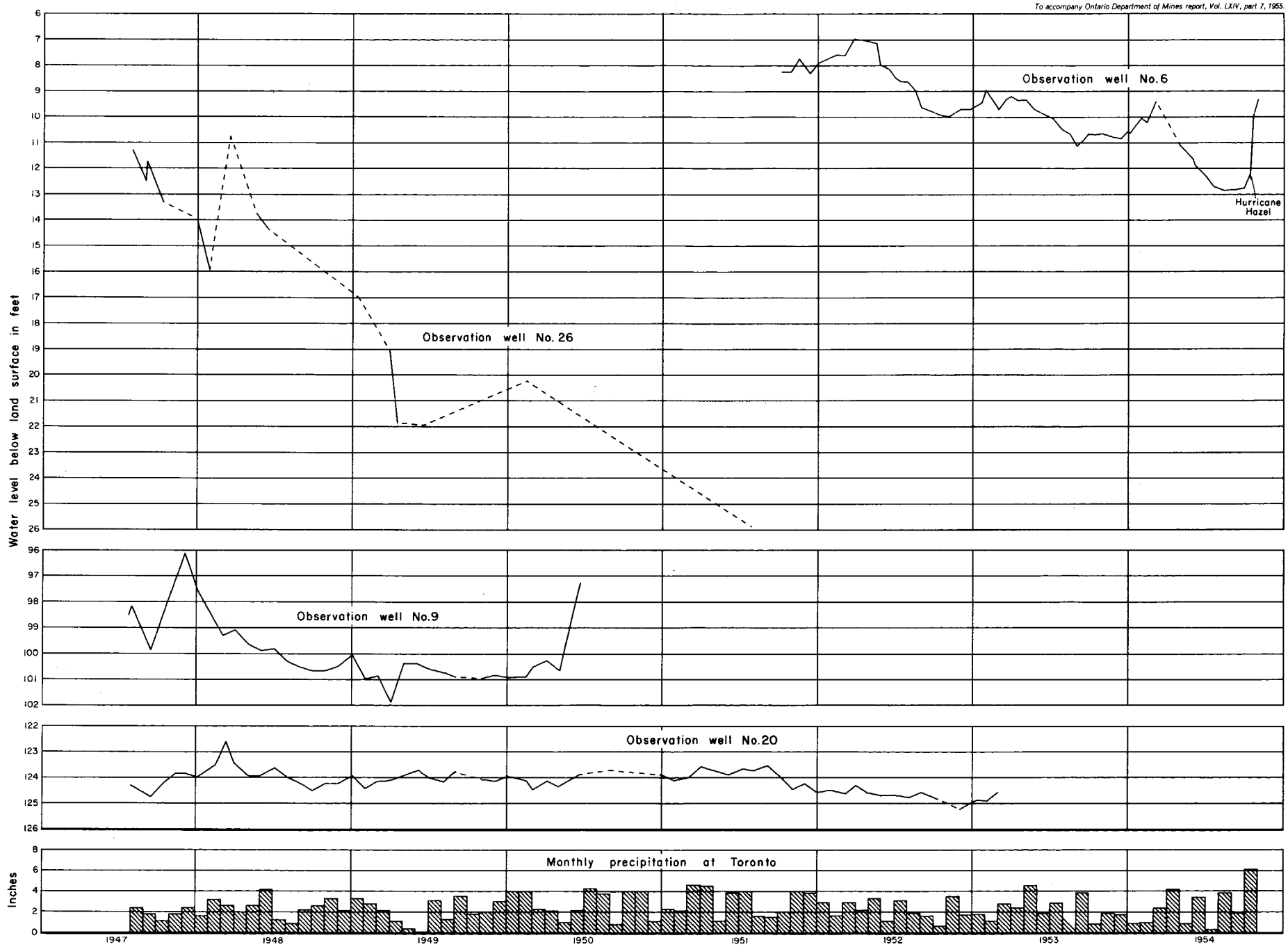
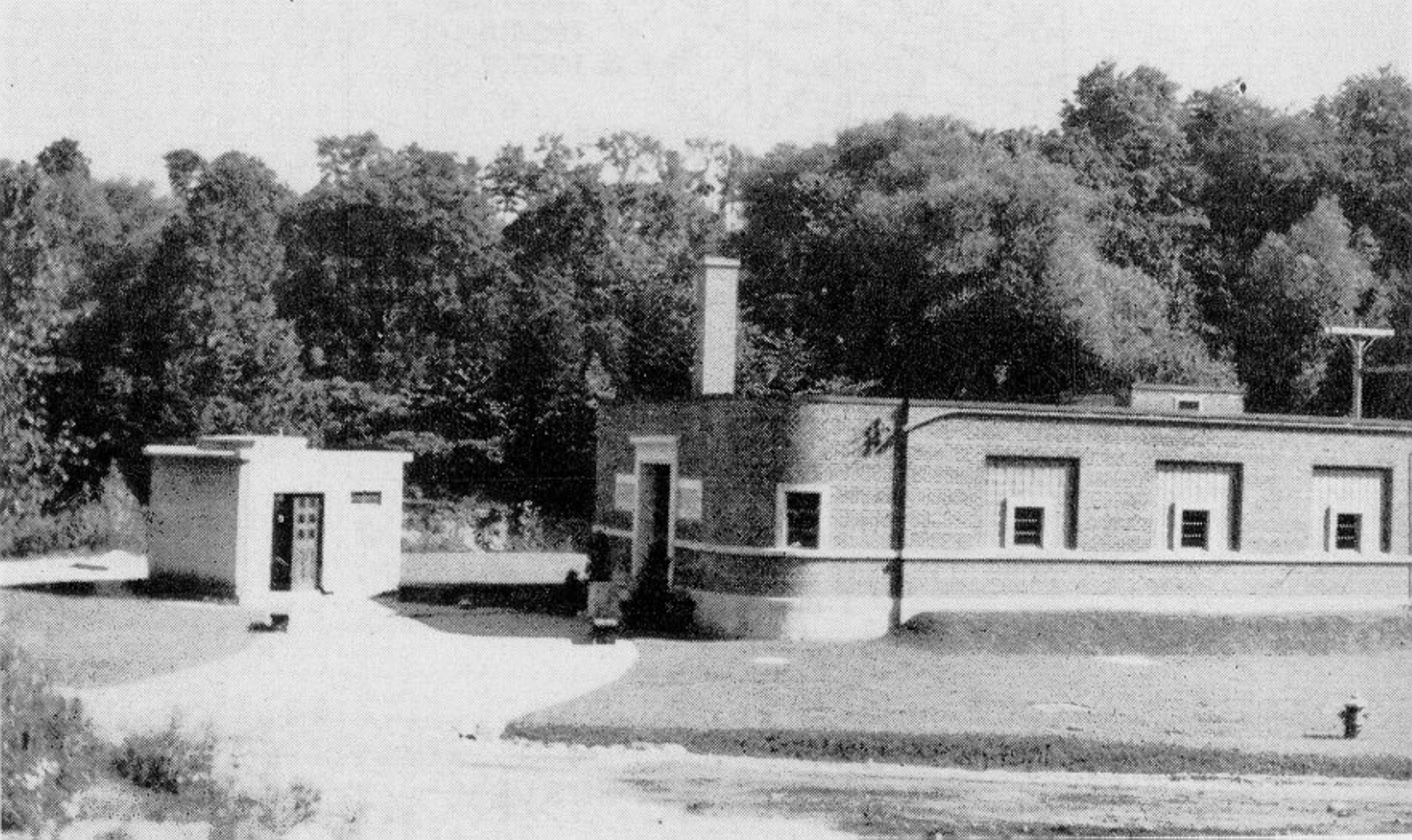
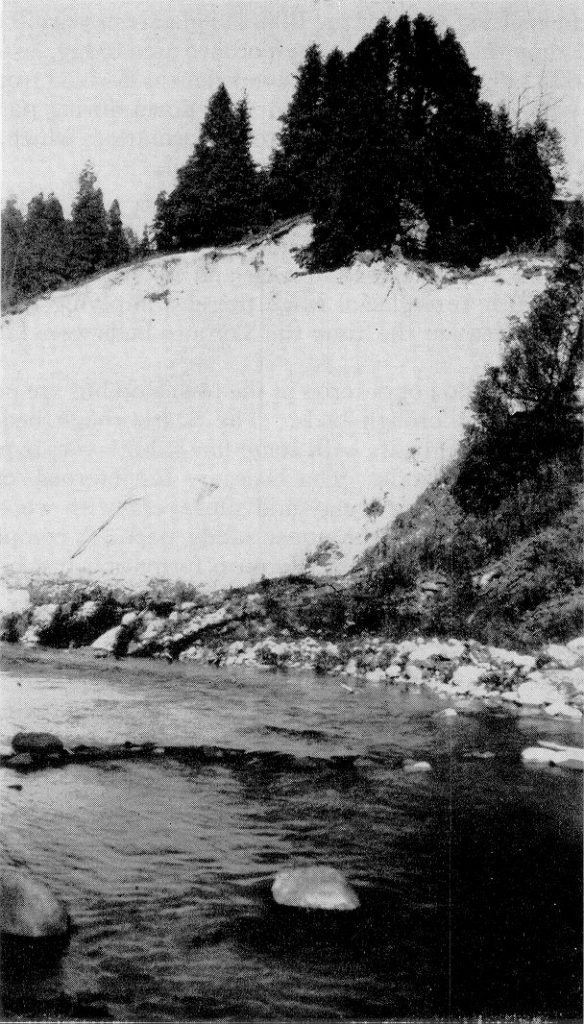
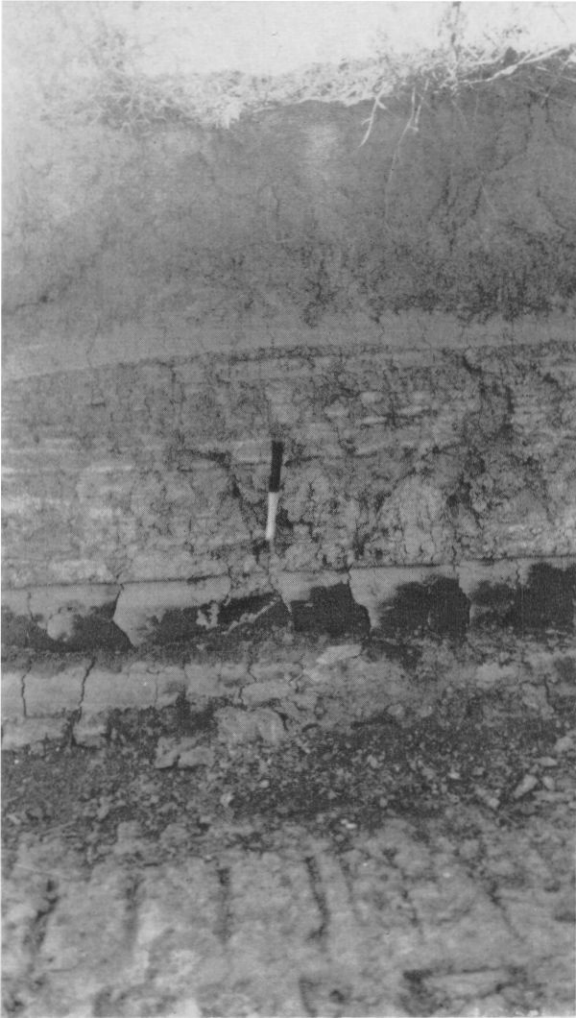


Figure 5. Hydrographs of water levels in observation wells.







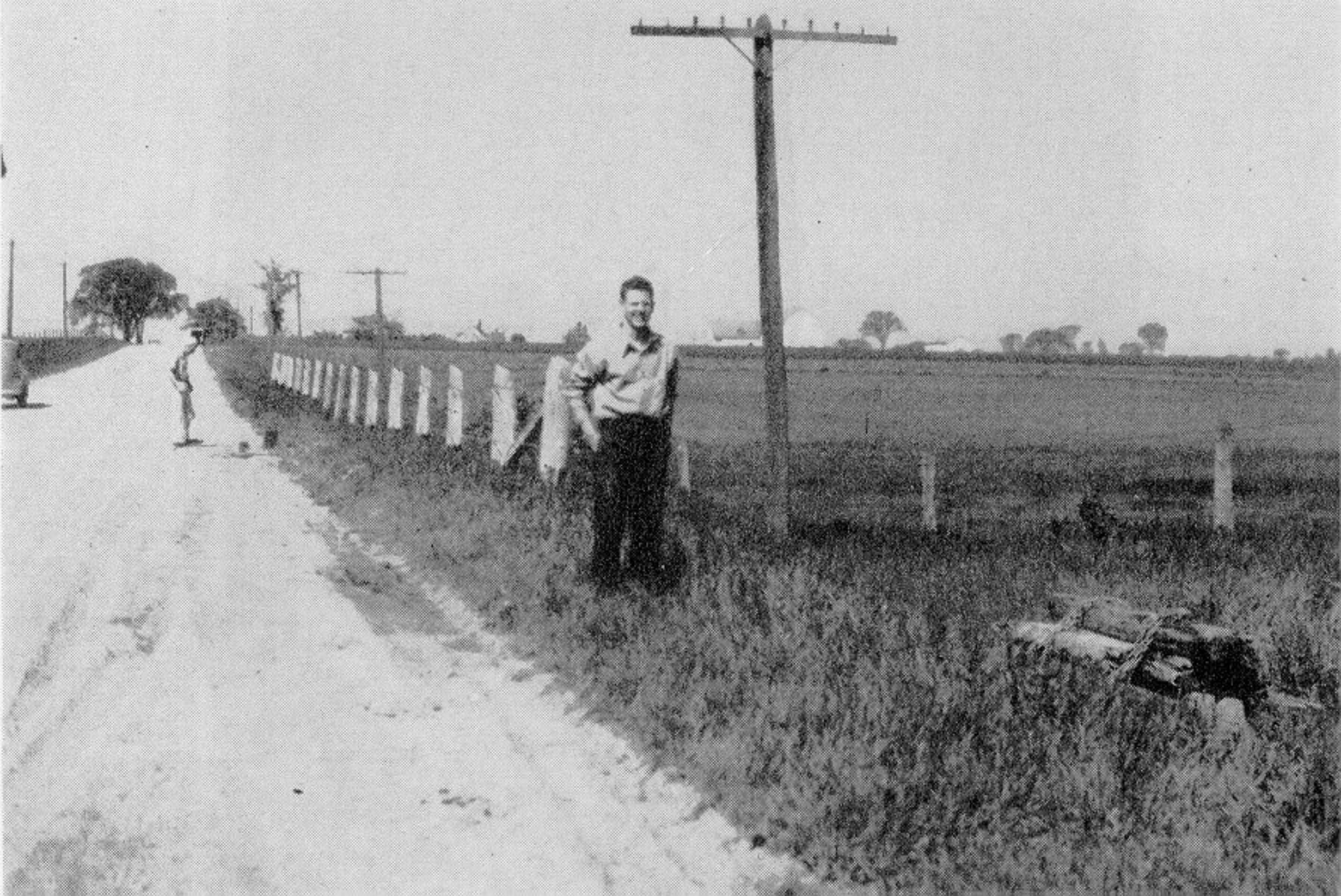




















PROVINCE OF ONTARIO
DEPARTMENT OF MINES

HON. PHILIP T. KELLY, *Minister of Mines* H. C. RICKABY, *Deputy Minister*
M. E. HURST, *Provincial Geologist*

SIXTY-FOURTH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. LXIV, PART 8, 1955

Geology of Dungannon and Mayo Townships

By
D. F. HEWITT and W. JAMES

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO
Printed and Published by Baptist Johnston, Printer to the Queen's Most Excellent Majesty
1956

TABLE OF CONTENTS
Vol. LXIV, Part 8

	PAGE
CHAPTER I—INTRODUCTION	1
Prospecting and Mining Activity	1
Present Geological Survey	2
Acknowledgments	3
Means of Access	3
Previous Geological Work	4
Physiography	4
Relief	5
Drainage	5
Natural Resources and Development	5
Agriculture	6
Forests	6
CHAPTER II—GENERAL GEOLOGY	6
Table of Formations	*facing* 7
Metavolcanic Rocks	9
Hastings Highland Gneiss Complex	9
Hastings Basin	10
Metasedimentary Rocks	11
Hastings Highland Gneiss Complex	11
Amphibolite	14
Paragneiss	15
Marble	15
Hastings Basin	16
Mayo Group	16
Plutonic Rocks	24
Older Basic Intrusive and Meta-intrusive Group	24
Mallard Lake Metagabbro	25
Eagan Chute Gabbro	26
Raglan Hills Metagabbro	26
Umfraville Gabbro	26
Other Basic Intrusive Bodies	26
Boulter Granite Group	27
Boulter Granite	27
Weslemkoon Granite	27
Bessemer Granite	27
Nepheline Gneiss Group	28
Occurrence	29
Age, Lithology, and Structure	29
Nepheline Pegmatite	31
Syenitic Rocks	38
Lithology and Structure	39
Younger Granitic Rocks	39
Great Bend Granite	39
Faraday Granite	40
Bronson Granite	40
Hybrid Granite Gneiss	40
McArthurs Mills Granite	40
Pleistocene and Recent Deposits	41
CHAPTER III—STRUCTURAL GEOLOGY	41
Folding	41
Faulting	42
CHAPTER IV—ECONOMIC GEOLOGY	43
Copper	43
Corundum	43
Dungannon Township	43
Concession XI, Lots 17–20	43
Concession XII, lot 12 (Egan Chute)	44
Concession XIII, lot 26 (Lily Robertson Property)	44
Concessions XIV and XV, Lots 11 and 12 (Dungannonite Property)	44
Other Occurrences	44

	PAGE
ECONOMIC GEOLOGY—*Continued*	
Feldspar	45
Dungannon Township	45
Concessions IX, Lot 24 (J. F. Tait)	45
Concession X, Lot 20	45
Garnet	45
Mayo Township	45
Concession XII, Lot 14	45
Gold	45
Iron	47
Dungannon Township	47
Hastings Road East, Lots 48 and 49 (Quarry Lake Anomaly)	47
Mayo Township	49
Concession VI, Lots 2–5 (Bessemer Mine) and Concession VII, Lot 1	49
Concession IX, Lot 10 (Rankin Property)	51
Concession IX, Lots 11 and 12 (Childs Mine)	52
Concession IX, Lot 13 (Stevens Property)	54
Limestone	54
Marble	54
Dungannon Township	54
Concession X, Lot 28 (McMillan Quarry)	54
Concession X, Lots 29 and 30 (Stewart Quarry)	55
Faraday Township	55
Lots 41 and 42 West, Hastings Road (Barker Quarries)	55
Molybdenum	56
Dungannon Township	56
Concession XVI, Lot 5, North Half (Stoughton Property)	56
Nepheline Syenite	56
Dungannon Township	57
Concession XI, Lot 12 (Goulding-Keene Quarry)	57
Concession XIII, Lot 10 (Morrison Quarry)	58
Concession XIII, Lot 27 (Robbins Quarry)	58
Concession XIV, Lot 9 (Davis Quarry)	58
Concession XIV, Lot 23 (Vardy Quarry)	59
Sillimanite	59
Dungannon Township	59
Concession X, Lot 22	59
Sodalite	59
Dungannon Township	59
Concession XIV, Lot 25 (Princess Quarry)	59
Uranium	59
Dungannon Township	60
Concession XVI, Lot 14 (Normingo Mines, Limited)	60
APPENDIX—MINERAL OCCURRENCES IN DUNGANNON AND MAYO TOWNSHIPS	61
INDEX	63

ILLUSTRATIONS

PAGE

Fracture cleavage and bedding in sandy argillite of the Hermon formation, Hartsmere road, Mayo township ... 7
Pillow lava, Rowland volcanics band, Rowland hill, Mayo township ... 9
Spotted scapolite schist of the Hermon formation, Upper Hermon cross-roads, Mayo township 17
Scapolitization along a fracture in pelitic schist of the Hermon formation, Upper Hermon cross-roads, Mayo township ... 17
Fracture cleavage cutting bedding in a pebble conglomerate member of the Hermon formation, Hartsmere road, Mayo township ... 19
Fracture cleavage and bedding in marble and feather amphibolite of the Dungannon formation, L'Amable Lake, Dungannon township ... 19
Feather amphibolite on a bedding plane in the Dungannon formation, Detlor Station, Dungannon township ... 21
Feather amphibolite in narrow bands in marble of the Dungannon formation, highway No. 62 near Green Corners, Dungannon township ... 21
Well-bedded "Hastings-type" limestone in the Dungannon formation near Detlor, Dungannon township ... 23
Tremolite in marble of the Dungannon formation on the Hartsmere road, Mayo township ... 23
Mallard Lake metagabbro north of Hermon, Mayo township ... 25
Nepheline-plagioclase gneiss showing development of nepheline pegmatite of the xenoblastic patch-replacement type, Goulding-Keene quarry, Dungannon township ... 31
Nepheline pegmatite–nepheline gneiss contact, Goulding-Keene quarry, Dungannon township 33
Nepheline pegmatite, Davis quarry, Dungannon township ... 33
Dragfolding in a competent band in the marble-amphibolite series at Egan Chute, Dungannon township ... 37
Feather amphibolite showing boudinage structure in marble, Green Corners, highway No. 62, Dungannon township ... 42
Nepheline pegmatite, Goulding-Keene quarry, Dungannon township ... 57

MAPS, SECTIONS AND PLANS

PAGE

Key map showing the location of Dungannon and Mayo townships ... 1
Generalized geological map of the Bancroft area ... *facing* 6
Sketch map of the York River nepheline band, lots 9–12, concessions XII–XIV, Dungannon township, showing locations of diamond-drill holes ... 36
Drill sections through the York River nepheline band ... *facing* 36
Surface plan of the Bessemer iron mine, lots 4 and 5, concession VI, Mayo township ... 46
Geological plan of the 100- and 160-foot levels, Bessemer No. 4 mine, Mayo township ... 48
Geological plan of the Rankin property, Mayo township ... 50
Geological plan of the Childs property, Mayo township ... 53

COLOURED GEOLOGICAL MAP
(In pocket at back of report)

Map No. 1955-8—Dungannon and Mayo Townships, County of Hastings, Ontario.
Scale, 1 inch to ½ mile.

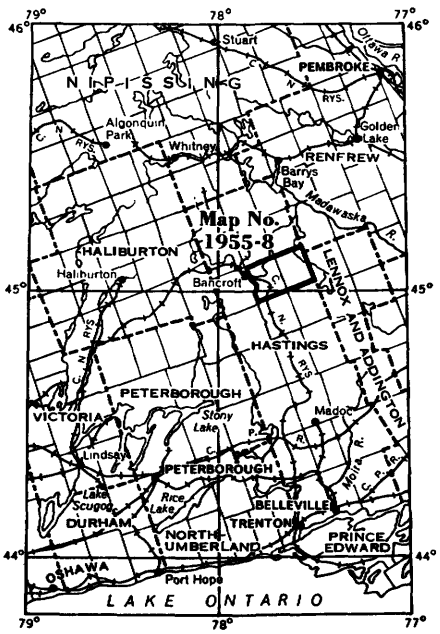
Geology of Dungannon and Mayo Townships

By D. F. Hewitt and W. James

CHAPTER I

INTRODUCTION

The townships of Dungannon and Mayo comprise an area of about 163 square miles lying in the northern part of Hastings county, eastern Ontario, just east of the town of Bancroft. The area is covered by the Bancroft and Coe Hill map sheets of the National Topographic Series.[1]



Key map showing the location of Dungannon and Mayo townships, Hastings county. Scale 1 inch to 50 miles.

The villages and post offices of Detlor, Hermon, L'Amable, McArthurs Mills, Hartsmere, Turriff, Green Corners, and Bronson lie within the area.

Prospecting and Mining Activity

Prospecting and mining have been carried out in the area for over 50 years, mainly for iron, nepheline syenite, and marble, with current interest being chiefly in radioactive minerals, copper, and nickel.

[1] Published on the scale of 1: 50,000 by the Canadian Department of National Defence and available from the Canadian Department of Mines and Technical Surveys, Ottawa.

The earliest mining activity in the area was iron mining. In 1902 the Bessemer mine was opened in Mayo township and was operated intermittently until 1913, with a total production of about 100,000 tons of magnetite ore. A small production of magnetite came from the Childs mine in 1913, and the Rankin property was also opened at this time. In 1941 and 1942 Frobisher Exploration Company, Limited, re-examined these three iron properties in Mayo township, and a program of diamond-drilling was carried out. Further diamond-drilling and magnetometer exploration was done in 1956.

Ontario Marble Quarries, Limited, operated four quarries in Dungannon and Faraday townships a few miles south of Bancroft for many years and supplied marble for several public buildings including parliament buildings at both Ottawa and Toronto. These quarries were opened in 1908 and operated intermittently until the late 1930's. Decorative stone was also produced from the Princess sodalite quarry (lot 25, concession XIV, Dungannon township) opened in 1906.

From 1937 to 1942 there was considerable interest in the nepheline syenite deposits in Dungannon township. The Goulding-Keene quarry (lot 12, concession XI, Dungannon township) on the York River was opened in 1937 and operated occasionally until 1942 by the Goulding-Keene Company, of Keene, New Hampshire, U.S.A. In 1937 this company also opened the Vardy quarry (lot 23, concession XIV, Dungannon township), and over 11,000 tons of material was shipped from these two properties.

In 1939 the Temagami Development Company, Limited, opened the Morrison quarry on the east side of the York River near Egan Chute and in 1939 and 1940 produced over 1,600 tons of nepheline pegmatite. This property was purchased by Ventures, Limited, and in 1941 and 1942 a considerable amount of trenching and diamond-drilling was done.

In 1940 the Canadian Flint and Spar Company, Limited, opened the Davis quarry on the east side of the York River 2½ miles north of the East road, which runs from Bancroft to McArthurs Mills. A small quantity of nepheline pegmatite was quarried in 1940 and 1942.

Recent activity in the area has been largely confined to prospecting for radioactive deposits in northwestern Dungannon township. Showings of uraninite in pegmatite and limestone have been found, but no appreciable development work has been carried out on any of the showings. However, the area offers good prospecting possibilities for radioactive minerals, and the large areas of basic intrusives good prospecting possibilities for nickel, copper, and iron.

Present Geological Survey

The present geological survey of Dungannon and Mayo townships was carried out during the summers of 1953 and 1954. The field party consisted of two senior geologists, who examined outcrops, and two junior geologists, who ran pace-and-compass traverses. From July to September, 1953, D. F. Hewitt and William James, with two junior assistants, mapped the northern two-thirds of Dungannon township and the northern third of Mayo township. From May to July, 1954, Mr. James and P. E. Giblin, with two junior assistants, compieted the mapping of these townships.

Plotting of geological data was done on Perfatrace fitted over air photographs on the scale of 1 inch to 1,320 feet. Pace-and-compass traverses were run between points easily recognizable on the air photographs. Owing to the abundance of topographic control such as rivers, lakes, and roads, no picketed base lines for

traverse control were run. Traverses were usually spaced at ¼-mile intervals. Where bush cover was not too heavy, outcrop areas and the geology between traverse lines were generalized by stereoscopic examination of air photographs.

Geological data were transferred by sketchmaster from air photographs to a base map, on the scale of 1 inch to 1,320 feet, which had been prepared by the cartography section of the Ontario Department of Mines from maps of the National Topographic Series. The original geological outcrop map compiled on the ¼-mile scale was reduced to 1 inch to ½ mile and redrawn with the geology simplified and generalized. The final map is reproduced on the scale of 1 inch to ½ mile. (See back pocket.)

On this geological map (see back pocket of report), areas of many small outcrops appear as single outcrop areas. In these townships, as in other parts of the Grenville subprovince, the rocks often show rapid variations over short distances, and in a single small outcrop several different types of rock may occur; consequently, on this scale of mapping the colours and symbols pertaining to an outcrop area often represent only the rock types most prominently exposed, and the map gives only a generalized picture of the geology. In using the map the prospector should realize that the generalization is based on a traverse interval of ¼ mile, and that, particularly in areas of heavy bush and heavy drift, the percentage of outcrop seen by the geologist may be small. In these areas the geologist's traverse line is often indicated on the map by a series of outcrops, so that the map reader can determine where the rock has been examined.

ACKNOWLEDGMENTS

D. F. Hewitt was ably assisted in 1953 by William James, S. K. Das Gupta, and D. G. Brooks. Mr. James carried out the mapping in 1954 assisted by P. E. Giblin, K. T. Doane, and N. E. Stewart. The geological mapping was carried out largely by Messrs. Hewitt, James, and Giblin. The authors acknowledge the efficient assistance and wholehearted co-operation of all the members of the party.

The party received assistance from many residents of the area, particularly from Louis Moyd, who supplied much valuable information on iron and nepheline deposits in the area. The authors also thank C. E. Tilley of Cambridge University for placing the results of his research work on the nepheline rocks of Egan Chute at their disposal.

Means of Access

The York River and its tributaries, the Little Mississippi River and Egan Creek, provided early access into the area. The Bronson farm at Bronson Landing on the York River was the earliest settlement in the area. In the 1850's the Hastings colonization road, from Belleville north to Maynooth, opened the area to settlers.

At present most of the area is easily accessible by motor road. Highway No. 62 from Madoc to Bancroft passes through the western part of Dungannon township. Highway No. 500 (the East road) runs eastward from Bancroft to Hermon, and good gravel roads run from Hermon north to Fort Stewart and Boulter, and east to McArthur Mills and Denbigh. Most of Dungannon township and the northern portion of Mayo township are well settled, and township roads serve most of the area.

The Canadian National Railways line from Trenton Junction to Bancroft passes through western Dungannon township with stations at Turriff, Detlor, and Bronson. A spur line 7 miles long runs northeastward from Bessemer Junction to the Bessemer and Childs iron mines in Mayo township.

Previous Geological Work

The earliest geological reconnaissance of the area was carried out in 1853 by Alexander Murray of the Geological Survey of Canada.[1] His canoe route took him up the York River, then known as the Shawashkong, to Baptiste Lake, in Herschel township.

The first geological maps and report on the area were those of Adams and Barlow.[2] These maps and this report were very comprehensive and included much original petrographic and petrologic data still useful to geologists working in the area.

The mineral deposits and general geology of the area are briefly described by J. E. Thomson.[3]

Many of the mineral deposits and geological features of the area are described in other reports and papers, the more important of which are listed below:

W. R. A. BARAGER, *Nepheline Gneisses of York River, Ontario*, Proceedings, Geol. Assoc. Can., Vol. 6, pt. I, 1953, pp. 83–111.

FELIX CHAYES, *Alkaline and Carbonate Intrusives near Bancroft, Ontario*, Bull., Geol. Soc. Amer., Vol. 53, No. 3, Mar., 1942, pp. 449–511.

W. K. GUMMER AND S. V. BURR, *Nephelinized Paragneisses in the Bancroft Area, Ontario*, Jour. Geol., Vol. LIV, No. 3, May, 1946, pp. 137–68.

D. F. HEWITT, *Petrology of the Nepheline and Corundum Rocks, Bancroft Area, Eastern Ontario*, Guidebook for No. 1 Field Trip in conjunction with the joint annual meeting of the Geological Society of America and the Geological Association of Canada, Toronto, 1953.

E. LINDEMAN AND L. L. BOLTON, *Iron Ore Occurrences in Canada*, Can. Dept. Mines, Mines Branch, No. 217, 1917.

LOUIS MOYD, *Petrology of the Nepheline and Corundum Rocks of Southeastern Ontario*, Amer. Mineralogist, Vol. 34, Nos. 9 and 10, Sept.–Oct., 1949, pp. 736–51.

F. F. OSBORNE, *Non-Metallic Mineral Resources of Hastings County*, Ont. Dept. Mines, Vol. XXXIX, 1930, pt. 6, pp. 22–59.

F. F. OSBORNE, *The Nepheline Gneiss Complex near Egan Chute, Dungannon Township*, Amer. Jour. Science, 5th series, Vol. 20, 1930.

In 1949 the Ontario Department of Mines, in co-operation with the Geological Survey of Canada, made an aeromagnetic survey of the area, and aeromagnetic sheets are available.[4] In 1949 and 1950 E. M. Abraham examined magnetic anomalies in the area.[5]

Physiography

The northern part of the area belongs to the Hastings Highlands, a terrane of high-grade metamorphic gneisses occupying northern Hastings county. These highlands form the westward extension of the Madawaska Highlands. The highland area is bounded on the south by the McArthurs Mills fault, which occupies a valley extending eastward from Bancroft through McArthurs Mills into Raglan township.

Physiographically the portion of the area south of the McArthurs Mills

[1]Alexander Murray, "Report for the Year 1853," *Report of Progress for the Years 1853-54-55-56*, Geol. Surv. Can., 1857, pp. 81–93.

[2]Frank D. Adams and Alfred E. Barlow, *Geology of the Haliburton and Bancroft Areas, Province of Ontario*, Geol. Surv. Can., Mem. 6, 1910, with maps Nos. 708 (Haliburton sheet) and 770 (Bancroft sheet).

[3]Jas. E. Thomson, *Mineral Occurrences in the North Hastings Area*, Ont. Dept. Mines, Vol. LII, 1943, pt. 3.

[4]Geol. Surv. Can., Geophysics Papers No. 15, Aeromagnetic Map, Bancroft, Ontario, 1950, and No. 16, Aeromagnetic Map, Coe Hill, Ontario, 1950.

[5]E. M. Abraham, *Preliminary Report on the Geology in the Vicinity of Aeromagnetic Anomalies on the Bancroft and Coe Hill Sheets*, Ont. Dept. Mines, P.R.1951-2, 1951.

fault belongs to the Cashel peneplane, described by G. Marshall Kay.[1] Geologically the area falls within the Hastings Basin.[2] The whole area was peneplaned in Precambrian times and was probably mantled by a thick cover of early Paleozoic sediments. In post-Devonian, pre-Pleistocene times there was a period of normal faulting tentatively dated as early Tertiary in age.[3] Several of the northwest-trending faults in the area were probably active during that period of faulting.

RELIEF

The maximum relief in the area is nearly 700 feet. The highest point in the are is Eagles Nest ridge in the northwest corner of Dungannon township where the fire ranger's tower stands on the top of a granite hill with an elevation of over 1,600 feet. The lowest point in the area is the valley of the York River, which has an elevation of 950–1,050 feet. To the south of the York River the upland area has an average elevation of 1,200–1,300 feet and an average relief of 200–300 feet.

Drainage

These townships contain over 50 small lakes and ponds, the largest of which is Mayo (Crooked) Lake in southern Mayo township; it has a length of over 2 miles and a maximum width of about ½ mile. Most of the lakes are in southern Mayo township, and this area, although more difficult of access than the other parts of the townships, is becoming an important tourist area, with many summer cottages.

The area is drained by the York River and its tributaries, the Little Mississippi River and Egan Creek. These waterways are navigable only with difficulty because of rapids, waterfalls, and log jams. The York River is navigable below Bronson Landing; it appears to be subsequent along the McArthurs Mills fault line over part of its course. The section of the York River from the East road through Egan Chute, Flat Rapids, and Farm Chute to a point 1 mile south of Bronson Landing is recent, and this appears to account for this short stretch of rapids and waterfalls. The authors believe that in pre-glacial times the river channel had a relatively straight course from the sawmill on the west side of the Great Bend granite ridge on the East road northwest to Bronson Landing. The channel was dammed by glacial moraine piled up against the west slope of the ridge of Great Bend granite, and in post-glacial times the York River was forced into a new course east of this granite ridge where it now flows.

The large kame terrace or glaciofluvial delta extending from McArthurs Mills northward to Norway Bay undoubtedly influenced the post-glacial course of the Little Mississippi River. The entire drainage of this area is into the Ottawa River via the Madawaska River.

Natural Resources and Development

The area was opened for settlement in the 1850's when the Hastings colonization road was built north from Belleville to Maynooth. Some lumbering was done in the area previous to this, with access by water from the Madawaska valley.

Dungannon township was partially surveyed by Quintin Johnston in 1857, and the work was completed by J. L. P. O'Hanly in 1864. Mayo township was

[1]G. Marshall Kay, *Ottawa-Bonnechere Graben and Lake Ontario Homocline*, Bull., Geol. Soc. Amer., Vol. 53, No. 4, Apr., 1942, pp. 585–646.

[2]D. F. Hewitt, "The Grenville Region of Ontario," *The Grenville Problem*, Royal Soc. Can., Special Publication No. 1, 1956.

[3]G. Marshall Kay, *op. cit.*

surveyed in 1869 by H. O. Wood. At this time the Mississippi colonization road was built into Mayo township from the east from the Addington road in the Denbigh area.

AGRICULTURE

The western and central parts of Dungannon township and the northern part of Mayo township are settled by farmers. The rugged topography and sandy, rocky nature of the soil are not well suited to agriculture. Farms range in size from 100 to over 1,000 acres and consist mainly of pasture and woodlot. Hay and oats are the chief crops. Sheep, cattle, and pigs are raised.

FORESTS

Lumbering is an important industry in the area, but it is becoming increasingly difficult for the lumberman to find suitable timber limits. The white pine is gone, and most of the timber cut is spruce, balsam, cedar, hemlock, poplar, maple, and yellow birch. In 1954 about twelve saw mills operated in the area.

CHAPTER II

GENERAL GEOLOGY

The bedrock formations are all of Precambrian age and consist of Grenville-type metasediments and metavolcanics cut by basic and acid plutonic rocks (diorite, gabbro, granite, syenite, nepheline syenite, and their gneissic equivalents).

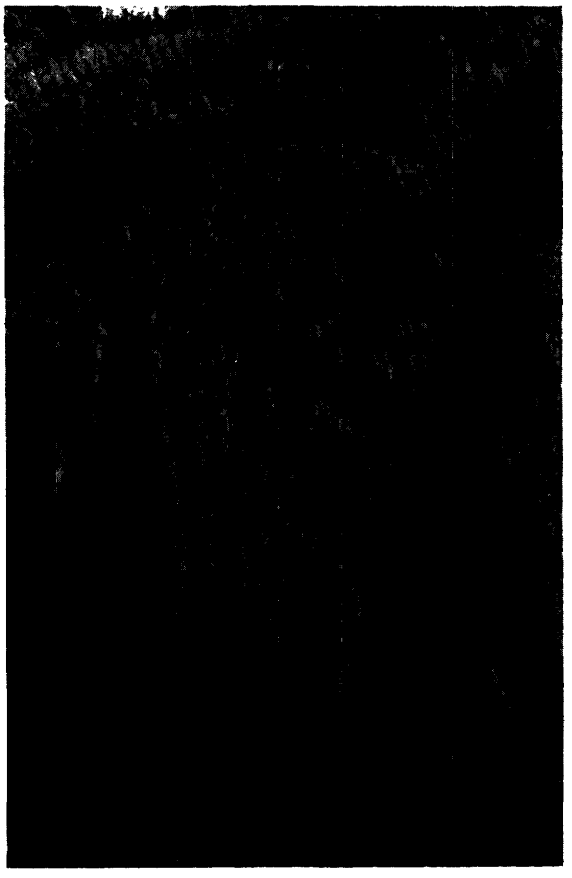
The area is divided into two parts:[1] the *Hastings Highland gneiss complex* lying to the north; and the *Hastings Basin* to the south, separated by the *McArthurs Mills fault*, which runs eastward from Bancroft through McArthurs Mills. The Hastings Highland gneiss complex is a terrane of high-grade metamorphic gneisses, characterized by rocks of the amphibolite and granulite metamorphic facies. The oldest rocks are the Rowland basic volcanics and the Grenville-type amphibolite, paragneiss, and marble; the latter are replaced and intruded by nepheline syenite, syenite, granite, and gabbro.

The oldest intrusive in the Hastings Highland area is the *Mallard Lake metagabbro*, a large body predominantly hornblende-plagioclase gneiss, lying in northeastern Dungannon and northern Mayo townships. This body extends eastward to join the large *Raglan Hills metagabbro* in southern Raglan township. The metagabbro is cut by the *Boulter granite*, a grey biotite-albite granite gneiss with little or no potash feldspar. This rock occurs in the northeastern part of Mayo township and forms part of two large stocks, which lie mostly in Carlow and Raglan townships to the north.

After this early period of intrusion came a second period during which the nepheline rocks, syenites and potash granites, were emplaced. These three groups of later plutonic rocks appear to have been emplaced by injection and replacement, as well as by intrusion of molten magma. With regard to relative ages, the nepheline rocks, which appear to have been emplaced in this area largely by replacement, are the oldest; they are intruded and replaced by grey and pink syenites, which are in turn cut and replaced by pink granite and granite pegmatite. *Lit par lit* injection and granitization played an important part

[1] See accompanying generalized geological map of the Bancroft area for the location of structural features described.

during this period of intrusion. Later folding and high-grade regional metamorphism produced a strong gneissic structure in all the rocks. In addition to the mixed granite-syenite-nepheline gneisses of northern Dungannon township, the authors recognized three bodies of pink potash leuco-granite gneiss that may be, in part, intrusive sheets. These are the *Great Bend granite*, the *Bronson granite* and the *Faraday granite*.



Fracture cleavage and bedding in sandy argillite of the Hermon formation, Hartsmere road, Mayo township. View taken east indicates that this outcrop is on the south limb of the Mayo anticline.

Within the Hastings Highland gneiss complex, intrusives are, for the most part, concordant, and there is much evidence of granitization and metasomatism and the formation of hybrid rocks by these processes. Original sedimentary and volcanic structures and textures have been largely destroyed. This prevents the application of normal stratigraphic and structural methods of geologic interpretation.

In contrast to these conditions, which pertain in the Highlands, the rocks in the Hastings Basin, south of the McArthurs Mills fault, are predominantly sediments of low to intermediate metamorphic grade, including pelitic schists and gneisses, conglomerate, arkose, rusty schists, quartzite, well-bedded limestone, impure marble, and basic and acid volcanics. High-grade metamorphic

gneisses and large areas of hybrid granitized gneiss are, for the most part, lacking. Sedimentary and volcanic structures are frequently well-preserved, and normal structural and stratigraphic methods may be applied.

In the Hastings Basin section of Dungannon and Mayo townships, the structure consists of two major anticlines trending and pitching northeast. The axis of the *Detlor anticline* runs from Umfraville on the west boundary of Dungannon township northeastward through Upper Hermon in Mayo township. The axis of the *Mayo anticline* runs from the southwest corner of Mayo township northeastward through Hartsmere into Ashby township. The sedimentary series exposed in these townships measures over 15,000 feet in thickness and is called the *Mayo group* by the authors. The group is divided into two formations, the *Hermon formation* and the *Dungannon formation.*

The Hermon formation, which is the uppermost formation of the group, consists of sandy pelitic gneisses and schists, conglomerate, arkose, and minor amphibolite schists and gneisses. This formation appears to be cut off against the McArthurs Mills fault; and, close to the fault, sillimanite often occurs in the pelitic gneisses. This formation is at least 5,000 feet thick.

All the sediments below the Hermon formation are grouped together as the Dungannon formation, which is predominantly marble. However, within the formation several non-marble members are recognized: the *Grassy Lake quartzite*, the *Crooked Lake schist*, the *Wendsley Lake rhyodacite*, the *Turriff basic volcanics*, the *Turriff rusty schist.* In addition to these members, which occur in the Mayo anticline, there is a thick section of interbanded marble and feather amphibolite in the Detlor anticline, which the authors term the *Detlor member.* This member is characterized by the development of feather amphibolite in both sediments and basic intrusives, and extends through southern Dungannon and Faraday townships.

The Mayo group is intruded by basic and acid intrusives. The basic intrusives consist of gabbro, diorite, and amphibolite. The *Umfraville gabbro*, a large stock of gabbro described by Adams and Barlow,[1] extends into southwestern Dungannon township. A second large body of gabbroic amphibolite occurs on the south boundary of Mayo township. Many narrow sills and dikes of gabbroic amphibolite occur in southern Dungannon and in Mayo townships within the Mayo group. Also intruding the Mayo group are two bodies of grey biotite-albite granite very similar to the Boulter granite. These are the *Bessemer granite* and the *Weslemkoon granite.* The Bessemer granite is a small elongated body about 2½ miles long and ½ mile wide occurring just north of the Bessemer iron mine. The Weslemkoon granite occurs in the southeastern corner of Mayo township, and is part of a very large body of grey biotite soda granite or tonalite, which occupies over 200 square miles in Mayo, Ashby, Effingham, Cashel, and Grimsthorpe townships. Both these granites are gneissic, but sedimentary inclusions or schlieren are uncommon.

The Bessemer and Weslemkoon granites are early soda granites probably related in age to the Boulter granite, which they resemble markedly. The authors believe that the Wendsley Lake rhyodacite may be the extrusive equivalent of the Bessemer granite.

Apparently later in age from its lack of gneissic structure is a third granite, the *McArthurs Mills granite*, which occurs in east central Mayo township, south

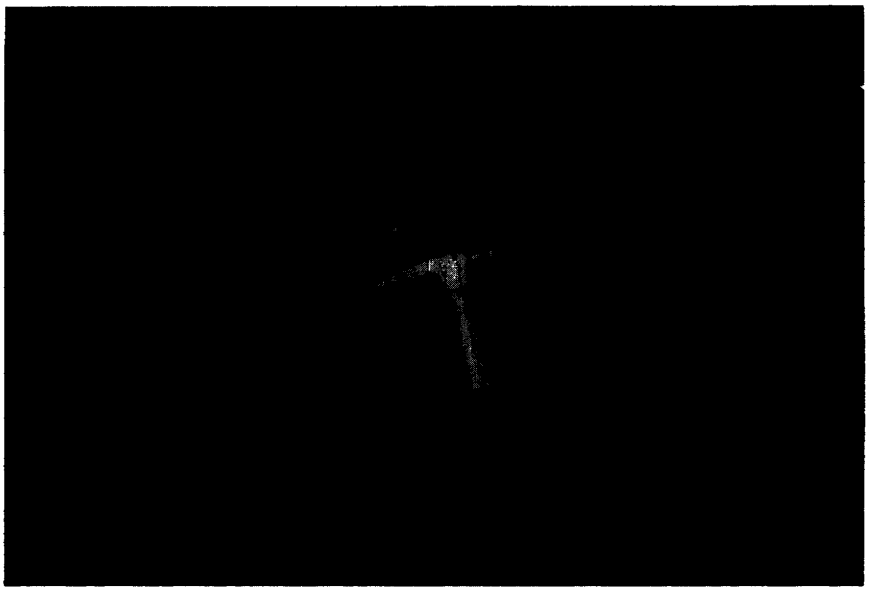
[1]Frank D. Adams and Alfred E. Barlow, *Geology of the Haliburton and Bancroft Areas, Province of Ontario*, Geol. Surv. Can., Mem 6, 1910.

and east of the village of McArthurs Mills. This is a massive, coarse-grained, pink biotite-microcline-microperthite granite.

Late pegmatites are rare in this part of the Hastings Basin, and no nepheline rocks occur south of the McArthurs Mills line in these two townships.

After the last period of Precambrian mountain building the whole area was eroded to a peneplane of low relief. In Tertiary times there was a period of normal faulting, followed by another period of erosion and peneplanation.

During Pleistocene times the area was glaciated; glacial till and fluvioglacial deposits of sand and gravel cover much of the bedrock.



Pillow lava, Rowland volcanics band, Rowland hill, Mayo township. Pillow tops indicate that the volcanics face south, in the direction of the hammer head.

Metavolcanic Rocks

HASTINGS HIGHLAND GNEISS COMPLEX

There is one band of metamorphosed basic volcanic rocks in the Hastings Highland gneiss complex in northern Mayo township. This band, called the *Rowland volcanics*, lies south of the Mallard Creek fault and north of the Mallard Lake metagabbro body. These rocks consist of black, medium-grained, amphibolite and hornblende schist. They have a well-developed gneissic structure; occasionally features that suggest ropy flow structure are seen. On Rowland hill, where these rocks are well exposed in fields just west of the Hermon-Boulter road, there is a small outcrop measuring about 10 by 6 feet, which shows good pillow structure.

Pillows are about 1 foot to 15 inches in size, with well-marked gre sh selvages ½ inch thick. The accompanying photo shows these pillows.

The shape of the pillows indicates that tops face south. This is the only occurrence of pillow lava in the Rowland volcanics band. Quartz stringers and epidote clots and stringers are common. A few epidotized clots up to 1 foot in diameter suggest, to some observers, relict epidotized bombs.

These basic volcanics are entirely altered to hornblende gneisses and schists of the amphibolite metamorphic facies, and original textures and structures are apparently preserved only in rare cases.

The Rowland volcanics are exposed over a strike length of 3½ miles in Carlow and Mayo townships. The exposed width of the band is ½ mile. It is apparently cut off along strike at each end by the Mallard Creek fault.

HASTINGS BASIN

The Dungannon formation of the Mayo group includes two volcanic members, the *Turriff basic volcanics* and the *Wendsley Lake rhyodacite*. Both of these volcanic members are exposed in south-central Dungannon township.

The Turriff basic volcanics are exposed in a northeast-striking band, 1,000 feet wide, extending ¾ mile northeast from the south boundary of Dungannon township, near Egan Creek siding. The volcanics are better exposed in Limerick township to the south. Their dip is vertical.

These volcanic rocks consist chiefly of hornblende schist with a dark-green to black weathered surface. This rock has a characteristic irregularly pitted, weathered surface common to no other rock in the map area. Criteria of volcanic origin are rare, but three small outcrops on the road at Egan Creek siding in Limerick township, just south of the Dungannon boundary, show small 6- to 7-inch pillows, with wide, 1- to 2-inch selvages. This pillowed lava is grey-weathering and appears to be intermediate in composition. On the hill to the east of Egan Creek siding in Limerick township some epidotized masses that might be relict bombs were observed by the authors. There was also some suggestion of ropy flow structure.

These volcanics are overlain by rusty pyritic schists, which may be, in part, tuffaceous.

The Wendsley Lake rhyodacite is exposed in a wide band immediately south of Wendsley Lake in southern Dungannon township. This band is vertically dipping and strikes northeast. On the Dungannon south boundary these volcanics have an exposed width of over 1 mile. The main band extends northeast into Mayo township for a distance of 6 miles but thins very rapidly to the northeast and has a thickness of only a few hundred feet in Mayo township. A second narrow band of acid tuffs, 2 miles in length and a few hundred feet wide, passes through Foster Lake in southern Mayo township.

The Wendsley Lake rhyodacite is a fine-grained, white-weathering, hard, massive rock with pronounced jointing. It is recrystallized and in the coarser facies in which the grain size reaches ½ millimetre a small content of biotite gives the rock a foliated appearance. This acid volcanic band consists of a series of units grading from fine-grained massive porphyritic rhyodacite to very fine-grained white tuff(?) beds. This repetition of medium fine-grained to very fine-grained facies suggests a series of welded tuffs.

A complete rock analysis for a sample of Wendsley Lake rhyodacite is given in the accompanying table.

ANALYSIS OF WENDSLEY LAKE RHYODACITE, LOT 15, CONCESSION I, DUNGANNON TOWNSHIP[1]

	Percent
SiO_2	71.31
Al_2O_3	16.09
Fe_2O_3	0.40
FeO	1.45
MgO	0.52
CaO	1.66
Na_2O	6.00
K_2O	1.60
H_2O+	0.31
H_2O-	0.03
CO_2	0.47
TiO_2	0.16
P_2O_5	0.12
Cr_2O_3	0.005
MnO	0.02
V_2O_3	0.006
Total	100.15

This acid volcanic is overlain and underlain by marble of the Dungannon formation.

Metasedimentary Rocks

The metasedimentary rocks exposed in the map area are of the Grenville type. The metasediments in the Hastings Highland gneiss complex consist of high-grade amphibolites and paragneisses, many of which are invaded and replaced by solutions that have granitized, syenitized, and nephelinized these metasediments. The sediments occur for the most part as relicts and pendants in plutonic rocks.

In the Hastings Basin there is a thick section of sedimentary rocks, which have suffered less metamorphism than those of the highlands; schists, phyllites, arkose, conglomerate, and well-bedded limestones are present, as well as some paragneiss and amphibolite. Few of these sediments have been granitized, and none of them syenitized or nephelinized. Sedimentary features may be preserved. These sediments, called the Mayo group by the authors, are divided into the Hermon formation, consisting of pelitic schists and gneisses, amphibolite, arkose, spotted schists, pebble conglomerate, and limy quartzite; and the Dungannon formation, consisting predominantly of marble, with feather amphibolite, rusty schist, basic and acid volcanics, and quartzite members occurring at various horizons.

The accompanying tables show the development of various grades of Grenville metasediments by the progressive regional metamorphism of an original sedimentary sequence consisting of limestone, shale, and sandstone. The amphibolites are believed to be developed largely from limy shales, whereas the paragneisses developed from sandy shales.

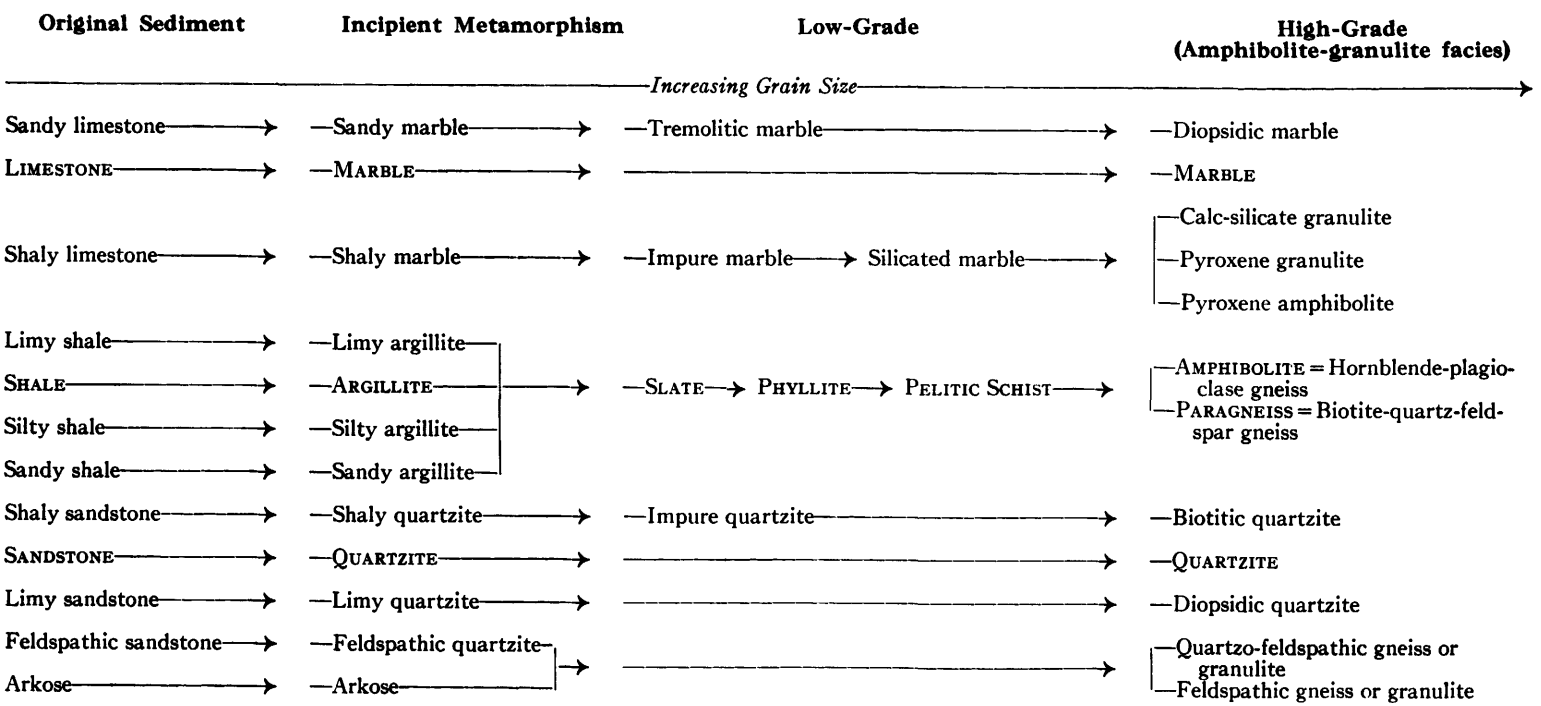
HASTINGS HIGHLAND GNEISS COMPLEX

In the Hastings Highland the Grenville metasediments are divided lithologically into two groups, the paragneiss-amphibolite group and the marble group. The paragneiss-amphibolite group includes all the metasediments except marble and associated calcareous rocks, and is made up chiefly of sandy and limy pelitic rocks. Amphibolite and paragneiss, which are the two main rock types in this subdivision, are generally dark-coloured gneisses with over 30 percent mafic minerals. Quartzite and quartzo-feldspathic gneiss, which constitute a small

[1]Analysis by the Provincial Assay Office, Ontario Department of Mines, 1955.

PROGRESSIVE METAMORPHISM OF GRENVILLE SEDIMENTS

1. Regional Metamorphism



PROGRESSIVE METAMORPHISM OF GRENVILLE SEDIMENTS

2. CONTACT METAMORPHISM
3. ULTRAMETAMORPHISM
4. DISLOCATION METAMORPHISM

Process	Marble	Pelitic Rocks
2. CONTACT METAMORPHISM	Skarn Tactite Metamorphic pyroxenite	Hornfels Contact slates Contact schists
plus Metasomatism	Biotite-scapolite rock	
plus Mobility	Carbonate-apatite-mica-scapolite-diopside vein dikes	
3. ULTRAMETAMORPHISM (Migmatites and Allied Rocks produced by Injection and Metasomatism)	Tactite Metamorphic pyroxenite Amphibolite Calc-silicate granulite	Type 1—Injection Gneisses and Migmatites (mixed gneisses) Type 2—Permeation or Replacement Gneisses (syenitic and granitic gneisses with sedimentary relicts) Type 3—Granite and Syenite Gneisses (almost completely reconstituted, origin often doubtful)
4. DISLOCATION METAMORPHISM	Lime mylonite Limestone tectonic breccia Marble cataclasite (breccia)	Mylonite, flinty crush rock Phyllonite Breccia, cataclasite

MINERAL ASSEMBLAGES OF THE AMPHIBOLITE-GRANULITE FACIES

Rock	Mineral Assemblages	
	Essential	Accessory (These minerals may or may not be present)
Diopside marble MARBLE	Carbonate-diopside Carbonate	Mica
Calc-silicate granulite	Carbonate-pyroxene	Plagioclase, mica, scapolite, garnet
Pyroxene granulite	Pyroxene-plagioclase	Mica, hornblende, garnet, scapolite
Pyroxene amphibolite	Pyroxene-hornblende-plagioclase	Microcline, scapolite, garnet
AMPHIBOLITE	Hornblende-plagioclase	Microcline, scapolite, garnet
Biotite amphibolite	Biotite-hornblende-plagioclase	Microcline, scapolite, garnet
Biotite-plagioclase gneiss	Biotite-plagioclase	Microcline, scapolite, garnet
PARAGNEISS	Biotite-quartz-plagioclase	Microcline, garnet, sillimanite, kyanite
Biotite or hornblende quartzite QUARTZITE	Biotite-quartz Quartz	Microcline-plagioclase
Diopsidic quartzite	Diopside-quartz	Tremolite, mica
Quartzo-feldspathic gneiss or granulite		
Feldspathic gneiss or granulite	Microcline-plagioclase	Biotite, muscovite

proportion of the metasedimentary group, are light-coloured gneisses, with from none to 30 percent mafic minerals. Hornblende is the predominant mafic mineral in the amphibolites, whereas biotite predominates in the paragneisses.

These rocks are generally medium-grained, equigranular, well banded or well bedded, with a marked continuity of banding or bedding. The light-coloured metasedimentary gneisses are difficult to distinguish from some orthogneisses, and the dark gneisses may be confused with amphibolites of metavolcanic or meta-intrusive origin. Light-coloured gneisses of metasomatic origin, such as the biotite-plagioclase gneisses of the York River section and dark-coloured gneisses of metasomatic origin such as the alkaline amphibolites of the York River section, are also very difficult to distinguish from some of the metasedimentary gneisses, and these metasomatic types are generally grouped with the respective light and dark gneisses of the paragneiss-amphibolite group.

Amphibolite

The amphibolites are medium-grained, equigranular rocks composed predominantly of hornblende and plagioclase (usually andesine or oligoclase). Biotite, pyroxene, scapolite, garnet, carbonate, vesuvianite, pyrite, titanite, apatite, magnetite, and quartz are often present. Texturally these rocks are even-grained and granoblastic, consisting of a mosaic of hornblende and plagioclase.

Within the Hastings Highland area, amphibolite is the predominant rock of the paragneiss-amphibolite group and occurs mainly in the northwestern part of Dungannon township. Here there is a strong development of mixed gneisses of the hybrid granite and hybrid syenite type, and these rocks usually consist of inter-banded amphibolite and granitic or syenitic gneiss, produced either by injection or replacement. In northwestern Dungannon township relict amphibolite bands in the hybrid gneiss complex rarely exceed a few hundred feet in width and cannot usually be traced more than a mile or so.

In places the proportion of mafic minerals in the amphibolite is 90 percent or more. A band of this hornblende-rich amphibolite occurs in northeastern Dungannon township along the west boundary of the Mallard Lake metagabbro. This well-banded black amphibolite is difficult to distinguish from the border facies of the metagabbro itself and may be either a meta-intrusive amphibolite belonging to the intrusive mass or a mafic hornfels along its contact.

Orthoclase and microcline are rarely present in amphibolite unless it has been granitized or syenitized, and the presence of pink microcline or microcline microperthite is taken as evidence of granitization or syenitization of these rocks.

The shonkinites described by Chayes[1] in the area east of Bancroft on the East road are mainly classified by the authors as amphibolites, syenitized amphibolite, or hybrid syenite gneiss (produced by potash metasomatism of amphibolite or paragneiss). The authors are in agreement with Chayes regarding the origin of the "syenite-amphibolite-shonkinite migmatites" and only differ in the terminology used to describe them.

In the York River section, detailed work by C. E. Tilley[2] indicates that the alkaline amphibolites associated with the nepheline gneisses at Egan Chute are of metamorphic-metasomatic origin and are produced by the alteration of marble and associated lime-rich metasediments. The characteristic mineral assemblage

[1]Felix Chayes, *Alkaline and Carbonate Intrusives near Bancroft, Ontario*, Bull. Geol. Soc. Amer., Vol. 53, No. 3, Mar., 1942, pp. 449–511.

[2]C. E. Tilley, unpublished manuscript, 1955.

of these alkaline amphibolites is hornblende (ferrohastingsite)-clinopyroxene (hedenbergite)-plagioclase-calcite, with or without garnet, scapolite, and vesuvianite. As alkaline metasomatism progresses, nepheline may occur in the assemblage.

Paragneiss

Paragneiss, consisting predominantly of the assemblage biotite-quartz-plagioclase, is the second common lithologic type found among the metasedimentary rocks of the Hastings Highland gneiss complex. The paragneisses are medium-grained, equigranular in texture, and have a pronounced banded or bedded structure. Garnet and sillimanite may be present as characterizing accessories of the higher metamorphic grades. Microcline, scapolite, pyroxene, tourmaline, titanite, apatite, carbonate, pyrite, and magnetite are sometimes present.

Where the paragneiss has been granitized or syenitized, pink microcline and microcline microperthite are prominent constituents. Amphibolite and paragneiss in various stages of replacement make up a large part of the hybrid syenite-granite gneiss complex of northwestern Dungannon township.

No large or continuous paragneiss bands are recognized in the Hastings Highland part of the area. Quartzite and quartzo-feldspathic gneiss are present in very minor amounts in the Hastings Highland gneiss complex.

Marble

The marble or crystalline limestone group includes pure-white to grey crystalline limestone and dolomite, often interbanded with limy amphibolite; silicated marble containing diopside, tremolite, phlogopite, and other silicates; lime silicate rocks; metamorphic pyroxenite; skarn; marble tectonic breccia; and marble mylonite.

Small patches and pods of marble occur in numerous places in the mixed gneiss complex in northern Dungannon township. Inclusions of marble occur in the Great Bend granite sheet in places. One such inclusion can be seen in the roadcut on the East road just west of the York River bridge. Another large marble and scapolitic amphibolite inclusion, measuring several hundred feet in length, may be seen at Farm Chute on the York River.

The widest and most continuous marble bands in the Hastings Highland gneiss area of northern Dungannon and Mayo townships occur flanking the nepheline gneiss band in the York River valley. This marble is well-exposed in the roadcut just east of the York River bridge on the East road. Two hundred yards north of the East road on the east bank of the York River there is a small pit in the marble that exposes a skarn zone in which grossularite, diopside, vesuvianite, wollastonite, zircon, spinel, forsterite, and chlorite, as well as calcite and feldspar, have been identified by Louis Moyd.[1] The skarn zone in the marble overlies the nepheline gneiss band and may be associated genetically with the alkaline gneisses.

The crystalline limestone and dolomite consist of medium-grained aggregates of calcite and dolomite up to ¼ inch in size. In the silicated or impure varieties of marble the following minerals are common: diopside, tremolite, phlogopite, graphite, scapolite, vesuvianite, garnet, quartz, feldspar, pyrite, pyrrhotite, and apatite. Most of the marbles are either calcitic or dolomitic limestone. Near the nepheline gneiss bands, nepheline occasionally occurs in the marble, replacing calcite. Hastingsite and alkaline pyroxene may also occur with nepheline in the

[1]Louis Moyd, personal communication.

marble contact zone. Forsterite, spinel, brucite, diopside, wollastonite, pectolite, vesuvianite, grossularite, chondrodite, and clinohumite were identified in marbles of the York River area by C. E. Tilley.[1]

The marble mylonites on the East road are well-exposed near the Clark (Clear) Lake road intersection, where they occur cutting syenitic gneiss. These mylonites have been described by Chayes.[2] The typical marble mylonite is dark grey in colour and very fine-grained. Under the microscope it consists of a very fine-grained almost isotropic carbonate mylonite. Flowage of marble has taken place in some areas, and marble tectonic breccias consisting of fragments of amphibolite, pyroxene granulite, feldspathic gneiss, granite gneiss, syenite gneiss, and other heterogeneous rocks floating disoriented in a marble matrix are found in several places. One such occurrence may be seen at the foot of the portage at Egan Chute.

"Lime silicate rock" is a general term for the products of contact metamorphism or metasomatism of marble, and includes skarn and metamorphic pyroxenite as special types. Skarn is a contact metamorphic rock developed from marble, consisting of diopside, augite, or hornblende, plus garnet, magnetite, and iron sulphides. Scapolite, phlogopite, vesuvianite, spinel, apatite, wollastonite, and forsterite may also occur in the skarn zone. It is essentially an iron-rich contact metamorphic deposit.

Metamorphic pyroxenite is a medium- to coarse-grained, dark-green rock consisting primarily of diopside or augite, often accompanied by phlogopite, scapolite, carbonate, apatite, pyrite, tremolite, and feldspar. It is developed by the metasomatic alteration of marble. Some of the best exposures of metamorphic pyroxenite in the Bancroft area are in roadcuts on highway No. 62 just north of the golf course, 3.3 miles northwest of Bancroft village. These occurrences are in the adjacent townships of Faraday and Herschel.

Detailed petrographic and chemical work by C. E. Tilley suggests that several of the common mineral assemblages in the gneisses of the York River valley are derived by metasomatic alteration of marble. Tilley[3] regards the assemblages, biotite-plagioclase-calcite, hornblende-plagioclase-calcite, and ferrohastingsite-hedenbergite-plagioclase-calcite, as products of metasomatic replacement of marble. Transitions of these iron-rich silicate assemblages to nepheline-bearing assemblages show that nephelinization is a final stage in this metasomatic process, and that some of the nepheline-bearing gneisses are produced by replacement of marble.

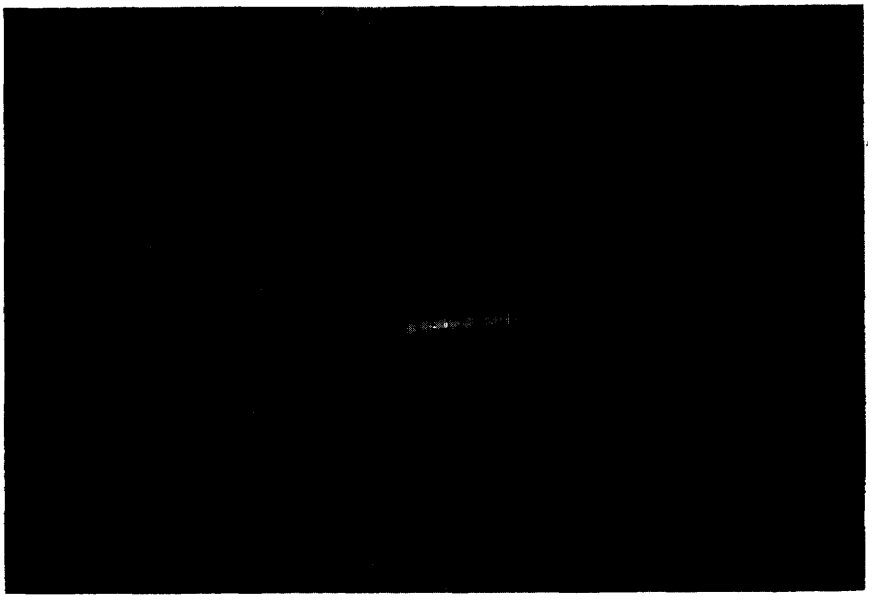
HASTINGS BASIN

The geological map (facing page 6) shows the distribution of the members and formations of the Mayo group in the Hastings Basin of southern Dungannon and Mayo townships. The table of formations (facing page 7) indicates the distribution of members of the Dungannon formation in the Detlor and Mayo anticlines.

Mayo Group

The metasediments south of the McArthurs Mills fault are termed the Mayo group by the authors. These sediments are distinguished from those of the Hastings Highland gneiss complex by their lower grade of metamorphism and by the lack of granitization and syenitization. It is quite clear that there are two markedly different metamorphic environments. To the north the gneiss complex

[1]C. E. Tilley, *op. cit.*
[2]Felix Chayes, *op. cit.*, p. 465.
[3]C. E. Tilley, *op. cit.*



Spotted scapolite schist of the Hermon formation at Upper Hermon cross-roads, Mayo township. Light-grey scapolite spots up to one inch in size occur in a sandy pelitic schist.



Hydrothermal development of scapolite along a fracture in sandy biotitic schist of the Hermon formation, Upper Hermon cross-roads, Mayo township.

represents a terrane of high-grade metamorphic mixed gneisses produced by granitization, syenitization, injection, and intrusion; recognizable sedimentary rocks occur as bands or pendants in the hybrid gneiss, and make up less than 20 percent of the exposed rock. This terrane is the product of *deep-zone metamorphism*. In contrast, to the south, sedimentary rocks make up over 80 percent of the exposed rock, and normal structural and stratigraphic methods may be applied to the less metamorphosed sediments.

Hermon Formation.—The Hermon formation is predominantly pelitic schist and paragneiss but includes amphibolite, spotted scapolite schist, sandy argillite, quartzite, arkose, and conglomerate.

The Hermon formation is best exposed in Mayo township, where it forms the uppermost formation in the eastward-plunging Detlor anticline. It extends in a wide band south of the McArthurs Mills fault from Bowen Corner eastward through Hermon to McArthurs Mills, and then southwest towards Bessemer.

A wide band of sandy pelitic schist, amphibolite, and conglomerate running northeast along the south limb of the Mayo anticline probably belongs to the Hermon formation also.

In Dungannon township a narrow band of sillimanite-garnet paragneiss along the York River just south of the McArthurs Mills fault is also correlated with the Hermon formation. Farther to the west, in Faraday and Cardiff townships, there is a wide band of pelitic schist and gneiss that has the distinctive lithology of the Hermon formation, and which is correlated with it, as shown on the map (facing page 6). This formation has been traced for over 40 miles and has a maximum thickness, in Cardiff township, of about 10,000 feet.

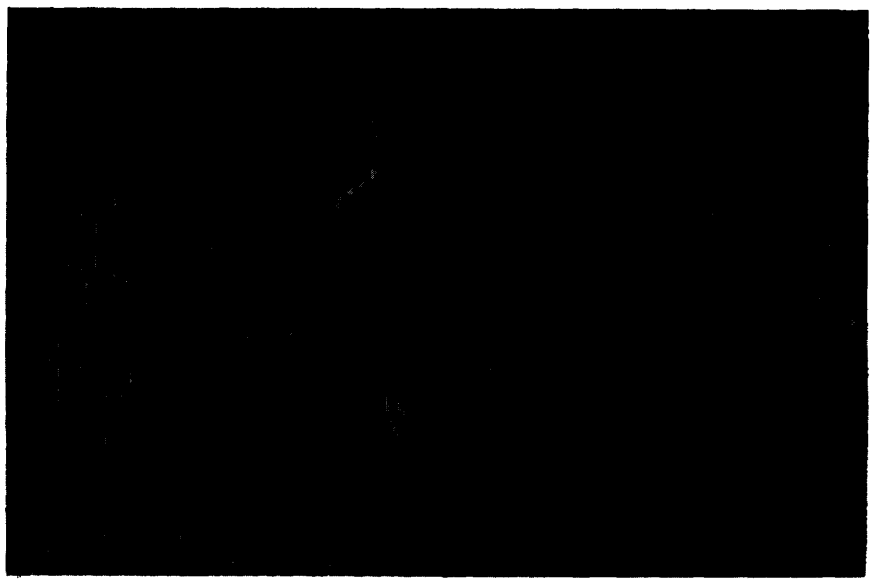
The Hermon formation consists predominantly of hornblende-biotite-quartz-plagioclase schist and gneiss. Narrow bands of pink arkose, consisting of detrital quartz and feldspar, chiefly microcline, plus white mica, make characteristic marker horizons up to 200 feet thick in the Hermon formation. These arkosic bands are uncommon in the area and are characteristic of the Hermon formation in Cardiff, Faraday, Dungannon, and Mayo townships.

The Hermon formation is well exposed on the ridges north of the East road at Bulpit Lake, and at Hermon. In a zone within a mile of the McArthurs Mills fault the common facies is sillimanite-garnet paragneiss and schist, consisting of sillimanite, garnet, biotite, muscovite, quartz, and plagioclase. Some amphibolite is usually present interbanded with the paragneiss.

An unusual and distinctive feature of parts of the Hermon formation in north-central Mayo township is *scapolitization*. Grey or white spots of scapolite up to 1 inch in diameter occur in sandy biotite-hornblende schists and gneisses. The best development of spotted scapolite schists and gneisses may be seen at the Upper Hermon cross-roads where several acres of bare exposures of these spotted schists are available for examination. The photographs on page 17 show the development of scapolite spots in these rocks. On fresh surfaces the scapolite has a grey lustrous sheen. One of the photographs shows the development of scapolite along a fracture cutting across the foliation of the schists. This indicates the hydrothermal origin of the scapolite. Clots of hornblende and magnetite stand up in relief on weathered surfaces. Clotting of hornblende is a feature of the metamorphism of these rocks; the hornblende is veinitic, and this formation of granoblastic aggregates of hornblende occurs both in the sediments and in the development of the typical metagabbro. Magnetite clots, up to ¼ inch in diameter, and garnet occur in the schists at Upper Hermon. Scapolitization occurs through north-central Mayo township from Bowen Corner to Lily Lake.



Fracture cleavage cutting bedding in a pebble conglomerate member of the Hermon formation, Hartsmere road, Mayo township.



Fracture cleavage and bedding in marble and feather amphibolite of the Dungannon formation, L'Amable Lake, Dungannon township. The view taken east indicates that the outcrop is on the south limb of an anticline whose axial plane dips north.

In southern Mayo township on the south arm of the Mayo anticline, the Hermon formation consists of sandy pelitic and amphibolite schists. The relation of fracture cleavage and bedding indicates that these sediments are on the south limb of the anticline. (See photographs on page 19.) On the Hartsmere road (Hartsmere to McArthur Mills), ¼ mile west of the Ashby boundary, there is a band of pebble conglomerate in the schist. The pebbles are very much elongated and are chiefly quartz or granite. There is another outcrop of conglomerate on an island in Gin Lake along strike about 2½ miles to the southwest. Here the pebbles are pink granite and are again elongated or stretched.

The Hermon formation is underlain by marble. Its upper limit is not known since it is cut off against the McArthurs Mills fault to the north and is intruded by the Weslemkoon granite to the southeast. The contact between the Hermon formation and the Weslemkoon granite is well exposed on the Hartsmere road near Gin Creek in Mayo township. The contact between the rusty schist of the Hermon formation and the grey biotite granite gneiss is sharp. There is no granitization of the Hermon formation near the contact, and no notable contact metamorphic effects in the sediments.

Dungannon Formation.—All the sediments below the Hermon formation are grouped together as the Dungannon formation. This formation consists predominantly of marble. Both limestone and dolomite are present, but dolomite appears to predominate.

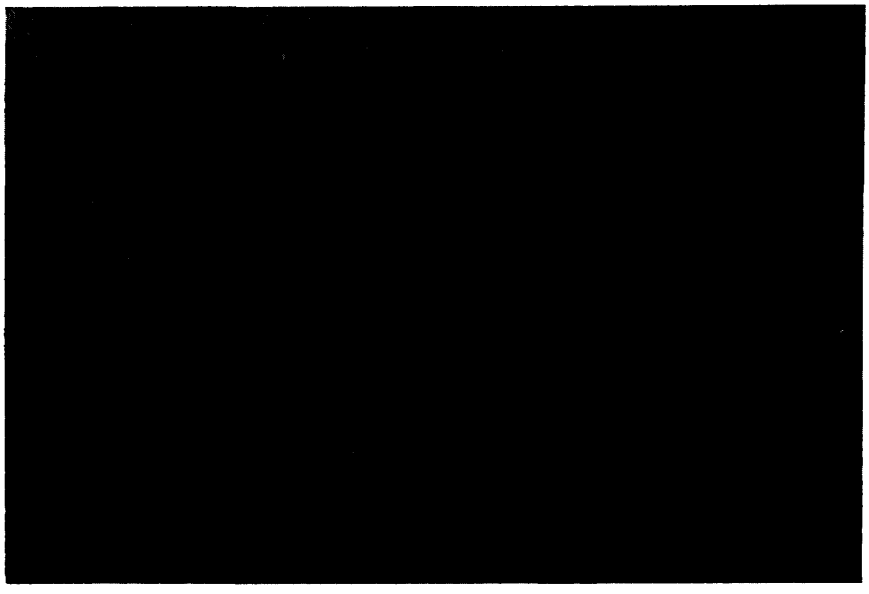
In the zone between the York River and L'Amable Lake in west-central Dungannon township the marbles are medium- to coarse-grained and predominantly white in colour. The formation is highly folded, and the marbles have frequently failed by fracture and brecciation rather than by flowage, as is characteristic of the marbles in the Hastings Highland gneiss complex. Brecciated zones in the marble may be seen in the Barker marble quarries just north of L'Amable Lake. The matrix between marble fragments is rich in brown mica.

Some of the interbanded marble and feather amphibolite shows fracture cleavage. A photograph on page 19 taken on an island in L'Amable Lake shows well-developed fracture cleavage cutting interbanded marble and feather amphibolite. The attitude of the cleavage indicates that the outcrop represents the south limb of an anticline overturned towards the south. This fold lies within a disturbed zone in the Dungannon formation lying between L'Amable Creek and the York River.

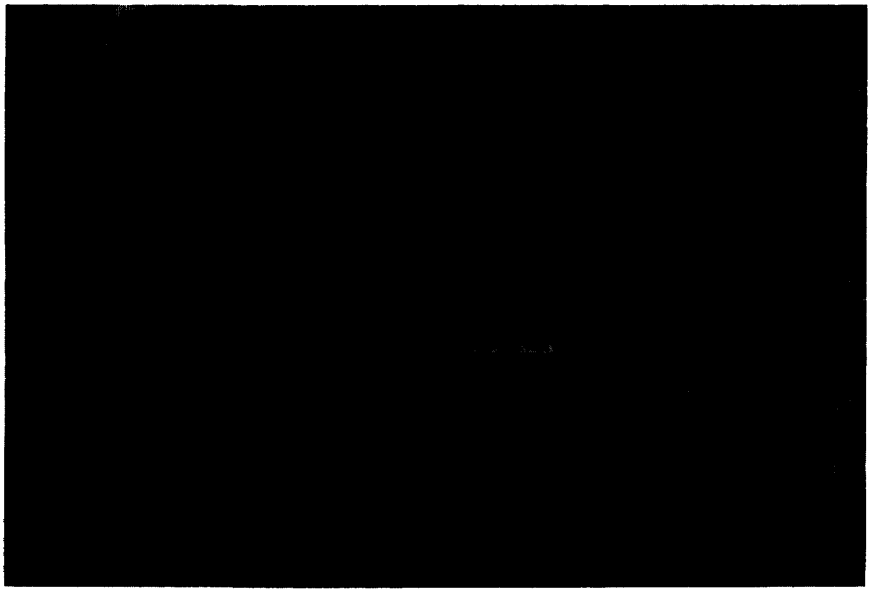
To the south the Detlor anticline is overturned towards the north with its axial plane dipping about 40°S. In south-central Dungannon township an unusual feature is the widespread development of feather amphibolite. The interbedded feather amphibolite and marble facies is called the *Detlor member* of the Dungannon formation. On the map (facing page 6) the distribution of this feather amphibolite facies is shown; it extends northeastward along the axis of the Detlor anticline through south-central Dungannon township to Jamieson Lake. It also occupies a large part of south-central Faraday township.

The feather amphibolite in this area was first described by Adams and Barlow,[1] and was regarded by them as being of sedimentary origin. The Detlor member consists of interbedded feather amphibolite and fine-grained grey-to-brown marble. The feather amphibolite bands are fine-grained sandy beds con-

[1]Frank D. Adams and Alfred E. Barlow, *Geology of the Haliburton and Bancroft Areas, Province of Ontario*, Geol. Surv. Can., Mem. 6, 1910, pp. 166–70.



Feather amphibolite developed on a bedding plane in the Dungannon formation, Detlor Station, Dungannon township.



Feather amphibolite developed in narrow bands in marble of the Dungannon formation on highway No. 62 near Green Corners, Dungannon township.

sisting of quartz, plagioclase, and hornblende. The distinctive feature of the feather amphibolite is the character of the hornblende. The hornblende occurs in long feathery slender crystals, which are usually oriented parallel to the bedding foliation. (See photographs on page 21.) Sometimes the stellate hornblende crystals are not confined to bedding planes but grow across or through them. The feather amphibolite bands range in thickness from a few millimetres to 30–40 feet. In thin section the hornblende blades are seen to have a sieve or filigree structure owing to many small inclusions of plagioclase and quartz. The hornblende is usually in a fine-grained granular matrix of plagioclase, quartz, and biotite.

Feather amphibolites of three types are recognized in the Detlor member. First, there are feather amphibolites of sedimentary origin in which the feathers develop in thin impure silty bands in the marble. Second, feather amphibolite develops in dikes and sills of gabbroic amphibolite, which occur widely distributed in the area. Third, some of the feather amphibolite appears to be of metasomatic origin, produced by the introduction of iron, soda, alumina, and silica into permeable beds in the marble sequence.

Feather amphibolites of all three types may be seen in road cuts on highway No. 62 between Green Corners and the south boundary of Dungannon township. Another excellent place to observe feather amphibolite is in the railway cuts at Detlor station. Where there has been flowage of the marble, boudinage structure is common; the competent feather amphibolite bands are broken into boudins or "sausages" in the marble. The photograph on page 42 illustrates this structure.

The marble that occurs interbanded with the feather amphibolite is often grey or brown in colour and well bedded. The accompanying photograph of well-bedded "Hastings-type" limestone was taken on the Detlor road 2 miles east of Green Corners.

In the Hastings Basin section of the area the marbles are frequently well-bedded, "dirty," or argillaceous limestone in which the impurities cannot be readily identified in hand specimens. In contrast, in the Hastings Highland area, the marbles are generally coarse-grained, white in colour, and in the impure facies the impurities are present as recognizable recrystallized constituent minerals such as tremolite, phlogopite, and diopside. The impure marbles of the Hastings Highland gneiss complex are "marble with silicates" rather than "dirty or argillaceous marble" as is found in the Hastings Basin. This is a reflection of the lower metamorphic grade of the Basin rocks.

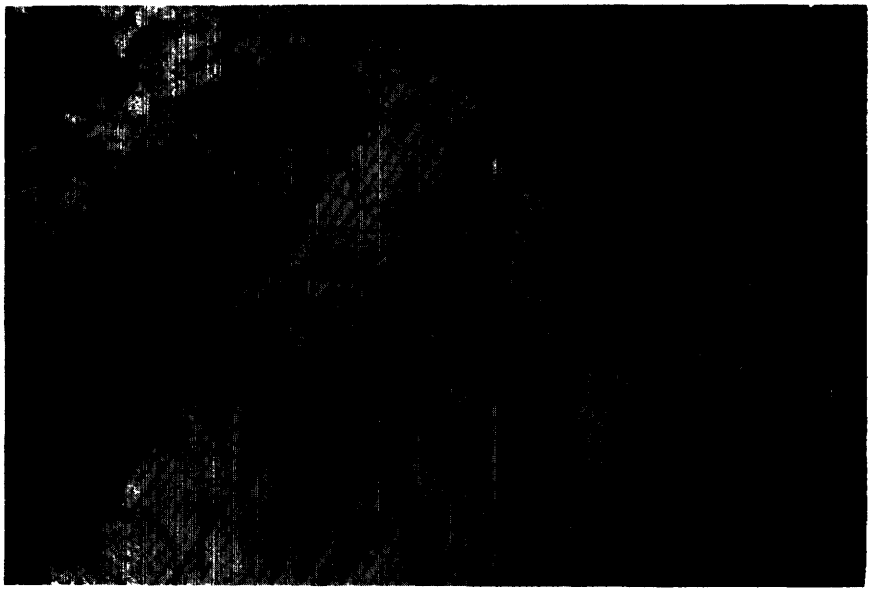
In places in the Dungannon formation coarse silicates do occur in the marble. The accompanying photograph shows tremolite patches up to 4 inches in length in white marble on the Hartsmere road, Mayo township.

In the dark-grey or brown, well-bedded marble of the Detlor member narrow bands of white, coarser crystalline marble sometimes occur. Originally it was suggested that these were calcitic bands in dolomite, but tests proved that there was little compositional difference between the bands. Analyses of marble from the Barker, Stewart, and McMillan quarries by M. F. Goudge[1] indicate that the stone is predominantly dolomitic marble, but one analysis indicates calcitic marble. A ridge of calcitic marble on lots 22–24, concession X, Dungannon township, was drilled by Ventures, Limited, and a substantial tonnage of crystalline limestone was indicated.

[1] M. F. Goudge, *Limestones of Canada, Part IV, Ontario*, Can. Dept. Mines, Mines and Geol. Branch, No. 781, 1938, p. 110.



Well-bedded "Hastings-type" limestone in the Dungannon formation near Detlor, Dungannon township.



Coarse knots of tremolite standing up on a weathered surface of marble of the Dungannon formation on the Hartsmere road, Mayo township.

The development of a pale-green, massive, banded, coarse-grained, diopside rock from marble by metasomatic replacement is well shown in the road cuts on highway No. 62 immediately north of the L'Amable Creek bridge. The source of the solutions may be the basic intrusives cutting the marble nearby.

Skarn zones are not common in the marble of the Dungannon formation, but the Bessemer iron deposit is a magnetite-rich skarn occurring in marble at the contact with dioritic amphibolite. Magnetite, hornblende, pyroxene, pyrite, pyrrhotite, chalcopyrite, garnet, epidote, scapolite, and titanite are developed in the skarn zone.

In the Mayo anticline in southern Dungannon and Mayo townships, several members are recognized in the Dungannon formation. Underlying the Hermon formation there is a thick section of white dolomitic marble. The marble ranges from fine- to medium-grained. Silicates are occasionally present, as indicated in the preceding photograph taken near Hartsmere.

In south-central Dungannon township this marble is underlain by the *Turriff rusty schist* member, which lies on top of the *Turriff basic volcanics*. The rusty schists are exposed over a width of nearly 2,000 feet. They dip vertically and strike northeast. They pinch out into marble about 2 miles to the northeast. The underlying basic volcanics only extend about 1 mile northeastward into Dungannon township before pinching out. The volcanic member is underlain by pelitic schist and paragneiss, which extends northeast along strike as far as Wendsley Lake.

The next lower member in the sequence is the Wendsley Lake rhyodacite, which has already been described. This member extends for 7 miles northeastward through Dungannon and into Mayo township but does not extend around the axis of the Mayo anticline. The rhyodacite is also underlain by grey and white marble.

The *Crooked Lake schist* member, consisting of rusty fine-grained pelitic schist and rusty diopsidic quartzo-feldspathic gneiss, extends around the crest of the Mayo anticline in the vicinity of Green Narrows on Mayo (Crooked) Lake. This member thins to the southwest along the north limb of the anticline and pinches out in marble about 3 miles southwest of Green Narrows. Relations between fracture cleavage and bedding in this member enable structural determinations to be made in the Mayo (Crooked) Lake area. Narrow interbeds of marble occur in the rusty schist.

About 2,000 feet of marble separate the Crooked Lake schist from the underlying *Grassy Lake quartzite*. This unit consists of about 1,400 feet of grey biotite quartzite, marble, and rusty schist. It is underlain by impure marble. The quartzite is a medium- to fine-grained, grey granular sediment consisting of quartz, biotite, and some feldspar.

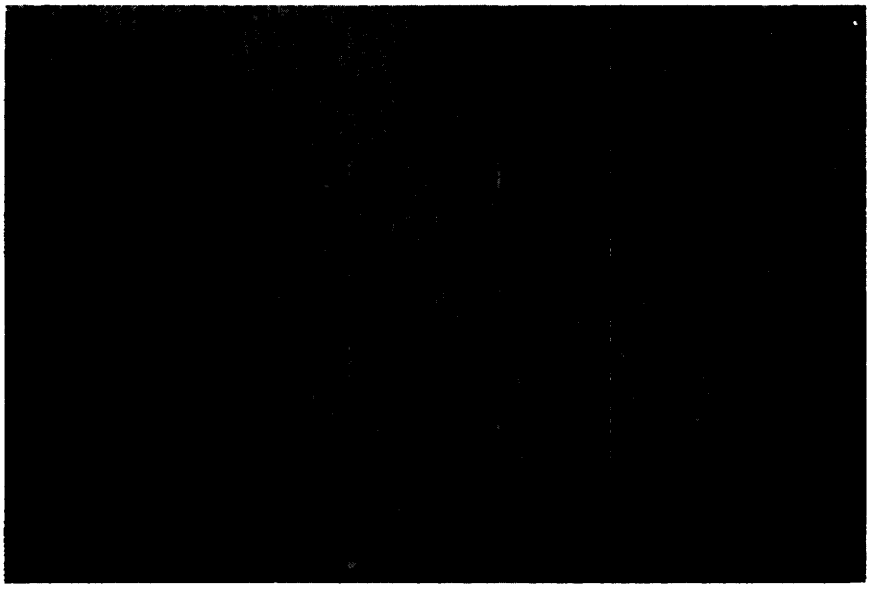
Plutonic Rocks

OLDER BASIC INTRUSIVE AND META-INTRUSIVE GROUP

A series of basic intrusives consisting of quartz diorite, diorite, gabbro, and olivine gabbro, are the oldest intrusive rocks in the area. Most of the basic intrusives have been highly metamorphosed and now consist of metagabbro, amphibolite, and hornblende schist. The term "metagabbro" is used to describe a coarse-grained hornblende-plagioclase gabbro gneiss in which clotted aggregates of hornblende crystals occur in a medium-grained granoblastic matrix of plagioclase. Granoblastic texture is characteristic of the metagabbro, and flaser struc-

ture is common. The metagabbro grades from a light-coloured, scapolite-plagioclase rock, with clots of black or dark-green hornblende crystals up to ¼ inch in diameter making up 20–40 percent of the rock, to a coarse-grained hornblendite made up of shiny, interlocking crystals up to ½ inch in diameter. Scapolite is very common in the metagabbro and may completely replace plagioclase. The plagioclase ranges from oligoclase to labradorite in composition.

As the metagabbro is metamorphosed further it is usually altered to a fine- to medium-grained amphibolite gneiss consisting of a granoblastic aggregate of hornblende and plagioclase. This amphibolite facies is particularly common along the borders of the large metagabbro bodies such as the Mallard Lake metagabbro, and in the small intrusive sills and dikes in southern Dungannon and Mayo townships. Some of the small dikes in the Hastings Basin section are only a few inches wide and consist of fine-grained black "trap" rock, sometimes with accessory mica.



Mallard Lake metagabbro north of Hermon, Mayo township, showing the characteristic texture of the metagabbro.

Mallard Lake Metagabbro

The Mallard Lake metagabbro is a large basic intrusive occupying an area of about 28 square miles in northwestern Mayo, northeastern Dungannon, and southern Carlow townships. It extends from the York River valley on the west, eastward for over 7 miles to the Mallard Lake fault in the vicinity of McArthurs Mills, and forms the series of hills lying north of the East road from York River bridge to Hermon. For the most part the metagabbro area lacks roads, but large exposures can be seen in the road extending northwest from Hermon, and on the Hermon–Fort Stewart road.

The Mallard Lake metagabbro consists predominantly of coarse-grained hornblende-plagioclase gneiss showing granoblastic aggregates of black hornblende crystals in a matrix of granular plagioclase. Other facies present in in the mass include fresh-looking, hard, massive, fine- to medium-grained quartz diorite, massive gabbro with ophitic texture, a leucocratic facies consisting largely of scapolite, medium-grained amphibolite, and hornblende schist. The scapolite-rich leucocratic facies is well exposed on the hillside north of the Hermon–Fort

Stewart road on lots 13 and 14, concession XIII, Mayo township. Foliation in the metagabbro generally dips to the southeast.

Fine-grained amphibolite forms the border facies on the west side of the metagabbro flanking the York River paragneiss-marble-nepheline gneiss belt.

Egan Chute Gabbro

A small satellite plug of fresh gabbro, measuring 1,000 feet long and 600 feet wide, intrudes the marble-paragneiss band at Egan Chute, just west of the main Mallard Lake metagabbro. The structure in the gneisses and marble swings around the small plug. This intrusive is remarkably fresh and massive compared with the highly metamorphosed Mallard Lake body, and whether it is of later age is not known. The authors believe that it is probably preserved as a large *boudin* in the marble sequence, and that its preservation is due to the cushioning of the incompetent enclosing formations. The period of nephelinization of the marble-paragneiss sequence into which the gabbro was intruded is thought by the authors to be post-gabbro, since other gabbros in the area are cut by nepheline-bearing stringers.

Under the microscope the gabbro consists of clinopyroxene and plagioclase with accessory quartz and biotite. The pyroxene is uralitized, and the plagioclase is clouded.

Raglan Hills Metagabbro

The westward part of the Raglan Hills metagabbro, which occupies a large area in southern Raglan township, extends westward into northeastern Mayo township and meets the Mallard Lake metagabbro at the Mallard Creek fault. The Raglan Hills body is described in the Brudenell-Raglan report.[1]

The predominant rock types exposed in Mayo township are quartz diorite, gabbro, metagabbro, and amphibolite.

Umfraville Gabbro

The northeastern part of the large Umfraville gabbro stock extends into the southwestern corner of Dungannon township. The marginal part of the gabbro body that is seen in this area consists of coarse-grained metagabbro and amphibolite. The central part farther south is fresh-looking, coarse-grained hypersthene gabbro characterized by purple plagioclase.

Other Basic Intrusive Bodies

Smaller bodies of dioritic and gabbroic amphibolite and metagabbro are very common in southern Dungannon and Mayo townships. In south-central Mayo township, on the Cashel boundary, there is a large body of metamorphosed gabbro now consisting mostly of metagabbro and amphibolite. A large number of small, amphibolite intrusive dikes and sills cut the Dungannon formation in southern Dungannon township, and these are well exposed in roadcuts on highway No. 62 south of Bancroft. In the feather amphibolite zone some of the amphibolite intrusives show the development of feathered amphiboles, especially along their margins. Garnet is often present in the amphibolite dikes and sills but has not been observed in the larger gabbro or metagabbro bodies.

Under the microscope the amphibolite dikes consist of a fine-grained grano-

[1]D. F. Hewitt, *Geology of the Brudenell-Raglan Area*, Ont. Dept. Mines, Vol. LXII, 1953, pt. 5, pp. 15–16.

blastic aggregate of plagioclase and bright-green hornblende. Biotite is often present. Quartz and titanite are accessories.

Crosscutting garnetiferous feather amphibolite dikes are well-exposed on lot 10, concession IX, Dungannon township. The dikes truncate marble at a low angle.

A concentration of amphibolite intrusives occurs in a band extending from lot 20, concession I, Dungannon township, to lot 20, concession IX, Mayo township. This zone lies between the Detlor and Mayo anticlines and may represent a zone of faulting. The Bessemer, Childs, and Rankin iron mines lie in this zone.

BOULTER GRANITE GROUP

Intruding the gabbro and metasediments are a group of older, grey biotite-albite granites. In the Dungannon-Mayo area this group is represented by the Boulter, Weslemkoon, and Bessemer granites. They are characterized by their grey colour, medium-grain size, characteristic accessory biotite, and the absence or scarcity of potash feldspar. They range from albite granite to tonalite, depending on the composition of the plagioclase.

Boulter Granite

The southern part of the Boulter granite stocks of Carlow township extend into northern Mayo township. The Boulter granite is a grey biotite-albite granite of medium-grain size. A complete description of the Boulter stocks is given in the Monteagle-Carlow report.[1] Chemical analyses are given below.

Weslemkoon Granite

In southeastern Mayo township an area of 9 square miles is underlain by the Weslemkoon granite. This Mayo occurrence forms part of the very large Weslemkoon batholith, which occupies parts of Mayo, Cashel, Ashby, Denbigh, Effingham, Abinger, and Grimsthorpe townships. The Weslemkoon granite is a grey biotite-oligoclase granite of medium-grain size. It is pronouncedly gneissic especially along its margins. Sedimentary inclusions and schlieren are lacking. The granite is cut by dikes of pink potash granite pegmatite.

A sharp contact between the Weslemkoon granite and the Hermon formation can be seen on the Hartsmere road at Gin Creek, Mayo township. There is little or no contact metamorphism and no hybrid contact zone.

Bessemer Granite

The Bessemer granite gneiss is an elongated body 2½ miles long and ½ mile wide, trending in a northeasterly direction in west-central Mayo township. This granite gneiss lies just north of the Bessemer iron mine. The rock is a medium-grained, grey biotite-plagioclase-quartz gneiss showing a pronounced foliation. It is fairly uniform in composition and texture throughout. The contacts between the grey, granite gneiss and the adjacent quartzo-feldspathic paragneiss are not well marked, and there was some difficulty in placing the contact for mapping purposes. This rock is very similar in lithology and texture to the gneissic border facies of the Weslemkoon granite and lithologically looks like a coarser-grained equivalent of the Wendsley Lake rhyodacite. Chemical analyses indicate a marked similarity between the Wendsley Lake rhyodacite, the Bessemer granite, the Boulter granite, and the Weslemkoon granite.

[1]D. F. Hewitt, *Geology of Monteagle and Carlow Townships*, Ont. Dept. Mines, Vol. LXIII, 1954, pt. 6, p. 15.

The accompanying table gives complete chemical analyses of these granites:

CHEMICAL ANALYSES OF GRANITES[1]

	Sample No. 1, Boulter granite	Sample No. 2, Boulter granite	Sample No. 3, Weslemkoon granite	Sample No. 4, Bessemer granite
	percent	percent	percent	percent
SiO_2	71.81	71.01	66.78	71.01
Al_2O_3	15.96	15.91	16.79	15.05
Fe_2O_3	0.42	0.12	0.26	1.05
FeO	0.74	1.37	2.60	1.75
MgO	0.47	0.83	1.48	0.72
CaO	3.61	3.39	4.34	2.03
Na_2O	5.25	5.25	4.50	5.40
K_2O	1.05	1.25	1.65	1.60
H_2O+	0.21	0.13	0.48	0.41
H_2O-	0.03	0.02	0.11	0.01
CO_2[2]	0.03	0.14	0.27	0.62
TiO_2	0.14	0.22	0.35	0.31
P_2O_5	0.00	0.00	0.00	0.05
Cr_2O_3	0.01	0.01	0.01	0.005
MnO	0.01	0.02	0.04	0.03
V_2O_3	0.01	0.01	0.01	0.005
Total	99.75	99.68	99.67	100.04
Loss on ignition	0.27	0.29	0.86	.....

Sample No. 1. Boulter granite, Fort Stewart, lot 20, concession II, Carlow township.
Sample No. 2. Boulter granite, Fraser Lake, lot 12, concession V, Carlow township.
Sample No. 3. Weslemkoon granite, Hartsmere road, lot 27, concession VIII, Ashby township.
Sample No. 4. Bessemer granite, lot 4, concession VII, Mayo township.

NEPHELINE GNEISS GROUP

The nepheline-bearing gneisses are confined to the Hastings Highland gneiss complex of northern Dungannon township, north of the McArthurs Mills fault and west of the Mallard Lake metagabbro. They are not represented in the Hastings Basin section of the map area. The nepheline gneisses are widely distributed throughout northern Dungannon township; those of the Bancroft (East road) area and the York River (Egan Chute) area have been described fully in earlier reports by Adams and Barlow,[3] Osborne,[4] Chayes,[5] Gummer and Burr,[6] Barager,[7] and Tilley.[8]

These nepheline rocks are of commercial interest as a source of raw material for glass and ceramics, as a potential source of alumina, and as host rock for corundum deposits. Pink and white alkaline syenite gneisses, which are closely associated spatially and genetically with the nepheline gneisses, are also an important corundum-bearing series.

The nepheline gneisses consist essentially of nepheline and plagioclase

[1]Analyses by the Provincial Assay Office, Ontario Department of Mines, 1955.
[2]Carbon dioxide calculated from loss on ignition.
[3]Frank D. Adams and Alfred E. Barlow, *Geology of the Haliburton and Bancroft Areas, Province of Ontario*, Geol. Surv. Can., Mem. 6, 1910, pp. 227–33.
[4]F. F. Osborne, *The Nepheline Gneiss Complex near Egan Chute, Dungannon Township*, Amer. Jour. Science, 5th series, Vol. 20, 1930.
[5]Felix Chayes, *Alkaline and Carbonate Intrusives near Bancroft, Ontario*, Bull. Geol. Soc. Amer., Vol. 53, No. 3, Mar., 1942.
[6]W. K. Gummer and S. V. Burr, *Nephelinized Paragneiss in the Bancroft Area, Ontario*, Jour. Geol. Vol. LIV, No. 3, May, 1946.
[7]W. R. A. Barager, *Nepheline Gneisses of York River, Ontario*, Proceedings, Geol. Assoc. Can., Vol. 6, pt. I, 1953.
[8]C. E. Tilley, unpublished manuscript, 1955.

(usually albite or oligoclase). Microcline and microcline microperthite are sometimes present. Biotite, hornblende, pyroxene, and magnetite are important mafic constituents in some of the gneisses and may make up over 30 percent of some facies. Garnet, scapolite, and corundum are characterizing accessories in some nepheline gneisses. Vesuvianite, titanite, muscovite, tourmaline, apatite, zircon, sodalite, cancrinite, hydronephelite, fluorite, calcite, and zeolites are minor accessories.

Nepheline-bearing rocks are easily recognized by their characteristic grey, pitted, weathered surface caused by the differential weathering of nepheline and feldspar. Feldspar, corundum, and ferromagnesian minerals stand up in relief above nepheline and scapolite on weathered surfaces. Nepheline and scapolite may occur together in the nepheline gneisses, and since they both weather easily and have a grey or blue-grey colour, they are often difficult to differentiate.

Occurrence

The nepheline gneisses occur in two main bands in northern Dungannon township. The York River (Egan Chute) nepheline gneiss band extends from the East road at the York River bridge (lot 12, concession XI), northward up the York River valley to leave the township at lot 4, concession XVI. This band is continuous with the east band described in the Monteagle-Carlow report.[1]

The second important band of nepheline gneisses, the Bancroft (East road) band, extends eastward from Bancroft on both sides of the East road to the Great Bend of the York River. The main development of this band is between Bancroft and the Vardy quarry in lot 23, concession XIV, Dungannon township. East of the Vardy quarry the nepheline band is interrupted by the intrusion of the Bronson granite, and only small unreplaced relicts of nepheline gneiss occur in the syenite gneiss north and south of the Bronson granite.

Several large hills consisting predominantly of nepheline-albite gneiss occur on each side of the York River in lots 14–16, concession XIV, and an important corundum-bearing ridge of nepheline and associated syenite gneisses occurs in lots 11 and 12, concessions XIV and XV, Dungannon township.

Several small occurrences of nepheline gneiss are shown on the map north of the Great Bend of the York River.

Age, Lithology, and Structure

The nepheline-bearing rocks are strongly gneissic in structure and vary in mineralogy both across and along strike. Structurally the nepheline gneiss bands conform to the structure of the metasediments and syenitic gneisses with which they occur. Nepheline gneisses are not found cutting any other rock types. Nepheline pegmatites cut and replace the nepheline gneisses, and in Carlow township nepheline pegmatite stringers cut gabbro.[2] In lot 21, concession XI, Dungannon township, a narrow dike of nepheline-albite pegmatite cuts dioritic amphibolite. In adjacent Faraday township the Faraday metagabbro is injected and partially replaced by nepheline. These occurrences indicate a post-gabbro age for the nepheline rocks.

The nepheline gneisses are intruded and replaced by white alkaline syenite (albite-oligoclase gneiss), by yellow-brown hornblende syenite and granite, by pink syenite and granite (and their gneissic equivalents), and by syenite and granite pegmatite. The age of the nepheline rocks with respect to the Boulter

[1]D. F. Hewitt, *op. cit.*, pp. 16–17, 60–61.
[2]D. F. Hewitt, *op. cit.*, p. 17.

granite is not known, but the nepheline rocks are placed provisionally as post-Boulter granite but pre-granitization.

The Great Bend, Bronson, and Faraday granite gneiss, as well as the main period of syenitization, granitization, and metamorphism are post-nepheline in age.

The sediments, basic intrusives, nepheline rocks, granite, and syenite have suffered strong regional dynamo-thermal metamorphism. Original structures and textures in the nepheline rocks have been largely destroyed by metamorphism, and these rocks are now metamorphic gneisses with metamorphic structure, texture, and mineralogy. Fortunately, the York River nepheline band, which is overlain and underlain by marble, is separated from the main mixed gneiss complex of hybrid syenitic and granitic rocks, and consequently the replacement textures, indicating that these gneisses have been produced by metasomatic replacement of limy sediments, have been preserved to a large extent.

Textures range from hypidiomorphic granitoid to equigranular granoblastic, or sometimes poikilitic. In the York River band, sieve replacement textures, vermicular nepheline in plagioclase, mantling of feldspar by plagioclase or nepheline and corona textures are described by Tilley.[1]

For the purposes of field mapping the nepheline rocks have been divided lithologically into the following subdivisions: (6a) nepheline-plagioclase gneiss· (6b) nepheline-hornblende gneiss; (6c) nepheline-biotite gneiss; (6e) nepheline-poor alkaline gneiss; (6g) scapolite gneiss, nepheline-scapolite gneiss; (6k) nepheline-corundum gneiss; (6p) nepheline pegmatite. These subdivisions are arbitrary, and one variety grades into another.

The light-coloured nepheline gneisses consist predominantly of nepheline and plagioclase; the latter is usually albite or sodic oligoclase, but occasionally it is as calcic as andesine. The more calcic plagioclase usually occurs with scapolite. Nepheline-plagioclase gneiss (6a) is the most common rock type, and it grades into white alkaline syenite consisting predominantly of albite, oligoclase, or andesine (6e). These rocks are often interbanded with pink and buff leuco-syenite gneiss (7a).

Biotite is a common mafic constituent, and nepheline-(plagioclase)-biotite gneiss (6c) is next to nepheline-plagioclase gneiss in abundance. Nepheline-biotite gneiss without plagioclase is rare. Corundum often occurs in crystals from microscopic size up to 1 inch or more in diameter. Corundum usually occurs in the nepheline-plagioclase-biotite facies, and muscovite is nearly always present. Corundum never occurs in the hornblende-nepheline facies. Well-known occurrences of nepheline-corundum gneiss (6k) are the Lily Robertson hill (lot 26, concession XIII), Egan Chute (lot 12, concession XII), and the Dungannonite ridge on the Great Bend of the York River (lots 11 and 12, concessions XIV and XV).

The mafic facies of nepheline gneiss are more common in the York River band. The nepheline-hornblende gneiss (6b) group includes nepheline-hornblende-plagioclase gneiss, nepheline-hornblende-garnet gneiss with or without plagioclase, nepheline-hornblende-hedenbergite gneiss with or without garnet and calcite, and other less common facies. Titanite and vesuvianite are common in the hornblende and pyroxene-bearing facies.

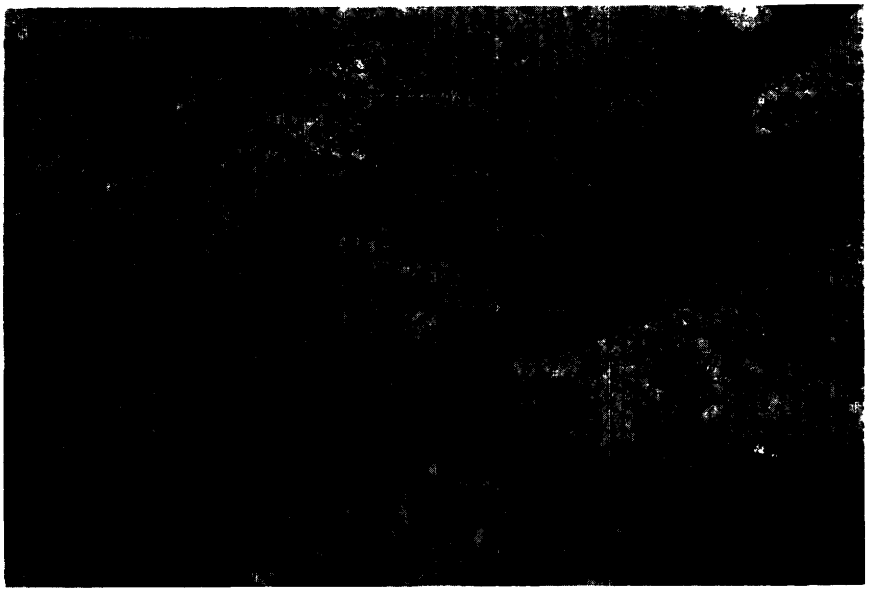
Microcline and microcline microperthite are often present, particularly in the nepheline rocks which occur as relicts in the pink and buff syenite gneisses.

[1]C. E. Tilley, *op. cit.*

Textural relationships suggest that much of the microcline is introduced. Destruction or replacement of the nepheline-bearing facies by pink and buff syenite gneisses is a feature of the Bancroft (East Road) band, and processes similar to those described in the Craigmont area (denephelinization by potash metasomatism) were active in this area also.[1]

Nepheline Pegmatite

Among the most interesting of the alkaline rock types of Dungannon township are the nepheline pegmatites. The best development of giant nepheline pegmatites in the Haliburton-Bancroft area is in the York River (Egan Chute) band of Dungannon township. The nepheline pegmatites consist of albite and



Nepheline-plagioclase gneiss showing development of nepheline pegmatite of the xenoblastic patch-replacement type at the Goulding-Keene quarry, York River, Dungannon township.

nepheline crystals, 1 foot to 6 feet in diameter, and occur cutting nepheline gneisses or as replacement patches in nepheline gneisses. Some of the pegmatite bodies are of large size, measuring 50–100 feet in width and several hundred feet in length.

Most of the nepheline pegmatites are of small size and consist merely of patches of pegmatitic nepheline and albite a few feet in diameter in a matrix of nepheline gneiss. These pegmatitic patches are irregular in shape and have rather indefinite or gradational boundaries. They are termed by the authors *xenoblastic patch pegmatites* and are interpreted as replacement pegmatites produced by recrystallization and mobilization of the nepheline and albite of the gneisses accompanied by the introduction of hydrothermal solutions along certain zones or fractures in the rock. They are endogenous to the nepheline gneiss rock units. The agents that have caused the xenoblastic patches of pegmatite to grow in the gneisses are probably dynamo-thermal metamorphism plus solutions. Some of the pegmatites show intrusive relations and sharp contacts with the enclosing nepheline gneisses, proving that some migration, injection, or mobilization took place.

[1]D. F. Hewitt, *Geology of the Brudenell-Raglan Area*, Ont. Dept. Mines, Vol. LXII, 1953, pt. 5, pp. 96–101.

The replacement origin of some of these pegmatite patches is indicated by relict granoblastic residuals of fine-grained albite in the pegmatitic nepheline.

The nepheline pegmatites of the York River nepheline band are well exposed and can be seen in a number of quarries. The Goulding-Keene quarry, lot 12, concession XI, is just north of the East road on the west bank of the York River. Here a large body of nepheline pegmatite cuts nepheline gneiss. Contacts are gradational over a few feet. The nepheline pegmatite consists of nepheline and albite with biotite, hornblende, calcite, and zircon as common accessories. Small yellow-weathering blebs of calcite occur throughout the large nepheline individuals rendering the material unsuitable for ceramic use. Apatite, sodalite, cancrinite, hydronephelite, and magnetite are other accessories.

On the road north from the East road on the east bank of the York River there are two nepheline pegmatite quarries. The Morrison quarry, lot 10, concession XIII, 1½ miles north of the East road, is in nepheline pegmatite consisting of nepheline and albite plus biotite, calcite, sodalite, magnetite, and a little cancrinite. A large area of nepheline pegmatite is exposed north and west of the quarry, and the pegmatite body has a length of several hundred feet.

The Davis quarry, lot 9, concession XIV, 2¼ miles north of the East road, is in nepheline pegmatite in which the nepheline individuals reach 12 feet in size. Masses of zircon crystals weighing up to 3 pounds were collected by the authors from this quarry. The largest zircon crystal seen by the authors from this quarry measured about 4 inches in length. This quarry also yielded good samples of hackmanite and pink cancrinite. Galena and apatite occur as accessories.

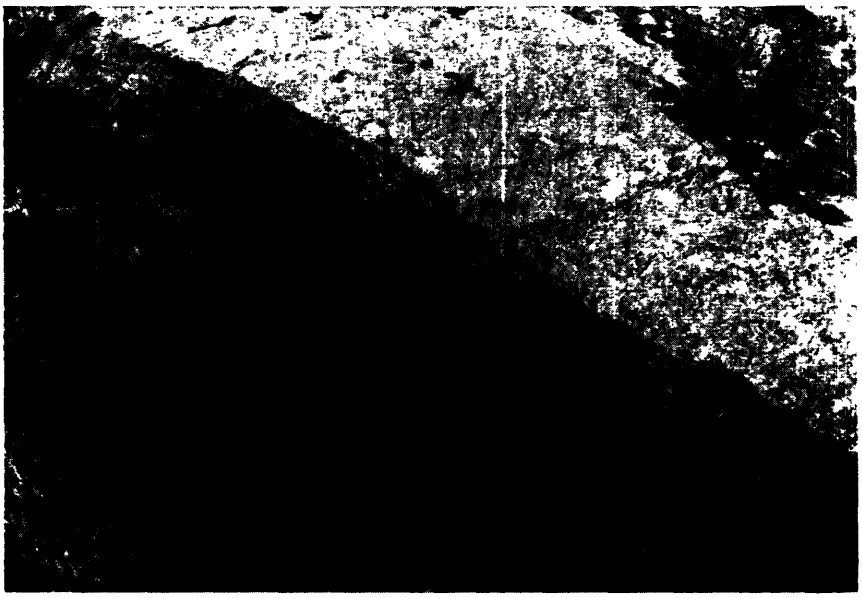
In the Bancroft (East Road) nepheline band several smaller nepheline pegmatites occur. The Robbins pegmatite was opened up on lot 27, concession XIII, ⅜ mile south of Coltson Lake. Here the large number of magnetite crystals, which occur up to 4 inches in size, is noteworthy. Biotite is the chief accessory.

Bancroft (East Road) Area.—The main part of the Bancroft (East Road) nepheline band extends eastward from Bancroft to the Vardy quarry, lots 23–30, concessions XIII and XIV. East of the Vardy quarry the band is intruded by the Bronson granite, and one part of the band swings to the north, passing ½ mile south of Holland Lake, whereas another part of the band occurs between the York River and the East road south of the Bronson granite. Throughout the whole band, nepheline gneisses occur interbanded with and replaced by pink and buff syenite gneiss and granite gneiss. Nepheline gneisses often occur as relict unreplaced bands in syenitic gneisses. Some bands of amphibolite occur, but, generally speaking, recognizable unaltered metasediments are not widespread. Much of the syenitic gneiss sequence can best be termed hybrid syenite gneiss, being a product of injection and metasomatism of metasediments, mainly limestone and amphibolite.

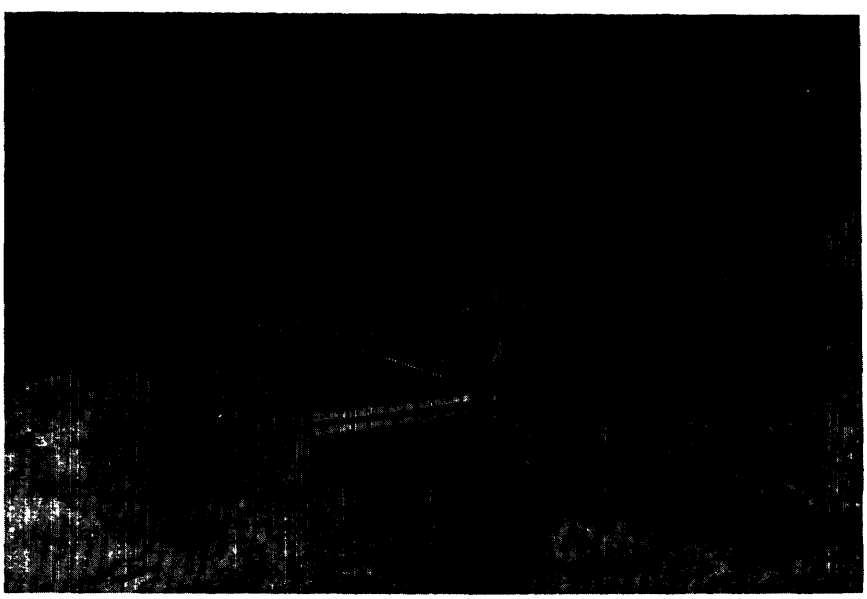
The Bancroft band has been described in detail by Chayes[1] and Gummer and Burr.[2] The more common facies present are nepheline-plagioclase gneiss (6a) and nepheline-biotite-plagioclase gneiss (6c). These occur intimately interbanded with pink and buff leuco-syenite gneiss. Excellent exposures of the nepheline

[1]Felix Chayes, *Alkaline and Carbonate Intrusives near Bancroft, Ontario*, Bull. Geol. Soc. Amer., Vol. 53, No. 3, Mar., 1942.

[2]W. K. Gummer and S. V. Burr, *Nephelinized Paragneisses in the Bancroft Area, Ontario*, Jour. Geol., Vol. LIV, No. 3, May, 1946.



Contact of nepheline gneiss with nepheline pegmatite at the Goulding-Keene quarry on the York River, Dungannon township. On the left is mafic hornblende-nepheline-plagioclase gneiss. The hammer rests on nepheline-rich gneiss carrying over 80 percent nepheline. To the right is the albite (white) and the nepheline (grey) of the pegmatite.



A large nepheline crystal of the nepheline pegmatite at the Davis quarry, Dungannon township. Albite is developed along a fracture in the nepheline.

gneiss may be seen in fields on Bronson hill, Hastings road, lot 60; Cooney hill, lot 27, concession XIII; Davis hill, lot 25, concession XIII; and at the Vardy quarry, lot 23, concession XIV. A plane-table map of the main part of the Bancroft nepheline band, on the scale of 1 inch to 660 feet, is published in J. E. Thomson's North Hastings report.[1]

A good sequence of mixed gneiss typical of the Bancroft belt may be seen on Lily Robertson hill, lot 26, concession XIII. Strippings on the north side of the hill expose nepheline gneisses, pink and yellow syenitic gneisses, paragneiss, and amphibolite. Very good exposures of nepheline-corundum-plagioclase xenoblastic patch pegmatite can be seen. Large crystals of corundum, up to 1 inch, mantled by nepheline, occur in the replacement pegmatites.

The best locality for sodalite is the Princess quarry, lot 25, concession XIV; here sodalite occurs in zones along joint cracks and fractures in nepheline gneiss. The sodalite in alteration zones, which have widths up to 3 feet, is sometimes quite coarse and pegmatitic.

On the northwest face of Cancrinite hill in the south half of lot 25, concession XIII, yellow cancrinite and blue sodalite replace a medium-grained nepheline-plagioclase-biotite gneiss with preservation of the original medium-grained granoblastic texture of the gneiss. Nepheline, biotite, and magnetite crystals frequently occur in vugs and along joint cracks in the nepheline gneisses. Good examples of this can be seen at the Princess quarry and on Davis hill. Euhedral nepheline crystals up to 6 inches in size were observed.

York River (Egan Chute) Area.—The York River (Egan Chute) nepheline gneiss band is quite different in character from the Bancroft band. Instead of forming part of a polymetamorphic complex of granitic, syenitic, and nepheline-bearing gneisses, the York River band forms traceable units, 500–1,500 feet wide and 3 miles long, extending north from the York River bridge on the East road, to the York River in the vicinity of Kings Marsh. Here it is cut off by faulting, but faulted segments of the band can be traced northward to the Monteagle township boundary where it is continuous with the York River nepheline band described in the Monteagle-Carlow report.[2] The nepheline gneisses are overlain and underlain by marble, and narrow bands of marble occur within the nepheline band. The band dips 30–60 degrees to the east.

Lithologically this band differs from the Bancroft band in that the mafic nepheline gneiss facies predominate; they include nepheline-hornblende-plagioclase, nepheline-hornblende-hedenbergite-plagioclase, and nepheline-hornblende-garnet (hedenbergite)-plagioclase assemblages.

Detailed work on the York River band was done by W. R. A. Barager,[3] and C. E. Tilley.[4] The York River band was diamond-drilled by Ventures, Limited, in 1942 and 1943, and, in logging the diamond-drill core, Louis Moyd found that he could divide the nepheline gneiss into three major members and several minor units on the basis of mineral assemblage. Petrographic work by Barager and Tilley confirmed this.

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[1]Jas. E. Thomson, *Mineral Occurrences in the North Hastings Area*, Ont. Dept. Mines, Vol. LII, 1943, pt. 3, p. 12.

[2]D. F. Hewitt, *Geology of Monteagle and Carlow Townships*, Ont. Dept. Mines, Vol. LXIII, 1954, pt. 6.

[3]W. R. A. Barager, *Nepheline Gneisses of York River, Ontario*, Proceedings, Geol. Assoc. Can., Vol. 6, pt. I, 1953.

[4]C. E. Tilley, unpublished manuscript, 1955.

Between the East road and the Davis quarry the nepheline band consists of a lower member, a middle member, and an upper member.

The lower member is rich in feldspar but contains little nepheline. Microcline, not observed elsewhere in the nepheline gneiss, is generally present in significant amounts, and biotite is the common ferromagnesian mineral. Scapolite is abundant in places and tourmaline was observed in one specimen.

The middle member is comparatively uniform in appearance and has a distinctive texture which may be easily recognized in the field. The rock contains nepheline, plagioclase, garnet, and pyroxene. The pyroxene is close to ferrosalite in composition and appears to be diagnostic of the middle member.

The upper member, the least uniform of the three, is generally rich in nepheline and poor in plagioclase. Its characteristic ferromagnesian mineral is hornblende.[1]

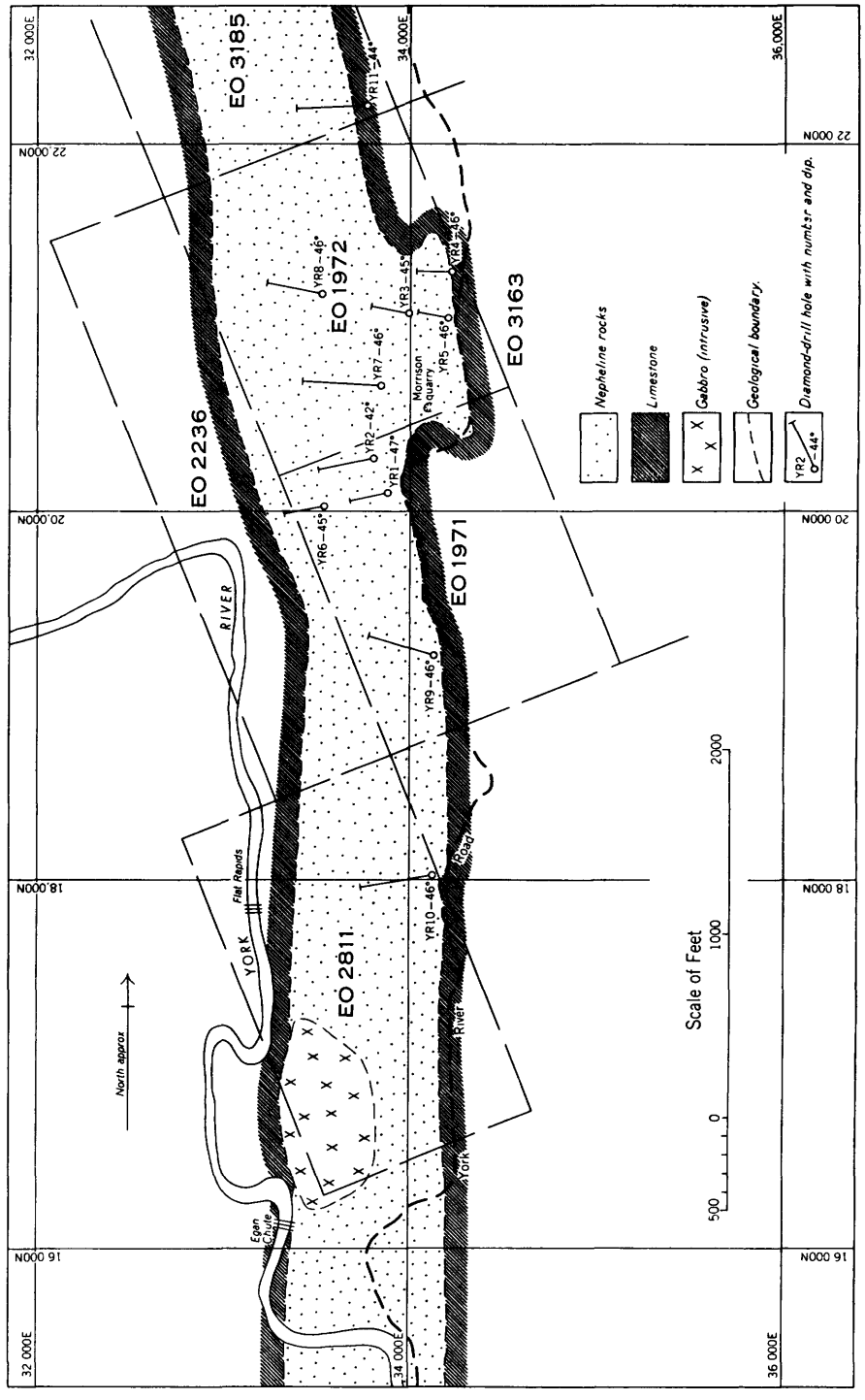
Diamond-drill core No. YR-10 sectioned the nepheline belt just east of Flat Rapids, ¼ mile south of the Morrison quarry. This diamond-drill core was examined by C. E. Tilley at the University of Cambridge by means of about 1,500 thin sections. The following table gives the principal mineral assemblages across the nepheline band as determined by Tilley.[2]

TABLE OF MINERAL ASSEMBLAGES

Drill Core No. YR-10, York River nepheline band, lots 10 and 11, concession XIII.
Examined by C. E. Tilley, University of Cambridge.

Footage	Principal Assemblage
	Upper Member
15– 35	Hornblende-nepheline-plagioclase-calcite; except 28–32 feet, dolomitic limestone.
35– 79	Hornblende-garnet-nepheline-plagioclase-calcite.
79–117	Hornblende-(clinopyroxene, biotite)-garnet-plagioclase-calcite (except 103–4½ feet, limestone).
117–122	Plagioclase-biotite-calcite Plagioclase-nepheline } pegmatite zone.
122–131	Hornblende-nepheline-plagioclase calcite.
131–139	Plagioclase-biotite-calcite (pegmatite zone).
139–187	Nepheline-hornblende-plagioclase-calcite.
187–204	Limestone with biotite, diopside.
204–248	Biotite-plagioclase-(nepheline) calcite. Hornblende plagioclase-(nepheline)-calcite.
248–277	Hornblende-nepheline-plagioclase-calcite with some narrow limestone bands carrying nepheline.
277–298	Hornblende-(clinopyroxene)-nepheline-garnet-plagioclase-calcite.
	Middle Member
298–372	Clinopyroxene-(hornblende) nepheline-garnet-plagioclase-calcite (vesuvianite also important in this section).
372–426	Clinopyroxene-plagioclase-nepheline-calcite. Plagioclase-nepheline-biotite-(hornblende)-microcline-calcite. Hornblende-nepheline-plagioclase-microcline-calcite.
	Lower Member
426–451	Hornblende-plagioclase-microcline-nepheline-calcite.
451–508	Hornblende-(biotite)-nepheline-plagioclase-microcline-calcite. Hornblende-plagioclase-calcite. Biotite-plagioclase-calcite.
508–522	Biotite-plagioclase-calcite.
522–534	Biotite-plagioclase-calcite.
	Footwall
534–570	Diopside-plagioclase-microcline (scapolite-biotite-calcite). These calc-silicate granulites often carry quartz and tourmaline. Limestone with biotite-diopside.

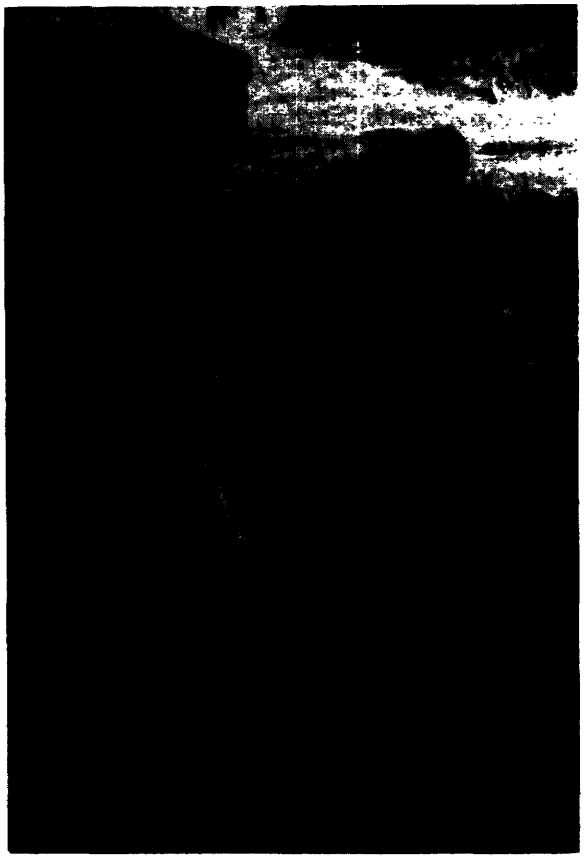
[1] W. R. A. Barager, *op. cit.*, p. 96.
[2] C. E. Tilley, *op. cit.*



From company plans, Ventures, Ltd.

Sketch map of the York River nepheline band, lots 9–12, concessions XII–XIV, Dungannon township, showing locations of diamond-drill holes.

Within the nepheline band there are gradations from marble to the assemblages biotite-plagioclase-calcite and hornblende-plagioclase-calcite; the mafics in these assemblages are properly termed siderophyllite and hastingsite, which are exceptionally iron-rich. These assemblages grade into nepheline-plagioclase-hornblende and nepheline-plagioclase-biotite assemblages characteristic of the nepheline gneiss zones. The hedenbergite (clinopyroxene)-garnet-vesuvianite-rich, nepheline-bearing assemblages have the characteristics of iron-rich alkaline skarns developed from marble.



Dragfolding in a competent bed in the marble-amphibolite series at Egan Chute, York River, Dungannon township.

Mineralogical, structural, and textural evidence indicates that the nepheline gneisses of the York River band were developed from marble by metamorphic-metasomatic processes. The alkaline metasomatism is of a distinctive type, the resulting assemblages being nepheline-bearing and iron-rich. The assemblages, biotite-plagioclase-calcite and hornblende-plagioclase-calcite, are themselves, in part, metasomatic in origin. They are not paragneisses but are polymetamorphic gneisses of hybrid origin.

In the York River band from the Davis quarry north to the Monteagle boundary, the nepheline-hornblende-plagioclase facies predominates. Sometimes garnet and clinopyroxene is present. Corundum occurs in nepheline-plagioclase gneiss on lot 5, concession XVI, and lot 7, concession XV. A garnet-plagioclase

skarn lacking both nepheline and mafic minerals was noted at the former locality.

Bronson Landing Area.—On lots 14–16, concession XIV, just north of Bronson Landing on the York River there are large hills of nepheline-plagioclase gneiss (6a) on both sides of the river. On the east side of the river a hill rising 100 feet exposes white nepheline-albite gneiss over a width of 1,200 feet and a length of ½ mile. The gneiss strikes N.20°W. and dips 40°–50°E. The nepheline content is 10–40 percent. Biotite and hornblende occur as accessories. The nepheline gneiss is flanked on the east by the Great Bend granite and pinches out in mixed gneisses to the north and south.

Dungannonite Area.—On the south side of the York River there is an 80-foot hill on lots 11 and 12, concessions XIV and XV, consisting of nepheline-biotite-plagioclase gneisses, nepheline-corundum gneisses, syenitic and granitic gneisses, nepheline and granite pegmatite, and mixed marble and amphibolite. This locality is noteworthy for its blue corundum crystals in nepheline gneiss and is the locality where Adams and Barlow[1] described "dungannonite," a nepheline-poor, corundum-scapolite-andesine gneiss.

Several small pits were opened for corundum on the top of this ridge, and material from the pits was analysed. The gneisses strike N.20°E. and dip east. The granitic and syenitic rocks invade and replace the nepheline gneisses, which occur as relicts in the granite gneiss and granite pegmatite, with zones of hybrid, pink and buff syenite lying between the nepheline-bearing and the granitic rocks.

The analysis of the "dungannonite" from this locality by Adams and Barlow is as follows:

Chemical Analysis	Percent
SiO_2	49.56
Al_2O_3	33.70
Fe_2O_3	0.93
FeO	1.42
CaO	5.89
MgO	0.97
K_2O	1.23
Na_2O	4.95
CO_2	0.17
H_2O	0.84
Total	99.66

Norm	Percent
Quartz	1.26
Orthoclase	7.23
Albite	41.92
Anorthite	29.19
Corundum	13.46
Hypersthene	4.12
Magnetite	1.39
Calcite	0.37
Water	0.84
Total	99.78

Mode	Percent
Andesine (Ab_3An_2)	72.00
Nepheline	3.00
Scapolite	2.00
Corundum	13.24
Biotite	5.00
Muscovite	3.00
Magnetite	1.39
Calcite	0.37
Total	100.00

In the nepheline-plagioclase pegmatites on the Dungannonite ridge, oval medium-grained aggregates of greasy, buff scapolite and black tourmaline up to 8 inches in diameter were noted by the authors. These are taken as an indication of pneumatolytic activity.

SYENITIC ROCKS

The syenite group includes all the plutonic rocks consisting predominantly of feldspar (plagioclase, microcline, or microcline microperthite), which are of intrusive or metasomatic origin. In the map area the syenitic rocks are confined to northern Dungannon township, north of the McArthurs Mills fault, and west of the Mallard Lake metagabbro. The syenitic rocks, therefore, are an important part of the mixed gneiss complex of the Hastings Highlands.

Most of the syenitic rocks are polymetamorphic gneisses of hybrid origin. Intrusion, injection, and metasomatic replacement are the agents of emplace-

[1]Frank D. Adams and Alfred E. Barlow, *Geology of the Haliburton and Bancroft Area, Province of Ontario*, Geol. Surv. Can., Mem. 6, 1910, pp. 317–23.

ment of the syenitic gneisses. Many of the hybrid syenite gneisses are amphibolites that have suffered syenitization (or potash metasomatism).

The syenitic gneisses envelop the Bancroft nepheline band, and nepheline gneisses occur as relicts in the pink and buff syenite gneisses. The syenitic rocks replace the nepheline gneisses and are themselves replaced and intruded by the later granitic rocks.

Lithology and Structure

The syenitic rocks are all foliated and frequently contain inclusions of metasedimentary material, usually amphibolite but occasionally marble. Structurally, most of the syenite gneiss lies interbanded conformably with nepheline gneiss, granite gneiss, and metasediments. About 30 percent of the northern Dungannon section of the Hastings Highlands is underlain by syenitic gneisses. Syenite pegmatites of the fissure-filling and replacement types occur. Corundum syenite pegmatites are not common.

Textures in the syenitic gneisses are usually hypidiomorphic granitoid. Microcline, microcline microperthite, and albite or oligoclase are the main constituents. Hornblende, biotite, corundum, muscovite, and magnetite are characteristic accessories, and zircon, carbonate, apatite, titanite, and pyrite are minor accessories.

Corundum-bearing syenites occur on lot 22, concession XIV; lots 17–20, concession XV; and lot 19, concession XVI, as indicated on the geological coloured map (in back pocket). The origin of the corundum and the replacement origin of the syenitic rocks are discussed in the Brudenell-Raglan report.[1]

YOUNGER GRANITIC ROCKS

Closely associated in age and genesis with the syenitic gneisses there is a group of younger granitic rocks of hybrid character. These, together with the Great Bend, Bronson, and Faraday pink leuco-granites, make up the granitic rocks of the Hastings Highland gneiss complex in northern Dungannon. Some granite pegmatites and pegmatic granite also occur.

Great Bend Granite

The Great Bend granite gneiss is a pink potash leuco-granite sheet, 5 miles long and up to 1 mile thick, which extends from the East road, at a point about 200 yards west of the York River bridge, northward almost to the Monteagle boundary. The sheet strikes northward and dips 20°–40°E. It underlies the York River nepheline and marble band.

The texture of the granite gneiss is hypidiomorphic granitoid. Albite, quartz, and microcline are the major constituents. Biotite, magnetite, zircon, and apatite are common accessories. Large inclusions or bands of marble, amphibolite, syenite gneiss, and nepheline gneiss sometimes occur in the granite gneiss especially near its margins.

The accompanying table gives two chemical analyses of the Great Bend granite. Both samples were taken from a roadcut on the East road, lot 17, concession XI, Dungannon township. The first analysis was made by the Provincial

[1]D. F. Hewitt, *Geology of the Brudenell-Raglan Area*, Ont. Dept. Mines, Vol. LXII, 1953, pt. 5, pp. 94–100.

Assay Office of the Ontario Department of Mines; the second by J. H. Schoon of Cambridge University and was supplied by C. E. Tilley:

Chemical Analysis	No. 1 Percent	No. 2 Percent
SiO_2	72.71	73.34
Al_2O_3	14.58	14.33
Fe_2O_3	0.71	0.76
FeO	0.87	0.92
MnO	0.01	0.02
MgO	0.02	0.10
CaO	0.83	1.02
Na_2O	4.40	4.47
K_2O	5.60	4.75
H_2O+	0.32	0.21
H_2O-	0.06	0.07
TiO_2	0.11	0.13
P_2O_5	....	0.10
CO_2(1)	0.10	....
Cr_2O_3	0.01	....
V_2O_3	0.01	....
Total	100.34	100.22
Loss on ignition	0.43	

Norm	Percent
Quartz	26.82
Orthoclase	28.08
Albite	37.73
Anorthite	4.17
Corundum	0.26
Hypersthene	1.26
Ilmenite	0.15
Magnetite	0.93
Apatite	0.34
Total water	0.28
Total	100.00

Mode	Percent
Quartz	30.4
Microcline	30.3
Albite	37.2
Biotite	2.1
Total	100.0

Faraday Granite

The east end of the Faraday pink potash leuco-granite sheet extends into northwestern Dungannon township and forms the Eagles Nest ridge where the fire tower stands just north of Bancroft village. Lithologically the Faraday granite gneiss is almost identical with the Great Bend granite, and is composed essentially of microcline, albite, and quartz, with minor biotite. The leuco-granite gneiss has an unusually low percentage of mafic minerals and lacks inclusions or schlieren of sedimentary material except near its margins. The sheet strikes east-west and dips 20°–50°S. It is overlain by mixed hybrid syenitic gneisses, and underlain by hybrid granite gneiss.

Bronson Granite

The Bronson granite occupies lots 18–22, concessions XII and XIII, Dungannon township, and is best exposed on the old Bronson farm. It is a pink leucocratic granite composed of microcline, albite, and quartz. The rock is poorly foliated, but has a lineation trending and pitching southeast. This granite appears to intrude and cut off the Bancroft nepheline gneiss band, and syenitic gneisses swing around it to the north and south.

Hybrid Granite Gneiss

A large proportion of the granitic rocks in northern Dungannon township is classified as hybrid granite gneisses. These are mixed gneisses or migmatites of granitic composition, which contain many bands of amphibolite and granitized amphibolite.

McArthurs Mills Granite

The McArthurs Mills granite is distinctly different from all the other granitic rocks in the map area. It is a coarse-grained, massive, pink biotite microcline microperthite granite or quartz syenite.

This granite occurs in a stock 3 miles long and 2 miles wide in the Hastings Basin section of Mayo township, just southeast of McArthurs Mills. It intrudes the Hermon formation, and some contact migmatites occur along its margins.

[1]Carbon dioxide calculated from loss on ignition.

A chemical analysis of a sample of this granite from lot 26, concession XI, Mayo township, analyzed by the Provincial Assay Office of the Ontario Department of Mines is given below:

	Percent
SiO_2	63.92
Al_2O_3	17.18
Fe_2O_3	1.33
FeO	2.51
MgO	0.73
CaO	2.55
Na_2O	4.40
K_2O	5.30
H_2O+	0.48
H_2O-	0.14
CO_2[1]	0.37
TiO_2	0.70
P_2O_5	0.19
Cr_2O_3	0.01
MnO	0.01
V_2O_3	0.01
Total	99.92
Loss on ignition	0.65

Pleistocene and Recent Deposits

The area was glaciated in Pleistocene times, and a heavy mantle of glacial drift covers much of the area. The north or stoss faces of most of the hills are heavily covered with overburden. The glacial drift is sandy with many boulders. A boulder field containing a great many large glacial erratics of the McArthurs Mills granite occurs south of McArthurs Mills on the Hartsmere road. Some of the erratics weigh over 200 tons and measure 20 by 15 by 10 feet.

Immediately south of Norway Bay on the Little Mississippi River an area of over a square mile is occupied by a flat-topped sand plain. This is interpreted as a sandy deltaic deposit of glaciofluvial origin. It may possibly be a kame terrace developed against the south flank of the Raglan hills. It is a prominent topographic feature of the McArthurs Mills valley.

CHAPTER III

STRUCTURAL GEOLOGY

Structurally the area is divided into two contrasting metamorphic terranes. To the north lies the Hastings Highland gneiss complex, to the south the Hastings Basin. Faulting and folding occur throughout the area. Foliation is usually well developed in both plutonic and metasedimentary rocks. Rock flowage has occurred in the marbles of the Hastings Highland gneiss complex. Failure in the Hastings Basin may be by brecciation rather than flowage. Fracture cleavage is well developed in the sediments of the Mayo group in the Hastings Basin, and an attempt has been made to work out the stratigraphic succession in that area.

Folding

In the Hastings Basin there are two major anticlines whose axes trend and plunge northeast. These are the Detlor and Mayo anticlines described earlier in this report. The Detlor anticline is overturned towards the north with its axial plane dipping about 40°S. The axial plane of the Mayo anticline appears to be

[1]Carbon dioxide calculated from loss on ignition.

nearly vertical. The attitude of fracture cleavage and bedding in a marble and amphibolite member of the Dungannon formation on an island in L'Amable Lake indicates an anticline in this area with the axis overturned towards the south.

The Bronson granite appears to occupy the crest of a major anticline plunging southeast. Gummer and Burr[1] interpret the structure of the Bancroft nepheline band as an overturned syncline. The authors were unable to agree with this interpretation and regard the Bancroft nepheline band as the west arm of a major anticline pitching southeast. However, the lack of any marker horizons and the minor folding, faulting, and intrusion in this mixed gneiss complex makes structural interpretation very difficult.



A two-foot band of feather amphibolite, showing boudinage structure in the marble, on highway No. 62 at Green Corners, Dungannon township.

Faulting

There is a considerable amount of major and minor faulting in the map area, indicated by truncation or displacement of geological formations and by topographic linear depressions.

The main fault zone is the *McArthurs Mills fault* which runs eastward from Bancroft along the York River valley to the junction with Egan Creek and on north of Hermon and McArthurs Mills to pass out of the area just north of Lily Lake. This fault zone separates the Hastings Highland gneiss complex from the Hastings Basin sediments.

A series of northwest-trending faults occur throughout the northern part of Dungannon and Mayo townships. The southeast extension of the *Mallard Creek fault* of Carlow township[2] extends into Mayo township and cuts off the Rowland

[1]W. K. Gummer and S. V. Burr, *Nephelinized Paragneisses in the Bancroft Area, Ontario*, Jour. Geol., Vol. LIV, No. 3, May, 1946, pp. 151–3.

[2]D. F. Hewitt, *Geology of Monteagle and Carlow Townships*, Ont. Dept. Mines, Vol. LXIII, 1954, pt. 6, p. 26.

volcanic belt. The *Musclow fault* also extends southeast from the Monteagle-Carlow area into Dungannon township. This fault, together with two smaller parallel faults to the north, offset the west boundary of the Mallard Lake metagabbro in several places and also interrupt the York River nepheline belt.

Some members of this northwest fault set occur in the Hastings Basin where they are marked by a linear depression cutting across the regional strike of formations at right angles.

Other linear depressions in southern Dungannon and Mayo townships may be northeast-trending strike faults. Kelly Creek in Dungannon township south of Detlor marks one such structure.

Mylonite zones and limestone tectonic breccias mark zones of shearing in northern Dungannon township. Marble mylonites and syenite mylonites are exposed on the East road near Bancroft and are described by Chayes.[1]

CHAPTER IV

ECONOMIC GEOLOGY

Deposits of corundum, nepheline syenite and pegmatite, iron, marble, and sodalite have been worked in Dungannon and Mayo townships, and mineral occurrences of arsenic, gold, copper, feldspar, molybdenum, garnet, sillimanite, and radioactive minerals have been reported. The area offers good prospecting possibilities for uranium, iron, copper, and nickel, as well as various industrial minerals.

Copper

Large and small intrusions of gabbro and diorite are common in the Dungannon-Mayo area, and a few small occurrences of sulphides occur associated with them near Turriff, in southern Dungannon township.

In 1903 a small shaft 25 feet deep was sunk for copper on the south half of lot 23, concession III, Dungannon township. The country rock is marble and feather amphibolite with some small sills of gabbroic amphibolite. Calcite, pyrite, and a little chalcopyrite occur in material on the dump. Stringers of sulphide occur in the country rock. Large bodies of basic rock such as the Mallard Lake metagabbro may be potential host rocks for base metals or iron.

Corundum

Corundum occurs in nepheline gneiss and in pink and buff alkaline syenite. There are two well-known occurrences of blue corundum in Dungannon township, but none of the occurrences have been developed commercially. The more important corundum deposits occur in Carlow[2] and Raglan[3] townships.

DUNGANNON TOWNSHIP

Concession XI, Lots 17–20

Four hundred feet south of the East road on lot 17, concession XI, there is a small occurrence of nepheline-corundum gneiss in pink leuco-syenite. Another

[1]Felix Chayes, *Alkaline and Carbonate Intrusives near Bancroft, Ontario*, Bull. Geol. Soc. Amer., Vol. 53, No. 3, Mar., 1942, pp. 465–67.

[2]D. F. Hewitt, *op. cit.*, pp. 28–38.

[3]D. F. Hewitt, *Geology of the Brudenell-Raglan Area*, Ont. Dept. Mines, Vol. LXII, 1953, pt. 5, pp. 46–66.

deposit was described by Miller[1] on lot 18, concession XI, where blue or blue-grey corundum occurs in nepheline gneiss. Some trenching and stripping were carried out on lot 19, concession XI, and on a large stripping measuring 60 by 80 feet, grey and blue corundum crystals up to ¾ inch in diameter were observed. One 6-foot zone traceable for 15 feet runs about 5 percent corundum by visual estimate. The corundum occurs in nepheline-muscovite-albite gneiss. Another small patch of corundum syenite was noted on lot 20, concession XI.

Concession XII, Lot 12 (Egan Chute)

The occurrence of grey-blue corundum at Egan Chute is well known. On a path on the west bank of the York River about a ¼ mile north of the East road there is a small outcrop area exposing nepheline-albite-muscovite gneiss with corundum crystals up to 2 inches in size. Some of these crystals are a good blue colour. They are mantled by silvery muscovite. Flecks of galena occur as a minor accessory in this nepheline gneiss.

Concession XIII, Lot 26 (Lily Robertson Property)

A small but rich corundum deposit was opened up by Louis Moyd of Bancroft on the northwest side of Robertson hill, lot 26, concession XIII. In the south pit, tapering bronze corundum crystals up to 3 inches occur in nepheline pegmatite. Pegmatitic nepheline, albite, and corundum occur as patchy segregations in nepheline-plagioclase gneiss. These are cut by pink and buff syenite gneiss. Corundum crystals are mantled by nepheline, and occasionally by magnetite or spinel.

The best showing of corundum is in a stripping about 50 feet north of the south pit. Corundum crystals up to 2 inches in diameter make up 20 percent of the coarse-grained nepheline-albite pegmatite over an exposed width of 10 feet. The corundum is bronze-black in colour. The country rock nepheline-plagioclase-biotite-corundum gneiss contains purplish-blue scapolite. Other trenches to the north expose a sequence of nepheline-plagioclase gneiss, nepheline-poor alkaline gneiss, syenitic gneiss, and amphibolite.

Concessions XIV and XV, Lots 11 and 12 (Dungannonite Property)

The Dungannonite property located on lots 11 and 12, concessions XIV and XV, on the south side of the York River, has been described in an earlier section (page 38). There are several pits and trenches on the top of the Dungannonite ridge, and these were opened for corundum. The main workings consist of two open cuts on lot 12, concession XIV, about ¼ mile south of the river. The largest cut measures 40 feet long by 6 feet wide and is 4–5 feet deep. It exposes corundum-rich nepheline-andesine gneiss. Garnet, zircon, hornblende, biotite, apatite, muscovite, tourmaline, and scapolite occur as accessories.

The nepheline-corundum-andesine gneisses strike N.50°E. and dip 65°E. They are cut and replaced by syenite and granite pegmatites. The corundum occurrence is of limited size and extent, and the nepheline-corundum bands occur as relicts in a ridge that is predominantly syenite and granite pegmatite.

Other Occurrences

Small occurrences of corundum have been observed by the authors in other parts of the area. On lot 22, concession XIV, ¼ mile east of the Vardy quarry,

[1]Willet G. Miller, *Corundum and Other Minerals*, Ont. Bur. Mines, Vol. VIII, 1899, pt. 2, p. 218.

there is a large outcrop of nepheline-corundum gneiss interbanded with pink corundum syenite gneiss. On the east side of the York River on lot 7, concession XV, another nepheline gneiss band carrying corundum is exposed. South and east of Holland Lake on lots 17–20, concession XV, many small outcrops of pink corundum-bearing syenite are exposed and an occasional relict of undestroyed nepheline-corundum gneiss also occurs in the pink syenitic gneisses. Corundum also occurs in nepheline gneiss on a ridge on lot 5, concession XVI on the east bank of the York River. A small pit on lot 15, concession XVI, just east of Bentley Creek, was sunk on nepheline-corundum pegmatite. The occurrence is small and of no commercial importance. Corundum was noted in pink syenite gneiss on lot 19, concession XVI.

Feldspar

Two small granite pegmatite dikes were opened up for feldspar in Dungannon township, but no commercial production has been reported.

DUNGANNON TOWNSHIP

Concession IX, Lot 24 (J. F. Tait)

On the farm of J. F. Tait there is a dike of white graphic granite pegmatite cutting marble. The dike, which is about 1,000 feet south of the road, strikes east-west and is exposed over a length of 600 feet. Some blasting has been done. The dike consists predominantly of white graphic granite with a little hornblende and biotite.

Concession X, Lot 20

A small quarry in granite pegmatite was opened just north of the road on lot 20, concession X. The pit measures 50 by 15 feet and is 6 feet deep. The pegmatite is exposed over a length of 130 feet, and cuts garnet-sillimanite paragneiss. The dike consists of pink potash feldspar, quartz, and a little biotite.

Garnet

MAYO TOWNSHIP

Concession XII, Lot 14

An occurrence of garnet schist on lot 14, concession XII, has been described by Osborne.[1] The garnet content is said to average 7–8 percent.

Gold

There are a few small occurrences of sulphides in Dungannon township that were examined as gold prospects in past years. They are described by J. E. Thomson[2] as follows:

DUNGANNON TOWNSHIP

Concession II, Lots 16 and 17

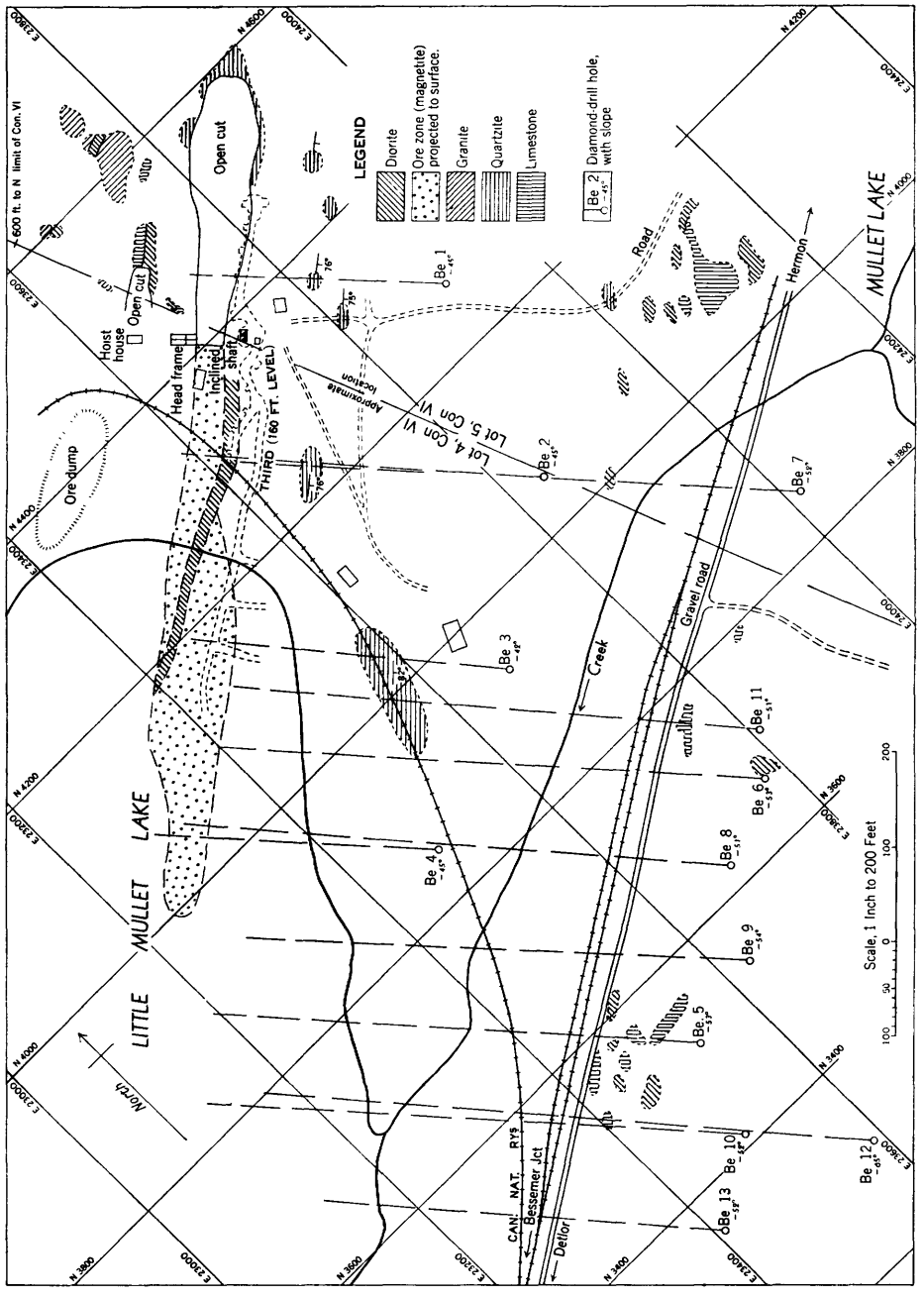
Towards the southeast corner of the farm of A. W. Munro in lots 16 and 17, concession II, Dungannon township, there are two rusty mineralized zones in the crystalline limestone, slate, and amphibolite. The southern zone strikes N.70°E., dips 70°S., and has been opened over a length of 180 feet. The exposed rock is black fissile slate containing disseminated sulphides over a width of 20 feet. A grab sample of the sulphide-bearing material assayed 0.01 ounces gold per ton.

The northern sulphide zone shows nodules and stringers of pyrite over a small area.

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[1] F. F. Osborne, *Non-Metallic Mineral Resources of Hastings County*, Ont. Dept. Mines, Vol. XXXIX, 1930, pt. 6, p. 34.

[2] Jas. E. Thomson, *Mineral Occurrences in the North Hastings Area*, Ont. Dept. Mines, Vol. LII, 1943, pt. 3, p. 31.



Surface plan of the Bessemer iron mine, lots 4 and 5, concession VI, Mayo township. (Copied from mine plans of the Frobisher Exploration Company, Limited, March, 1942.)

Concession III, Lot 26

A short distance north of the Turriff road in lot 26, concession III, Dungannon township, three test pits have been put down over a length of 90 feet along a strike of N.70°E. The eastern pit is about 25 feet deep and is timbered. The rock on the dump consists of massive sulphides, chiefly pyrite with traces of arsenopyrite and chalcopyrite. A grab sample of these sulphides assayed 0.02 ounces of gold per ton and 0.25 per cent copper. Nothing could be seen at the other pits or elsewhere along the strike. The country rock is crystalline limestone cut by an occasional gabbro dike.

Concession X, Lot 1

On the farm of Thomas Fulton, of Detlor P.O., in lot 1, concession X, Dungannon township, a vein containing disseminated sulphides may be traced at intervals over a length of 725 feet along a strike of N.70°E. It is exposed in two old test pits and is about 30 inches wide. A grab sample taken by the writer from the shallow pit was assayed for gold, silver, and lead with negative results. A grab sample from the deeper pit assayed 0.02 ounces gold per ton but contained neither silver nor lead. The vein lies in bedded limestone, which is cut by narrow diorite dikes. In places there is evidence of a parallel rusty zone 15 to 20 feet removed from the main vein.

Iron

A number of small magnetite deposits are known in the Hastings Basin section of Dungannon and Mayo townships. The Bessemer, Childs, and Rankin mines are the best known, and production of about 100,000 tons of ore was reported from the Bessemer mine, which was active from 1902 to 1913.

The magnetite deposits are non-titaniferous and appear to have been formed as limestone replacement deposits probably associated with the diorite or gabbro intrusives of the area. The ore usually occurs in skarn replacement zones, and minerals such as garnet, epidote, pyroxene, hornblende, pyrite, pyrrhotite, and calcite are associated with the magnetite. Although titaniferous magnetite deposits usually occur in diorite or gabbro, the non-titaniferous deposits such as occur in Mayo township are usually in limestone somewhat removed from the diorite or gabbro.

The Rankin and Childs deposits are larger than that of the Bessemer mine but are low-grade disseminated ores that would require beneficiation. At the Bessemer mine, reserves of nearly 1,000,000 tons of magnetite ore, averaging 40–50 percent iron, were reported.

In 1941, 1942, and 1956 Canada Iron Mining, Limited, controlled by the Frobisher Exploration Company, Limited, examined the Bessemer, Childs, and Rankin properties and carried out a considerable amount of diamond-drilling.

DUNGANNON TOWNSHIP

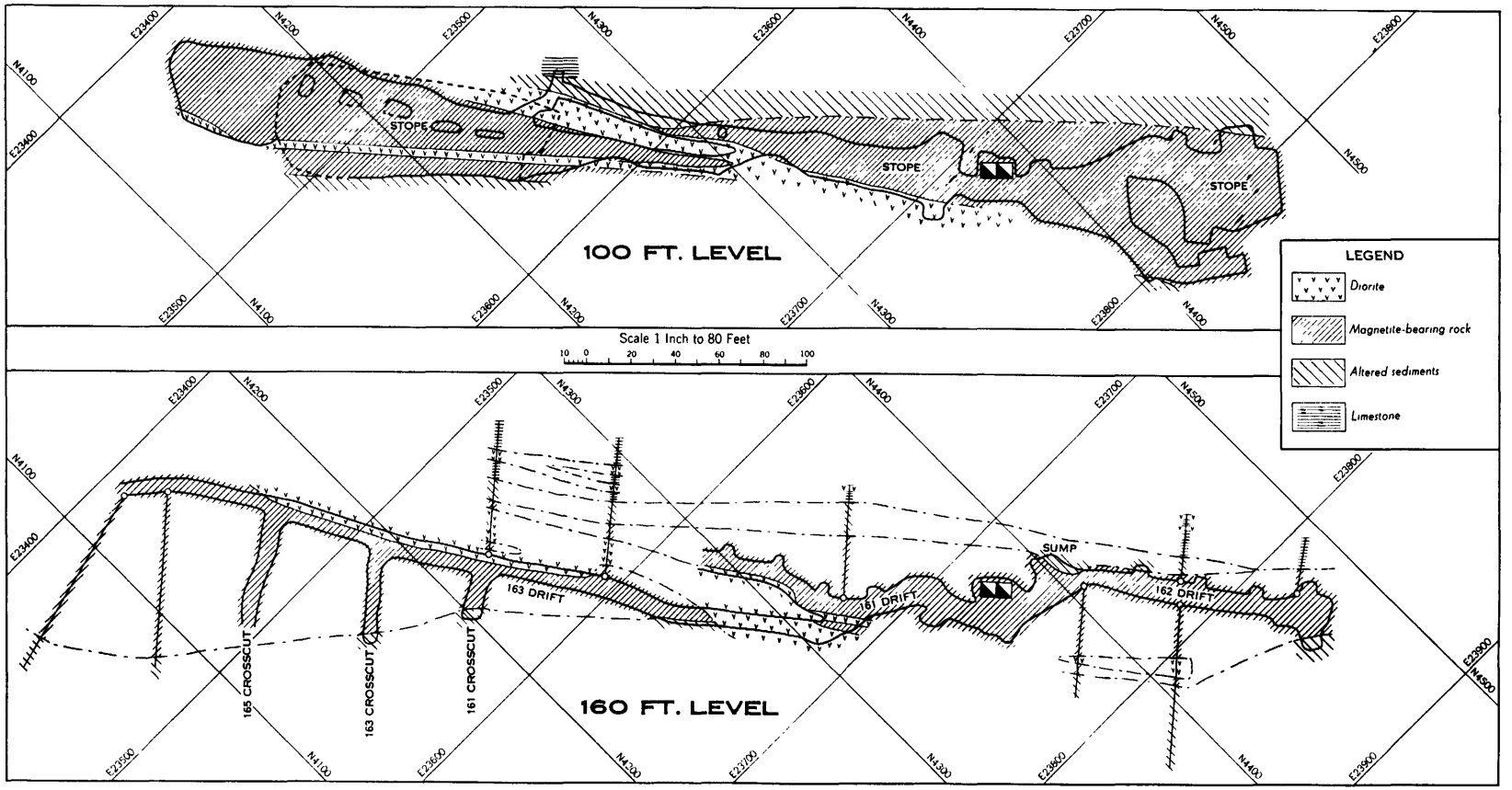
Hastings Road East, Lots 48 and 49 (Quarry Lake Anomaly)

The Quarry Lake magnetic anomaly is located ¼ mile east of highway No. 62, just north of the concession X–concession XI side-road north of Quarry Lake. The anomaly indicated on the Bancroft aeromagnetic sheet has an intensity of 4,600 gammas and a magnetic relief of 2,500 gammas. Rock outcrop is sparse, but there is one small outcrop of serpentinite and several outcrops of marble and mica schist.

There is a test pit with a small dump about 500 feet north of the road. Material on the dump is a magnetite-bearing biotite schist. An analysis of material from the dump ran 37.2 percent iron.[1]

In 1950 Louis Moyd carried out a magnetic survey on the property for Frobisher, Limited. A small amount of diamond-drilling was done. A dip needle survey showed a zone of high magnetic disturbance over a length of 1,200 feet and a width of 600 feet.

[1]E. M. Abraham, *Preliminary Report on the Geology in the Vicinity of Aeromagnetic Anomalies on the Bancroft and Coe Hill Sheets*, Ont. Dept. Mines, P.R.1951-2, 1951.



Geological plans of the 100- and 160-foot levels, Bessemer No. 4 mine, Mayo township. (Copied from plans of the Frobisher Exploration Company, Limited, November, 1941.)

MAYO TOWNSHIP

Concession VI, Lots 2 - 5 (Bessemer Mine)
Concession VII, Lot 1

The Bessemer iron mine is located on lots 2–5, concession VI, and lot 1, concession VII, Mayo township. The shaft and underground workings are on lots 4 and 5, concession VI, just east of Little Mullet Lake, north of the railway track. The Bessemer spur line of the Canadian National Railways joins the Bancroft-Trenton junction line at Bessemer Junction, 5 miles to the west. This spur line was built to serve the Bessemer and Childs iron mines and extends as far as the Childs mine 2 miles northeast of the Bessemer mine.

The Bessemer mine was opened by H. C. Farnum in 1902 under ownership of the Mineral Range Iron Mining Company. Shipments of ore were made in 1902, 1903, 1906, and 1907. In February, 1908, the Canada Iron Furnace Company took over the property and operated under lease until May, 1910. In 1911 the mine was acquired by Canada Iron Mining, Limited, which operated it in 1912 and 1913, shipping ore to their magnetic concentrating plant at Trenton. In 1941 the Frobisher Exploration Company, Limited, acquired the Bessemer and Childs properties and optioned the Rankin property. They carried out exploration and diamond-drilling on all three properties in 1941 and 1942. The shaft was dewatered and sampled. Further work on these deposits was carried out by Frobisher in 1956.

The magnetite orebodies occur as lenses in the Dungannon formation, which consists of interbedded marble, paragneiss, and quartzite. The country rock strikes northeast and dips vertically or steeply south. The magnetite lenses occur in marble or skarn zones on the south side of the Bessemer granite. The marble is intruded by numerous narrow sills and dikes of dioritic amphibolite.

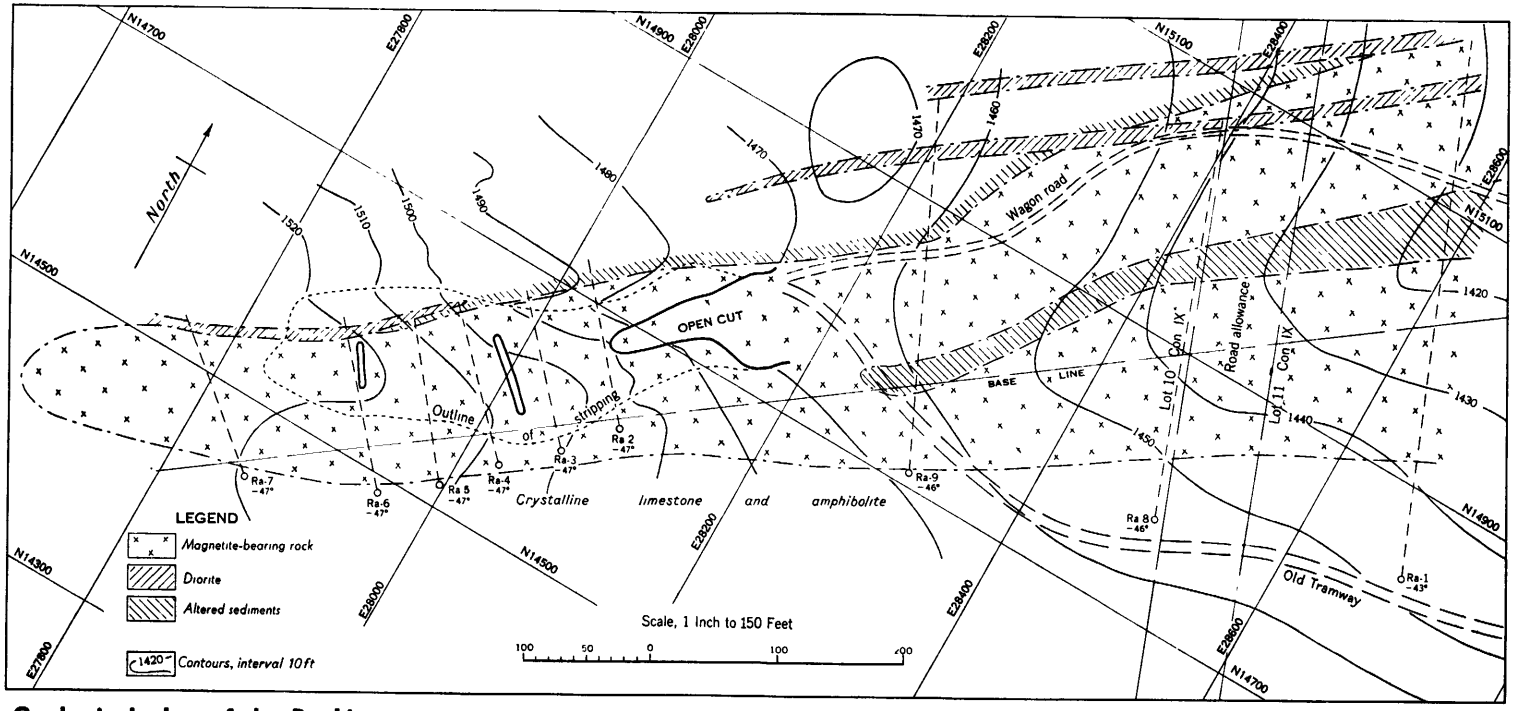
The ore consists of magnetite, sometimes as coarse-grained massive, pure, lenses, and sometimes intimately intergrown with hornblende, garnet, epidote, and pyroxene. The best ore is reported to have averaged 54 percent, but much hand cobbing was required to maintain that grade. Pyrite, pyrrhotite, and chalcopyrite occur as lenses and stringers in the ore. The phosphorous content is low, averaging 0.010–0.025 percent.

The orebody at the Bessemer mine is an elongated zone of skarn lying on the contact of marble and white feldspathic quartzite. Garnet is restricted to certain lenses in the skarn. Epidote is common and is associated with hedenbergite and calcite. Pyrite, pyrrhotite, and chalcopyrite replace gangue silicates and magnetite.

Mining operations were carried out on four deposits. These are described by Lindeman and Bolton[1] as follows:

> Deposit No. 1, on lot 1, concession VII, was developed as an open-pit, and a small tonnage of ore has been shipped from it. The ore in this pit is badly mixed with gangue minerals, chiefly hornblende. The presence of a number of small ore-lenses adjacent to deposit No. 1, is indicated by the magnetometric survey by E. Lindeman.
>
> Deposit No. 2, is one of a group of deposits on lot 2, concession VI, all of which the magnetometric survey indicates as being very small. It has been developed as an open-cut from which a little ore was extracted. The workings show the magnetite to be intermixed with various gangue minerals.
>
> Deposit No. 3, is located on lot 3, concession VI, and is about 1,300 feet east of No. 2. It consists of two open-pits, which have been opened up on two ore-lenses separated from each other by about 50 feet of gangue rock, through which a small amount of magnetite is disseminated; the smaller pit is 40 feet by 90 feet and 6 feet deep, and the larger is 60 feet by 60 feet and 20 feet deep. About 5,000 tons of ore were shipped from these two workings.

[1] E. Lindeman and L. L. Bolton, *Iron Ore Occurrences in Canada*, Can. Dept. Mines, Mines Branch, No. 217, 1917, Vol. I, pp. 48, 49, and appendix maps Nos. 191 and 191a.



Geological plan of the Rankin property, Mayo township. (Copied from plans of the Frobisher Exploration Company, Limited. After N. H. C. Fraser, February, 1942.)

From the bottom of the larger pit a drill hole was put down, and it was still in ore at 160 feet when discontinued.

In addition to the two lenses opened up the magnetometric survey indicates, a short distance east and west of these workings, several other deposits, all of which are, however, covered by drift.

Deposit No. 4, the largest and richest of the Bessemer group, is situated on lots 4 and 5, concession VI. According to the magnetometric survey, the total possible length of this deposit may be estimated at about 1,000 feet, the western end extending 400 feet under Little Mullet Lake. The average width of the deposit is roughly estimated to be about 50 feet (see maps 191 and 191a).

This deposit was first worked as an open-pit, and from this a very considerable tonnage was extracted, the pit being carried to a depth of 80 feet. Operations in recent years have been conducted from a 3-compartment shaft started in 1908. The shaft is inclined to the southeast at 65 degrees, and has a depth of 236 feet, and from it levels have been opened at depths of 55 feet, 101 feet, 161 feet, and 236 feet respectively. On the 2nd level the length of the workings in ore is 495 feet, and on the 3rd it is 525 feet. The present workings have proven ore to a greater depth than did the diamond drill holes put down a few years ago.

Judging from the results of the magnetometric survey, confirmed by the distribution of a few natural exposures, we may estimate the total ore area of the seven largest deposits to be about 83,000 square feet, of which 50,000 are attributed to the No. 4 deposit.

This estimate does not, however, pretend to be more than a very rough approximation; besides, a considerable portion of this area contains, no doubt, ore which has too low an iron content to be suitable for economic iron smelting without previous concentration.

Shipments to the end of 1914 are reported by Lindeman and Bolton[1] as follows:

From deposit	Gross tonnage
No. 1	700 (hand-sorted)
No. 2	1,500 (hand-sorted)
No. 3	5,000 (hand-sorted)
No. 4	92,413 (hand-sorted and crude)
Total	99,613

Representative analyses of ore shipped, as reported by Canada Iron Mines, Limited, are given by Ontario Iron Ore Committee of 1923[2] as follows:

Analyses of Ore from Bessemer Mines

Deposit	Tonnage	Condition	Iron	Silica	Sulphur	Phosphorus
			percent	percent	percent	percent
No. 1	480	hand-sorted	49.30	13.30	nil	0.071
No. 2	1,500	hand-sorted	56.00	7.20	nil	0.004
No. 3	5,000	hand-sorted	61.30	8.91	0.042	0.008
No. 4	28,000	crude	49.30	.....	0.465	0.020

The accompanying surface and underground plans were supplied by Frobisher Exploration Company, Limited. Ore reserves were estimated to be 757,500 tons before dilution, averaging 42.18 percent iron, 0.86 sulphur, 0.018 phosphorus, and 15.9 silica.

Concession IX, Lot 10 (Rankin Property)

The Rankin mine is located on the top of a hill about ¼ mile west of the Bessemer road on the south half of lot 10, concession IX, Mayo township. The magnetic anomaly is the westward extension of the northern anomaly on the Childs property to the east.

The accompanying geological plan of the property was supplied by Frobisher Exploration Company, Limited, and is based on their 1941 field work and drilling.

[1] E. Lindeman and L. L. Bolton, *op. cit.*, p. 50.
[2] *Report of the Ontario Iron Ore Committee*, 1923, p. 166.

The magnetite-bearing zone is exposed in a clearing 350 feet long and 100 feet wide. At the eastern end of the clearing there is an open cut measuring 75 feet by 20 feet with a 15-foot face at the west end. One hundred feet to the west there is a trench measuring 70 feet by 6 feet by 4 feet deep, and 120 feet farther west there is another trench, measuring 45 feet by 6 feet and 4 feet deep, as indicated on the accompanying plan. The rocks exposed are a rusty hornblende schist, rusty-green garnet pyroxenite skarn, magnetite-bearing skarn, and magnetite-hornblende-pyroxenite (altered marble). Marble and amphibolite are exposed to the south. Two small sills of dioritic amphibolite cut the sediments. The sediments strike northeast and dip 70 degrees south.

The magnetite occurs as massive lenses and disseminated in a pyroxenic skarn, in a green granular metamorphic pyroxenite (which is an altered marble) and in rusty schist. Pyrite and pyrrhotite stringers occur in the ore. There is much green epidote alteration.

Nine diamond-drill holes put down by Frobisher Exploration Company, Limited, in 1941 indicate a large body of low-grade disseminated ore.

An analysis of an average sample of ore exposed in the open cut is given by Lindeman and Bolton.[1]

	Percent
Iron	42.70
Silica	15.87
Sulphur	0.215
Phosphorus	0.104
Lime	8.08
Magnesia	1.74
Titanium	0.10

Concession IX, Lots 11 and 12 (Childs Mine)

The Childs mine is located on lots 11 and 12, concession IX, Mayo township. ½ mile east of the Rankin mine and 2½ miles northeast of the Bessemer mine. It is served by the Bessemer railway spur. The property was opened by H. C. Farnum and the Mineral Range Iron Mining Company. Mining operations were carried on in 1913, and 9,649 tons of magnetite ore were shipped to the magnetic concentrator at Trenton, Ontario. In 1941 the Frobisher Exploration Company, Limited, carried out a program of surface exploration and diamond-drilling. The accompanying geological plan was provided by Frobisher.

The disseminated magnetite ore occurs in a skarn assemblage consisting of magnetite, garnet, calcite, zoisite, epidote, pyroxene, and hornblende. The ore-body occurs in marble and amphibolite of the Dungannon formation. Country rocks consist of marble, mica schist, and amphibolite intruded by dioritic amphibolite and granite. The country rocks strike northeast and dip steeply to the south.

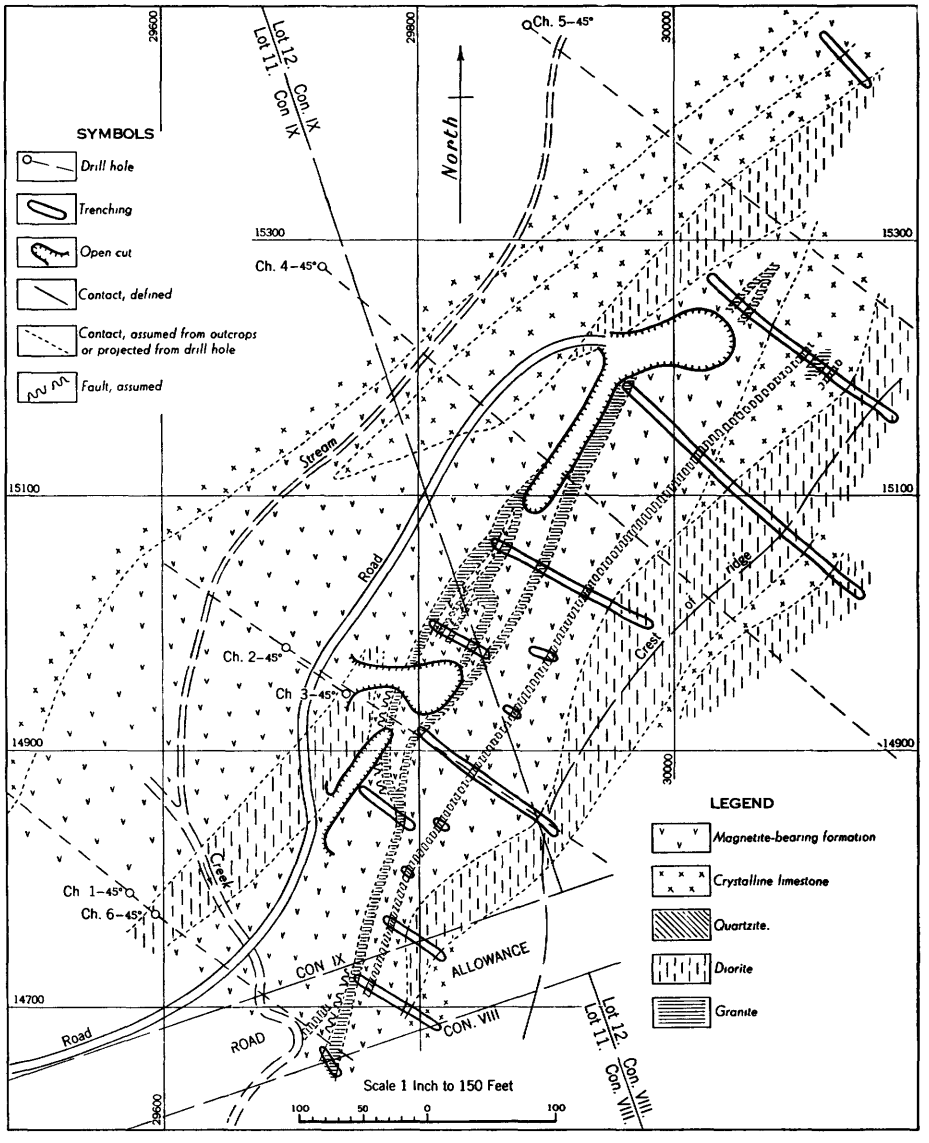
The average analysis of the ore from the Childs mine is given in the report of the Ontario Iron Ore Committee[2] as follows:

	Percent
Iron	38.70
Sulphur	0.149
Phosphorus	0.049

This report also gives an estimate of the size and grade of the deposit as reported by Canada Iron Mines, Limited, in 1914, as follows:

> As a result of the surface and diamond-drill exploration the owners [Canada Iron Mines, Limited, Trenton, Ontario] believe the probable dimensions of the ore body to be as follows: length 700 feet; width 100 feet, and depth 500 feet. This would yield 3,500,000 tons of ore.

[1] Lindeman and Bolton, *op. cit.*, Vol. II, p. 117.
[2] *Report of the Ontario Iron Ore Committee, 1923*, p. 167.



Geological plan of the Childs property, Mayo township. (Copied from plans of the Frobisher Exploration Company, Limited. After N. H. C. Fraser, September, 1941.)

Diamond-drilling by the Frobisher Exploration Company, Limited, in 1941 indicated that the ore lies in marble at the contact with diorite that lies to the south of the ore zone.

Concession IX, Lot 13 (Stevens Property)

The Stevens property on lot 13, concession IX, Mayo township, is described as follows by Lindeman and Bolton:[1]

> On this property a number of test pits and strippings have been made. Judging from the magnetometric survey the ore deposits on this lot are of an extremely irregular character, an inference which is well confirmed by the work done. (See maps Nos. 192 and 192A, Vol. I.)
>
> The character of the ore is indicated in the following analysis of an average sample of the ore exposed:—

	Percent
Iron	30.70
Insoluble	23.00
Sulphur	0.015
Phosphorus	0.080

Limestone

Both limestone and dolomite are found in the area.

In 1942 a limestone deposit on lots 22–24, concession X, Dungannon township, was drilled by the American Nepheline Corporation and the Aluminum Company of Canada, Limited. An east-west trending ridge of crystalline limestone crosses lots 22–24 and has an exposed width of 500 feet. The limestone is generally pure, but graphite, phlogopite, pyrite, and silicates occasionally occur. Dioritic amphibolite and granite pegmatite cut the limestone.

Marble

For about thirty years after their opening in 1908, there was intermittent production of marble from four small quarries south of Bancroft. These Bancroft marble quarries supplied much of the marble used for interior trim in the Parliament Buildings in Toronto; the Royal Ontario Museum in Toronto; the Parliament Buildings at Ottawa; the Court House in Vancouver; and Canadian Government buildings in Hamilton and Windsor. The four Bancroft marble quarries are the McMillan quarry, lot 28, concession X, Dungannon township; the Stewart quarry, lots 29 and 30, concession X, Dungannon township; and the two Barker quarries, lots 41 and 42, Hastings Road West, Faraday township.

A description of the early operations of these quarries is given by W. A. Parks,[2] and M. F. Goudge[3] describes operations in the 1930's. The properties have been inactive since the late 1930's.

DUNGANNON TOWNSHIP

Concession X, Lot 28 (McMillan Quarry)

The McMillan marble quarry is located just south of the concession road on lot 28, concession X, Dungannon township, and is adjacent to the Canadian

[1] E. Lindeman and L. L. Bolton, *op. cit.*, Vol. II, p. 117.

[2] W. A. Parks, *Report on the Building and Ornamental Stones of Canada, Vol. I*, Can. Dept. Mines, Rept. No. 100, 1912, pp. 321–26.

[3] M. F. Goudge, *Limestones of Canada, Part IV, Ontario*, Can. Dept. Mines, No. 781, 1938, pp. 106–9.

National railway line from Bancroft to Trenton Junction. The following description of the McMillan quarry is taken from Goudge's report.[1]

... the McMillan quarry is opened in a band of medium-grained, white dolomite having faint brownish and pinkish tinges in places. This band is 60 feet wide, strikes N.75°W, and dips to the northeast at a fairly steep angle [85°]. On the north side there is a band of greenish mica schist and on the south a band of black micaceous gneiss [amphibolite]. [Note: The sericite schist contains biotite metacrysts, which are aligned on the foliation surface with a plunge of 60 degrees to the West.] The quarry is opened across the full width of the vein and is 120 feet long and 40 feet deep. This lenticular bands of dark siliceous rock run both lengthwise and crosswise of the quarry; one of the cross bands being at the west end, another 35 feet farther east, and another 50 feet still farther east. The bands running lengthwise are more irregular in distribution. Coarser grained white dolomite is seen 300 feet to the east along the strike of the vein, and pure white, coarse-grained dolomite is seen 200 feet north of the quarry, along the railway siding. ... A short distance from the quarry some small masses of silicate minerals were observed in outcrop of the dolomite but these minerals are not conspicuous in the quarry. The marble is cut into blocks by means of drills mounted on quarry bars and lifted from the quarry by a 12-ton, stiff-leg derrick operated by steam.

Concession X, Lots 29 and 30 (Stewart Quarry)

The Stewart quarry is located on the boundary between lots 29 and 30, concession X, Dungannon township, about ⅜ mile southwest of the McMillan quarry. A mill was operated on this property but is now dismantled. The Stewart quarry consists of a shallow cut, 160 feet long and 80 feet wide, into the southeast corner of a low marble ridge. The maximum quarry face on the north side of the opening is about 12 feet. A second opening 3–7 feet deep in the quarry floor measures 70 by 40 feet. The marble strikes N.70°–80°E. and dips vertically. The sequence across the strike from the south side of the quarry is described by Goudge[2] as follows:

120-foot band of light blue, medium-grained, rather siliceous dolomite veined with white.

33-foot band of fine-grained, banded, brownish pink dolomite containing less siliceous material than the blue marble....

30-foot band of pale, clouded green, fine-grained dolomite also siliceous; this is adjoined to the northeast by fine-grained, serpentinous green, micaceous dolomite which yields what is known as "Imperial Green" marble. Occasional narrow bands of pink calcium marble are present in this zone. The outcrops of green marble are very rough.

Feathery rosettes of green tremolite are common in the green marble and siliceous streaks, and nodules stand out on weathered surfaces throughout the quarry area. Brown magnesian tourmaline (dravite) occurs in micaceous facies of the marble.

FARADAY TOWNSHIP

Lots 41 and 42 West, Hastings Road (Barker Quarries)

The Barker marble quarries, located west of highway No. 62 on Hastings road, lots 41 and 42, west, Faraday township, are within the Dungannon-Mayo map sheet. These quarries are located north of L'Amable Lake, ¼ mile west of the highway. A great variety of marble is available on this property, including several beautiful marble breccias.

The property is described by Goudge[3] as follows:

... This quarry is opened along the northeast face of a hill. At the eastern end is a siliceous greyish white, fine-grained dolomite striking N.75°E. and dipping nearly vertically. Running through this in a direction parallel to the strike is a brecciated zone 12 to 15 feet wide in which angular fragments of greyish white to greenish white dolomite are cemented by a chocolate-brown material consisting largely of brown and black mica. From this zone a very handsome marble known as "Laurentian No. 10" is obtained....

[1] M. F. Goudge, *op. cit.*, p. 106.
[2] M. F. Goudge, *ibid.*, p. 107.
[3] M. F. Goudge, *ibid.*, p. 107.

Adjoining this to the northwest is 120 feet of calcium marble, medium to coarse in grain and of various shades of pink and red, irregularly veined with black and with minor amounts of pale green. The green and black veins often form circles enclosing a patch of brightly coloured pink. In the centre of this band of pink marble . . . is a lenticular mass of siliceous grey dolomite. Two dykes of trap rock 50 feet apart, trending N.70°W., intrude the pink marble and another thin dyke runs diagonally between them.

To the northwest of the pink marble is another band, 35 feet wide, of dolomite breccia similar in many respects to Laurentian No. 10, and known as "Larentian No. 14." The angular fragments of dolomite are larger than in the former and are themselves tinted with green and brown, mostly brown. Narrow veins of white calcite traverse both the angular fragments and the cementing material.

Northwest of this again is a rather siliceous, fine-grained, banded brownish dolomite that has not been quarried.

At the western [south] end of the property, about 200 yards from the Barker [north] quarry, fine-grained buff dolomite, veined and clouded with dark brown micaceous bands is exposed in a cliff 90 feet high. Along the top of this cliff a small quarry has been opened, from which "Laurentian Buff" marble is obtained.

Molybdenum

DUNGANNON TOWNSHIP

Concession XVI, Lot 5, North Half (Stoughton Property)

The Stoughton property on the north half of lot 5, concession XVI, Dungannon township, has been described by Eardley-Wilmot[1] as follows:

This property, which is 8 miles northeast of Bancroft, was worked for short periods from 1917 to 1920, by Messrs. J. Waring of Madoc and A. A. Stoughton of Bessemer.

J. C. Gwillim, who examined the property in 1917, stated that a few shallow pits were sunk on the exposed main pegmatite ridges that intrude crystalline limestone and gneiss.

The present workings consist of two trenches, 30 and 20 feet long, and 2 to 3 feet deep. The ore-bodies so far opened up do not appear to have much commercial value. There are a few camp buildings on the property.

The Bancroft Mining Company took an option in 1917, and, early in 1918, 694 pounds of hand-picked ore, running 4.19 per cent, was sent to the Mines Branch plant, Ottawa, from which 28 pounds of molybdenite was recovered and sold.

A leuco-granite pegmatite striking north-south cuts marble. Large inclusions of marble caught in the pegmatite are altered to pyroxenite, and molybdenite crystals up to one inch in size occur in the pyroxenite.

Nepheline Syenite

Nepheline syenite is characterized by the presence of the mineral nepheline, $NaAlSiO_4$, one of the feldspathoid group. The nepheline syenites consist predominantly of the minerals nepheline and plagioclase, sometimes with appreciable microcline feldspar. Accessory biotite, hornblende, and magnetite are nearly always present but must be removed from the commercial product. Iron-free nepheline syenite is used as a ceramic raw material in the manufacture of glass, pottery, porcelain, sanitary wares, and other ceramic products. In the glass batch it is a source of alumina and alkalis. It replaces feldspar in some ceramic bodies, glazes, and enamels.

To be of commercial interest nepheline syenite should be low in ferromagnesian minerals, and the iron-bearing constituents that are present should be amenable to easy separation, preferably by magnetic concentration. The rock is crushed, and the accessory biotite, magnetite, and hornblende are removed by magnetic separation. The marketed product consists of nepheline, plagioclase, and microcline. For use in the glass and ceramic trades the iron content should not exceed 0.07 percent. Nepheline syenite being produced commercially at Blue Mountain, Peterborough county, has an alumina content of 24 percent.

When nepheline syenite deposits were first being examined in the late 1930's

[1] V. L. Eardley-Wilmot, *Molybdenum*, Mines Branch, Can. Dept. Mines, No. 592, 1925, p. 76.

and early 1940's for their commercial possibilities, a number of nepheline pegmatites and nepheline syenites in the Bancroft area were opened up. Although there was a small production from the Vardy, Goulding-Keene, Morrison, and Davis quarries, none of these proved to be commercially successful owing to the content of iron and calcite in the nepheline.

Cooney hill (lot 27, concession XIII), Davis hill (lot 25, concession XIII), and the Bronson Landing nepheline area (lots 14 and 15, concession XIV), appear to offer the best possibilities in Dungannon township for development of large nepheline syenite deposits. The York River belt is generally too high in mafics, and the pegmatite bodies are generally rather small and irregular.



Nepheline pegmatite, Goulding-Keene quarry, Dungannon township.

DUNGANNON TOWNSHIP

Concession XI, Lot 12 (Goulding-Keene Quarry)

The Goulding-Keene quarry is located on the west bank of the York River just north of the East road, lot 12, concession XI, Dungannon township. The quarry was opened in 1937 by the Goulding-Keene Company of Keene, New Hampshire, U. S. A., and its affiliate, the New England Nepheline Company. This quarry and the Vardy quarry on lot 23, concession XIV, were operated by these companies from 1937 to 1939, and 11,092 tons of nepheline syenite and nepheline pegmatite were shipped from both properties.

The Goulding-Keene quarry is in nepheline-albite pegmatite that intrudes nepheline-plagioclase gneiss. The pegmatite consists of nepheline and albite in crystals up to 8 feet in diameter. Biotite and calcite are the chief accessories, with the buff-weathering calcite occurring in blebs throughout the nepheline crystals. As shown in the accompanying photograph, the white albite stands up on weathered surfaces above the grey nepheline. Mafic hornblende-rich facies of the nepheline gneiss can be seen on the north and south sides of the quarry. Zircon, sodalite, hyronephelite, and apatite are minor accessories.

The quarry measures 80 by 60 feet, with a 40-foot face. The nepheline gneiss

strikes north-south and dips nearly vertically. The contacts of the nepheline pegmatite with nepheline gneiss are well-exposed on stripped surfaces around the rim of the quarry, and the replacement character of the pegmatite is well shown.

Concession XIII, Lot 10 (Morrison Quarry)

The Morrison quarry is located on lot 10, concession XIII, Dungannon township, on the Davis quarry road on the east side of the York River, 1½ miles north of the East road. In 1939 and 1940 this quarry was operated by the Temagami Development Company, and 1,663 tons of nepheline pegmatite is reported to have been shipped to the United Feldspar Corporation of Maine, U. S. A. This property was acquired by the American Nepheline Corporation, and in 1941 and 1942, a considerable amount of trenching, stripping, and diamond-drilling was carried out along the nepheline band north and south of this quarry.

The quarry is in a massive nepheline-albite pegmatite which cuts nepheline-plagioclase gneiss. Biotite, sodalite, and cancrinite are accessories. Some flatly dipping shears, along which biotite schist is developed, cut the quarry face. On stripped surfaces adjacent to the quarry a fairly uniform nepheline pegmatite with nepheline and albite crystals 2–8 inches in diameter is exposed.

A second small quarry, 20 feet long with a 10-foot face, was opened on the west side of the hill. A third quarry on the east side of the nepheline ridge 300 feet north of the Morrison quarry consists of a 40-foot slash along the side of the hill. The nepheline pegmatite consists of crystals of nepheline and albite 4–6 inches in diameter, together with biotite, sodalite, cancrinite, apatite, and a great many small calcite blebs.

Concession XIII, Lot 27 (Robbins Quarry)

Half a mile south of the East road at the south end of lot 27, concession XIII, Dungannon township, a small nepheline pegmatite quarry was opened by William Robbins. Well-banded, nepheline-rich plagioclase gneiss striking N.60°E. and dipping 70°S. is cut by nepheline pegmatite consisting predominantly of nepheline and albite, with biotite, magnetite, calcite, apatite, sodalite, cancrinite, "gieseckite," and hyronephelite as accessories. The quarry is on the side of a hill, and the cut is 35 feet wide and 30 feet high, ascending the hill in 6- to 8-foot benches. The pegmatite has the character of an irregular replacement body with more than one age of introduction of nepheline and albite. Joints cut the nepheline gneiss and pegmatite, and late cancrinite and "gieseckite" alteration along these joints is a very noticeable feature of the deposit.

Concession XIV, Lot 9 (Davis Quarry)

In 1940 Canadian Flint and Spar Company, Limited, under the direction of N. B. Davis, opened a small nepheline pegmatite quarry on lot 9, concession XIV, 2¼ miles north of the East road. The quarry may be reached by road from the York River bridge at Egan Chute. Production of 944 tons of nepheline pegmatite was reported from the property between 1940 and 1942 when it was closed down.

The quarry is 100 feet long in a north-south direction and 30–40 feet wide. Quarry faces range from 10 to 25 feet in height. The quarry is in coarse-grained nepheline pegmatite, consisting of nepheline and albite, with accessory microcline, tourmaline, biotite, zircon, apatite, cancrinite, "gieseckite," muscovite, hackmanite, and galena. Some calcite and allanite were also noted. This quarry is well-known for its hackmanite and large zircon crystals.

Concession XIV, Lot 23 (Vardy Quarry)

In 1937 a small nepheline syenite quarry was opened up on the north side of the Clark (Clear) Lake road on lot 23, concession XIV, Dungannon township, by the Goulding-Keene Company.

The quarry measures 80 by 40 feet with a quarry face of 10–16 feet. The quarry is in nepheline-plagioclase gneiss which strikes N.65°E. and dips 45°SW. In some outcrop surfaces the nepheline content exceeds 60 percent. The nepheline-rich facies occur interbanded with nepheline-poor plagioclase gneiss and are cut and replaced by white albitite. There is a widespread development of albite along joints. The nepheline is destroyed by hydrothermal replacement. Magnetite and biotite are the chief accessories in the nepheline gneiss.

Sillimanite

Sillimanite-bearing paragneisses and schists of the Hermon formation occur in north-central Dungannon and Mayo townships just south of the McArthurs Mills fault.

DUNGANNON TOWNSHIP

Concession X, Lot 22

A band of sillimanite-rich paragneiss striking east-west and dipping steeply south crosses lot 22, concession X, Dungannon township, south of the railway.

Sodalite

The mineral sodalite from the Bancroft area has been used as an ornamental stone. It has a beautiful deep-blue colour and occurs replacing nepheline syenite and nepheline pegmatite. It is often found with yellow cancrinite and pink hydronephelite. Since sodalite usually occurs along fractures in the nepheline rocks it is difficult to obtain large blocks.

DUNGANNON TOWNSHIP

Concession XIV, Lot 25 (Princess Quarry)

The Princess sodalite quarry is located 300 feet north of the East road on lot 25, concession XIV, Dungannon township. The property was opened up about 1906, and 130 tons of sodalite rock was shipped to England for use as decorative stone. A north-south open cut about 200 feet long with a face of 5–10 feet is the main working. The country rock is nepheline syenite, which is cut by veinlets of sodalite. Some coarse, blue pegmatite sodalite is developed; in other places sodalite replaces the medium-grained nepheline syenite. Biotite is a common constituent. The main sodalite-bearing zone strikes N.15°E. and dips 40°E. The sodalite alteration zones have a maximum width of about 3 feet.

On joint surfaces good crystals of nepheline have been developed. The sodalite is irregularly developed, and it is very difficult to estimate the amount present. Much of the material has been damaged by blasting.

Uranium

Recent prospecting activity in the Bancroft area has centred on uranium, and several commercial orebodies have been outlined in the adjacent townships of Cardiff and Faraday. Numerous radioactive occurrences have been reported

in Monteagle township,[1] but up to the end of 1955 only one uranium prospect has been seen by the authors in the Dungannon-Mayo area.

The northwestern party of Dungannon township appears to offer good prospecting possibilities for uranium mineralization. A description of the types of uranium deposits found in the Bancroft area is given by J. Satterly and D. F. Hewitt.[2]

DUNGANNON TOWNSHIP

Concession XVI, Lot 14 (Normingo Mines, Limited)

The following description of the Normingo property in Dungannon township is taken from page 48 of the report mentioned above:

In 1954, Normingo Mines, Limited, held under option and carried out exploration on a radioactive showing on lot 14, concession XVI, Dungannon township, Hastings county. The writer examined the property on June 24 and July 2, 1954. Work on the property had ceased on the latter date.

Exploration was carried out by bulldozing an area 50 by 300 feet and by stripping in four trenches to bedrock over a length of 80 feet in a direction N.10°W. This work exposed a belt, 10–28 feet wide, of micaceous crystalline limestone and mica pyroxenite lying between two sills of pink leuco-granite intrusive into hornblende gneiss. The gneisses dip about 50°E. The radioactive mineral is uranian thorianite, which occurs in minute grains or cubes up to ⅛ inch diameter in the crystalline limestone. The radioactive parts of the limestone are salmon-pink in colour and, give geiger readings of from 20 to 35 (10M), with a few spot-high readings on the 50M scale. White areas of the limestone have negligible radioactivity. The radioactive area of the limestone is about 20 by 30 feet.

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[1] D. F. Hewitt, *Geology of Monteagle and Carlow Townships*, Ont. Dept. Mines, Vol. LXIII, 1954, pt. 6, pp. 69–70.

[2] J. Satterly and D. F. Hewitt, *Some Radioactive Mineral Occurrences in the Bancroft Area* Ont. Dept. Mines, Geol. Circ. No. 2, Mar., 1955.

APPENDIX

MINERAL OCCURRENCES IN DUNGANNON AND MAYO TOWNSHIPS

1. Dungannon Township

Mineral	Concession and lot	Name of property or owner	For description see page
Copper	III, 23	.....	43
Corundum	XI, 17–20	.....	43
	XII, 12	Egan Chute.....	44
	XIII, 26	Lily Robertson property.....	44
	XIV, 22	.....	44
	XIV, XV, 11, 12	Dungannonite property.....	44
	XV, 7	.....	45
	XV, 17–20	Holland Lake area.....	45
	XVI, 5	.....	45
	XVI, 15	.....	45
	XVI, 19	.....	45
Feldspar	IX, 24	J. F. Tait.....	45
	X, 20	.....	45
Gold	II, 16, 17	.....	45
	III, 26	.....	47
	X, 1	.....	47
Iron	Hastings Road East, 48, 49	Quarry Lake anomaly.....	47
Limestone	X, 22–24	.....	54
Marble	X, 28	McMillan Marble quarry.....	54
	X, 29–30	Stewart Marble quarry.....	55
Molybdenum	XVI, 5, N. ½	Stoughton property.....	56
Nepheline syenite	XI, 12	Goulding-Keene quarry.....	57
	XIII, 10	Morrison quarry.....	58
	XIII, 27	Robbins quarry.....	58
	XIV, 9	Davis quarry.....	58
	XIV, 23	Vardy quarry.....	59
Sillimanite	X, 22	.....	59
Sodalite	XIV, 25	Princess quarry.....	59
Uranium	XIV, 14	Normingo Mines, Ltd.....	60

2. Mayo Township

Mineral	Concession and lot	Name of property or owner	For description see page
Garnet	XII, 14	Simon Bronson.....	45
Iron	VI, 2–5	Bessemer mine.....	49
	VII, 1		
	IX, 10	Rankin.....	51
	IX, 11, 12	Childs.....	52
	IX, 13	Stevens.....	54

INDEX, PART 8

A

PAGE

Access 3
Acknowledgments 3
Agriculture 6
Allanite 58
Alteration, rock 7
  In marble 16, 24, 37
  In nepheline rocks 31
Aluminum Co. of Canada, Ltd. 54
American Nepheline Corp 54, 58
Amphibolite.
  Gabbroic 8, 22
  Intrusive 25–27
  Magnetite in 52
  Photos 19, 21, 42
  Sedimentary 11–15, 18–22
  Syenitized 39
  Volcanic 9, 10
Analyses.
  Granites 28, 40, 41
  Iron ore 51, 52, 54
  Rhyodacite 11
Anticlines 8, 20, 24, 41
Argillite 18
  Photo 7
Arkose 18
Ashby tp.
  Granite, analysis 28
  Rocks, structure 8

B

Bancroft area.
  Marble quarries 54, 55
  Nepheline rocks 29, 32
  Sodalite 59
Bancroft Mining Co. 56
Barager, W. R. A. 34, 35
Barker marble quarries 55
Basic intrusives 8, 24–27
Basic volcanics 9, 10
Bedding, photos 7, 19
Bentley Creek 45
Bessemer granite 8, 27
  Analysis 28
Bessemer iron m. 2, 61
  Report and plans 46, 48–50
Bibliography 4
Boundinage structure 22
  Photo 42
Boulter granite 6, 27
  Analyses 28
Bowen Corner 18
Breccia, marble 13, 16, 20, 55
Bronson granite 7, 40, 42
Bronson Landing 3, 5, 38
Brooks, D. G. 3
Bulpit Lake 18

C

Canada Iron Furnace Co. 49
Canada Iron Mines, Ltd. 51, 52
Canada Iron Mining, Ltd. 47, 49
Canada Flint and Spar Co., Ltd. 2, 58
Cancrinite 32, 34, 58
Cardiff tp.
  Map, geological ..... *facing* 6
  Rocks 18

PAGE

Carlow tp.
  Granite, analyses 28
  Nepheline rocks 29
Childs iron m. 2, 61
  Report and plan 52–54
Coltson Lake 32
Conglomerate, notes and photo 18–20
Copper 43, 47
Corundum 30, 39
  Blue 38, 44
  Deposits described 43–45
    listed 61
Crooked Lake. *See* Mayo L.
Crooked Lake schist 24
Crystalline limestone.
  See Limestone, crystalline.

D

Das Gupta, S. K. 3
Davis, N. B. 58
Davis nepheline quarry 61
  Pegmatite, notes and photo 32, 33
  Report on 58
Detlor, rocks 21–23
Detlor anticline 8, 18, 20, 41
Detlor member 20
Diopside rocks 13, 24
Doane, K. T. 3
Dolomite, crystalline 15, 20, 22, 24
  See also Marble.
Drag-folding, photo 37
Drainage 5
Dungannon formation 8
  Lithology 20, 22, 24
  Magnetite in 49, 52
  Photos 18, 21, 23
Dungannon tp.
  Mineral occurrences listed 61
Dungannonite, notes and analysis 38
Dungannonite ridge 38
  Corundum mg. 44

E

Eagles Nest Ridge 40
Economic geology 43–60
Egan Chute.
  Corundum 44
  Drag fold, photo 37
  Gabbro 26
  Marble breccia 16
  Nepheline rocks 29–31, 34
    origin 14, 37
Egan Creek 5

F

Faraday granite 7, 40
Faraday tp.
  Map, geological ..... *facing* 6
  Rocks 18, 20, 29
    marble quarries 55
Farm Chute 15
Farnum, H. C. 49, 52
Faulting 42, 43
Feather amphibolite 8, 18, 20, 22
  Photos 19, 21, 42
  Types of 22

PAGE
Feldspar....45, 61
Folding....20, 41, 42
Drag fold, photo....37
Formations, table of....*facing* 7
Foster Lake....10
Fracture cleavage, notes and photos.7, 19, 20
Frobisher Exploration Co., Ltd....2
Iron properties, reports and plans...46–53
Fulton, Thomas....47

G

Gabbro....2, 24–26
See also Metagabbro.
Gabbroic amphibolite....8, 22
Garnet....45, 49
Garnetiferous rocks....18, 26
Geology, economic....43–60
Geology, general....6–41
Geology, structural....41–43
See also Anticlines.
Giblin, P. E....2, 3
Gin Lake....20
Glacial deposits....5, 41
Gneisses....6, 7
Amphibolite....25
Granite....27, 39
Nepheline....28–38
Sedimentary. *See* Paragneiss.
Syenite....38, 39
Gold....45, 61
Goulding-Keene Co....57, 59
Goulding-Keene nepheline quarry....2, 61
Pegmatite, notes and photo....31–33
Report on....57
Granite....6–8, 27, 39
Analyses....28, 40, 41
Contact with sediments....20, 40
Grassy Lake quartzite....24
Great Bend granite....7
Description and analyses....39, 40
Marble inclusions in....15
Green Corners.
Rocks, notes and photos....21, 22, 42
Grenville series....6
Metamorphism in....11–13

H

Hackmanite....32, 58
Hartsmere....8
Hastings Basin....6–9
Granite in....40
Iron deposits....47
Metasediments....16–24
Volcanics....10, 11
Hastings Highlands....4
Gneiss complex....6, 7
Metasediments....11–16
Volcanics....9, 10
Hermon, rocks....18, 25
Hermon formation....*facing* 7, 8
Lithology....18, 20
Photos....7, 17, 19
Sillimanite in....59
Thickness....8, 18
Historical notes....2, 5
Holland Lake....45, 61
Hornblende schist....9
See also Amphibolite.
Hybrid rocks....7, 38–40

I

PAGE
Inclusions, marble....15
Intrusive rocks....6–8, 24–41
Iron properties, listed....61
Reports and plans....46–54

J

James, William....2, 3
Jamieson Lake....20

L

L'Amable Lake.
Marble quarry near....55
Rocks, notes and photo....19, 20
Lily Lake....18
Lily Robertson corundum m....34, 44, 61
Limerick tp., rocks....10
Limestone, crystalline....15, 20, 22
Bedding in, photo....23
Drilling in....54
Uranium in....60
See also Marble.
Little Mississippi River....5, 41
Little Mullet Lake....49

M

Magnetite.
Crystals....32
In marble....24, 49
Orebodies....47–54
Mallard Creek fault....42
Mallard Lake metagabbro.
Notes and photo....25
Maps, geological, coloured.
Bancroft area....*facing* 6
Dungannon and Mayo tps....*in pocket*
notes on....2, 3
Maps, geological, sketch.
See also Plans.
York R. nepheline band....36
Marble....8, 15, 20–24
Alteration in....16, 24, 37
Bedding in, photos....19, 23
Dragfolded, photo....37
Magnetite in....24, 49, 52
Metamorphism in....12, 13
Quarries, reports on....54–56
Tremolite in, photo....20
See also Limestone, crystalline.
Mayo anticline....8, 20, 24, 41
Mayo group.
Lithology and photos....16–24
Thickness....8
Mayo Lake....5, 24
Mayo tp.
Garnet....45, 61
Iron properties listed....61
reports and plans....46–54
McArthurs Mills....18
McArthurs Mills fault....4, 6, 8, 42
McArthurs Mills granite....8, 9, 40
Analysis....41
McMillan marble quarry....54, 61
Metagabbro....6, 24–26
Metamorphism.
In Grenville sediments....11–13
Replacement, in nepheline rocks....31, 37
Metasedimentary rocks....6
Distribution; lithology....11–24
See also Marble.
Metavolcanic rocks....6, 9–11
Mineral occurrences listed....61
Mineral Range Iron Mining Co....49, 52

PAGE

Molybdenum....56, 61
Morrison nepheline quarry....2, 32, 61
  Report on....58
Moyd, Louis....3, 15, 34, 44, 47
Munro, A. W....45
Musclow fault....43
Mylonites....13, 16, 43

N

Natural resources....5, 6
Nepheline rocks.
  See also Nepheline syenite.
  Alteration in....6, 31
  Corundum in....43–45
  Distribution; lithology....28–38
  Origin....16, 37
Nepheline syenite....2, 61
  Industrial notes....56
  Quarries, reports on....57–59
New England Nepheline Co....57
Normingo Mines, Ltd....60, 61

O

Ontario Marble Quarries, Ltd....2

P

Paragneiss....11–15, 18
  Sillimanite in....59
Pegmatites.
  Granite....39, 45
  Nepheline, notes and photos..31–33, 57, 58
  Syenite....39
Pelitic rocks....7, 8, 11, 18
  Metamorphic origin....12, 13
Physiography....4, 5
Pillow lava, notes and photo....9, 10
Plans.
  Bessemer iron m....46, 48
  Childs iron m....53
  Rankin iron property....50
Pleistocene....41
Plutonic rocks....6, *facing* 7
  Lithology....24–41
Precambrian rocks....6–41
Princess sodalite quarry....2, 34
  Report on....59
Pyroxenite.
  Magnetite in....52
  Molybdenite....56
  Origin....16

Q

Quarries.
  Marble....54–56
  Nepheline syenite....57–59
Quarry Lake....47
Quartz syenite....40
Quartzite....11–13, 18, 24

R

Radioactive minerals....2, 60
Raglan tp., rocks....6, 26
Rankin iron property....2, 61
  Report and plan....50–52
Rhyodacite....8, 24
  Notes and analysis....10, 11
Robbins, William....58
Robbins nepheline quarry....32, 58, 61
Robertson corundum m....44, 61
Rowland volcanics, notes and photo....9, 10

S

PAGE

Scapolite.
  In metagabbro....25
  In nepheline rocks....29, 38
  In schists, notes and photo....17, 18
Scapolitization....18
Schists....7–10, 20, 24
  Iron in....47
  Scapolitization in....18
Schoon, J. H....40
Sedimentary rocks.
  See Metasediments.
Shonkinites....14
Sillimanite....8, 18, 59
Skarn....13, 15, 16, 24
  Iron ore in....47, 49, 52
Sodalite....34, 58
  Quarry....59, 61
Stevens iron property....54, 61
Stewart, N. E....3
Stewart marble quarry....55, 61
Stoughton, A. A....56
Structural geology....41–43
  See also Anticlines.
Sulphides....43, 45, 47
Surveys, geological....2–4
Syenite....29, 38, 39
  Corundum in....43, 44
  See also Nepheline syenite.

T

Tait, J. F....45, 61
Temagami Development Co....2, 58
Tilley, C. E....3, 14, 16, 34, 35
Tonalite....8
Tourmaline....38, 55
Tuffs....10
Turriff, sulphides....43
Turriff schist....24
Turriff volcanics....10

U

Umfraville gabbro....8, 26
Uranium....2, 59–61

V

Vardy nepheline quarry....59, 61
Ventures, Ltd....2, 22, 34
Volcanic rocks....6, 10
  See also Metavolcanics.

W

Waring, J....56
Wendsley Lake rhyodacite....8, 10, 24
  Analysis....11
Westlemkoon granite....8, 20, 27
  Analysis....28

X

Xenoblastic pegmatite, notes and photo....31

Y

York River....3, 5
  Corundum....44
  Quarries, nepheline syenite....57, 58
  Rocks....15, 16, 18, 25
    nepheline gneisses....29–37

Z

Zircon....32, 58

Insert to face page 7

TABLE OF FORMATIONS

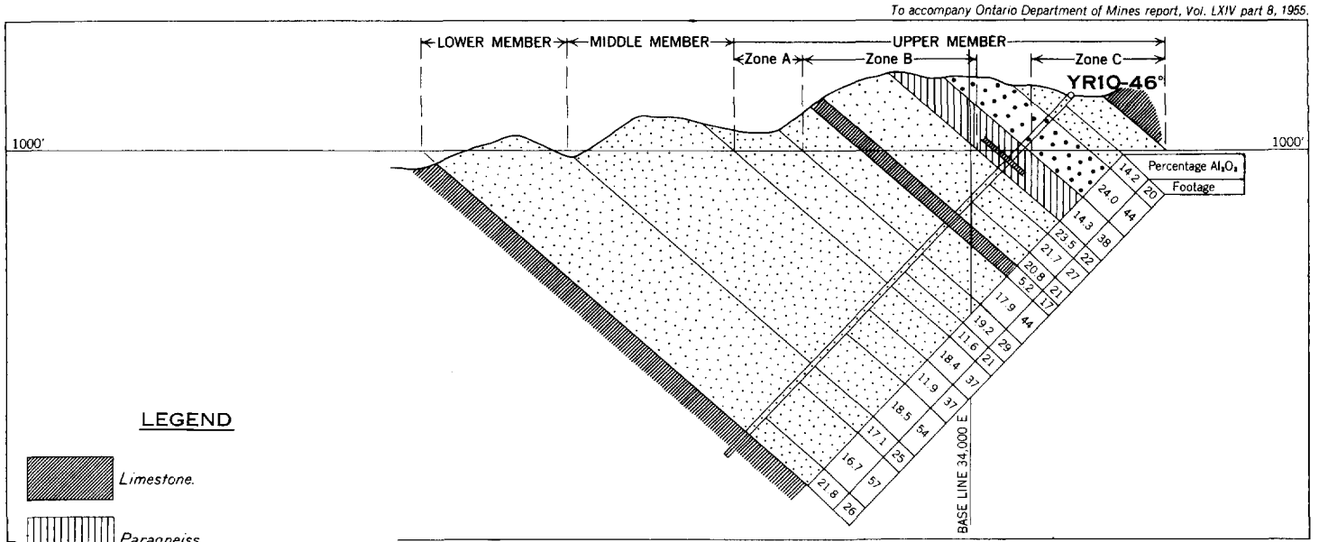
Dungannon and Mayo Townships

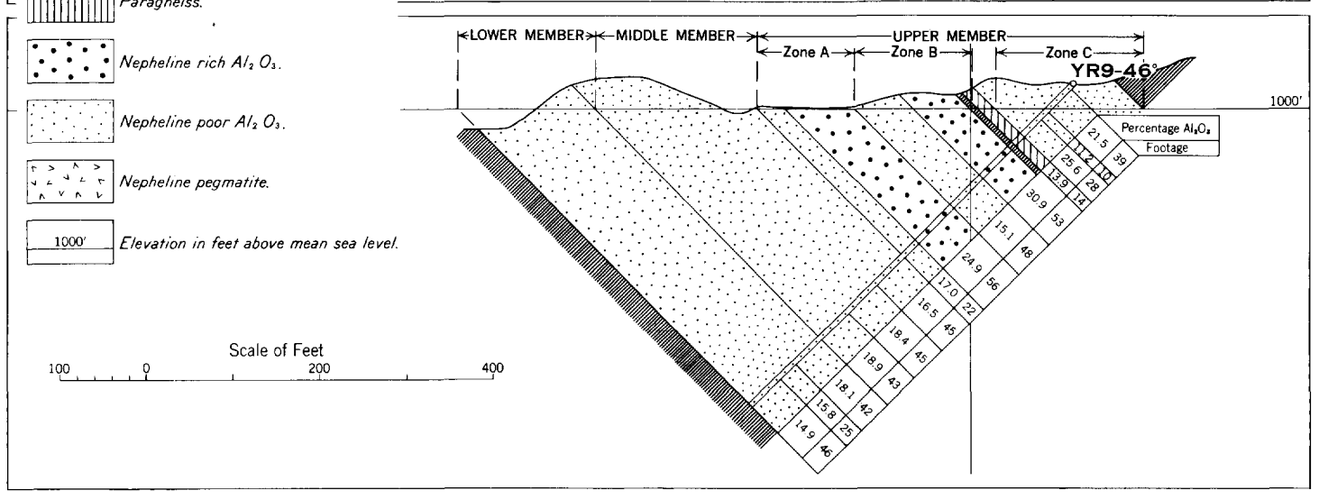
		Hastings Highlands	Hastings Basin			
PLEISTOCENE		Boulder clay; sand; gravel	Boulder clay; sand; gravel			
		Great Unconformity	*Great Unconformity*			
PRECAMBRIAN	PLUTONIC ROCKS	(Not represented)	McArthurs Mills granite			
			Intrusive Contact			
		Hybrid granite and syenite gneisses Great Bend granite Bronson granite Faraday granite	(Not represented)			
		Intrusive Contact				
		Nepheline syenite gneisses	(Not represented)			
		Intrusive Contact				
		Boulter granite	Weslemkoon granite Bessemer granite			
		Intrusive Contact	*Intrusive Contact*			
		Gabbro: Mallard Lake metagabbro Raglan Hills metagabbro	Umfraville gabbro Gabbro and amphibolite			
		Intrusive Contact	*Intrusive Contact*			
	GRENVILLE-TYPE METASEDIMENTS and METAVOLCANICS	*LITHOLOGIC SUBDIVISION*[1]	Mayo Group		**DETLOR ANTICLINE (North-Central Dungannon Township)**	**MAYO ANTICLINE (South Dungannon and Mayo Townships)**
		Marble Group:[2] Marble; interbedded marble and paragneiss or amphibolite; silicated marble; skarn; lime silicate rock		Hermon Formation	Pelitic schist and paragneiss; spotted schist; amphibolite; sandy argillite; arkose	Pelitic schist and paragneiss; amphibolite; conglomerate; quartzite
		Paragneiss-amphibolite Group:[3] Amphibolite; biotite amphibolite; garnet amphibolite; paragneiss; garnet-sillimanite paragneiss; quartzite; quartzo-feldspathic paragneiss and schist		Dungannon Formation	Marble Detlor feather amphibolite and marble member Marble	Marble Turriff rusty schist member Turriff basic volcanic member Marble and schist Wendsley Lake rhyodacite and tuff Marble Crooked Lake schist member Marble Grassy Lake quartzite member Marble
		Metavolcanic Rocks: Amphibolite; hornblende schist; pillow lava				

[1]No top determinations are available in the Hastings Highlands area, and the subdivision is based on lithology. These metasediments and metavolcanics probably correlate with the Mayo Group in the Hastings Basin, but no stratigraphic division was possible.

[2]Includes all calcareous rocks. The term "group" in the Hastings Highlands area has no stratigraphic significance.

[3]Includes all psammo-pelitic rocks and some limy pelitic rocks.



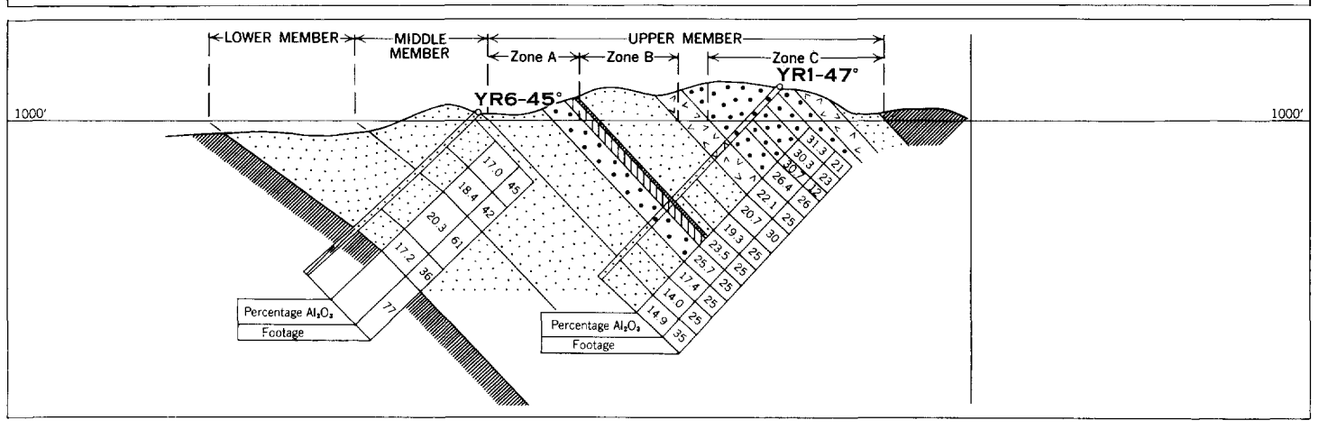


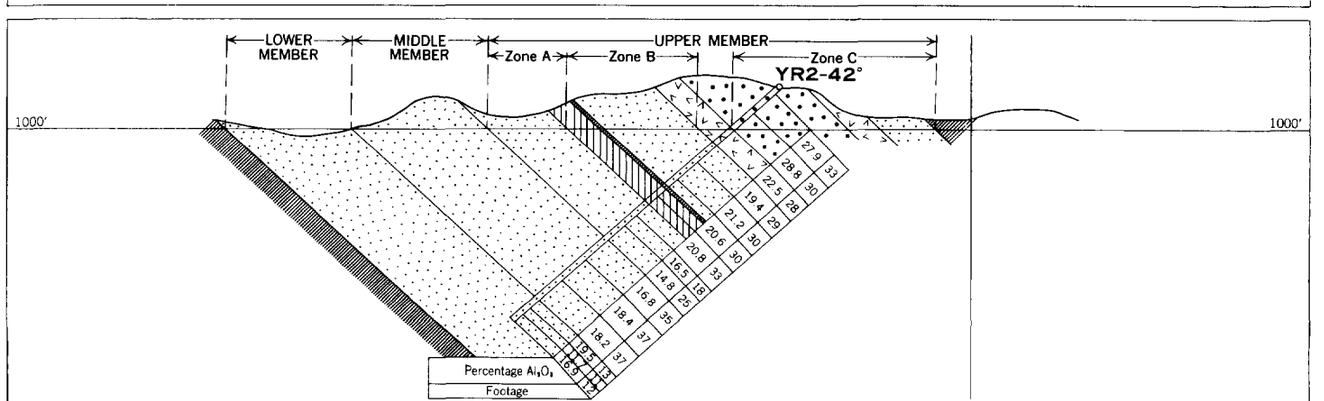
LEGEND

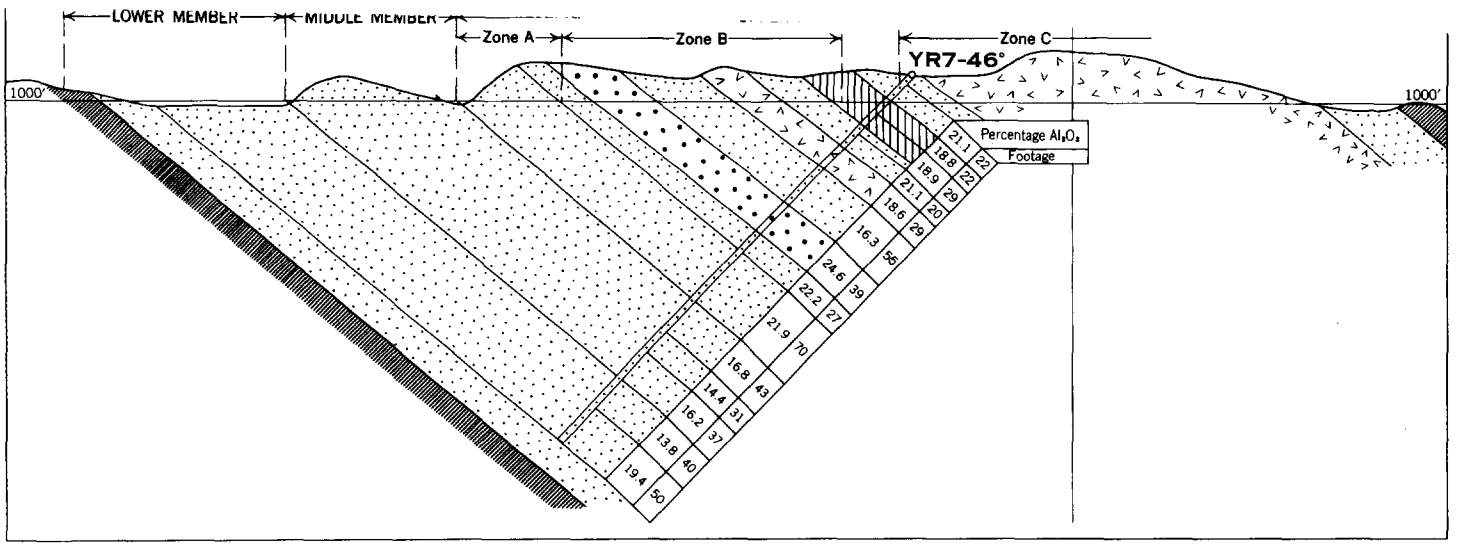
- *Limestone.*
- *Paragneiss.*
- *Nepheline rich Al_2O_3.*
- *Nepheline poor Al_2O_3.*
- *Nepheline pegmatite.*
- 1000' *Elevation in feet above mean sea level.*

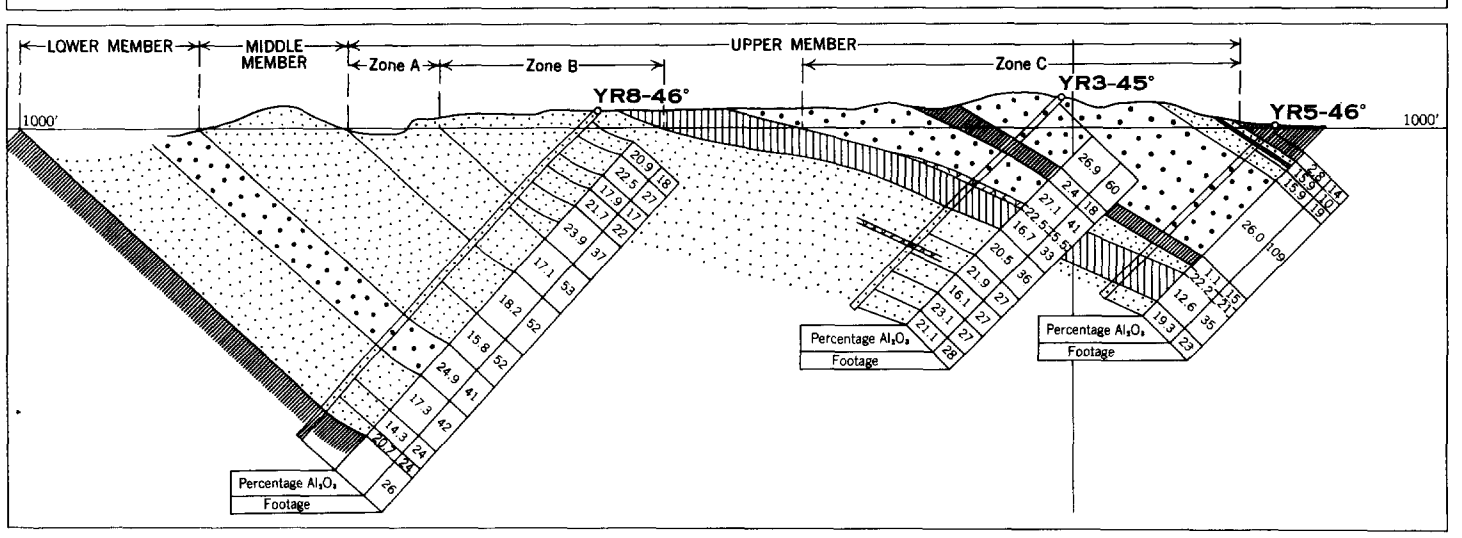
Scale of Feet

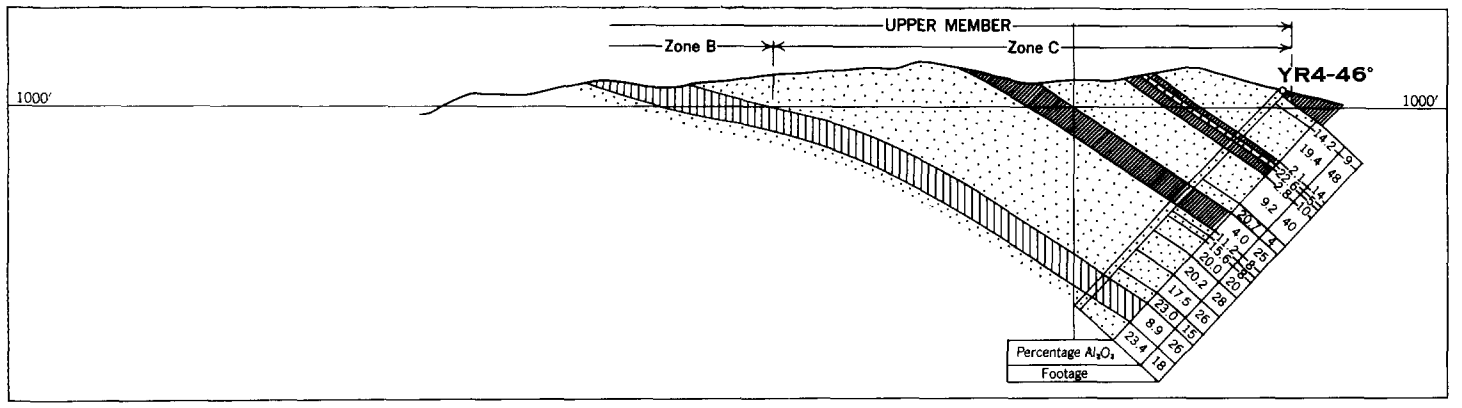
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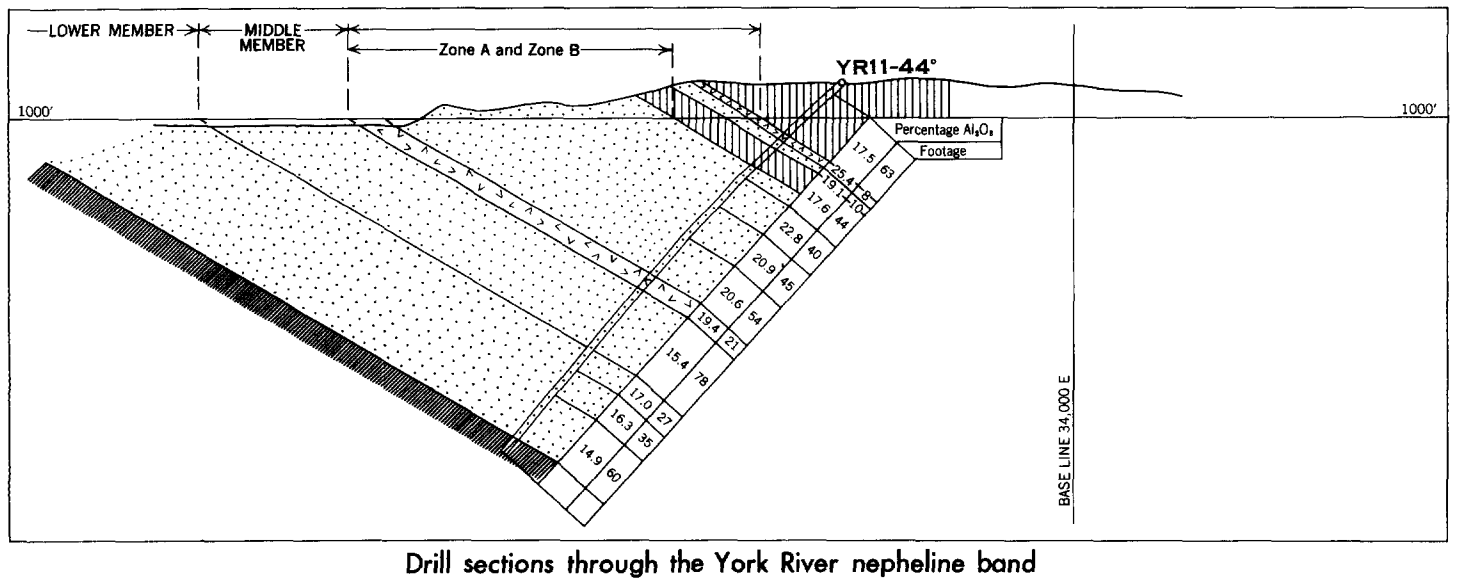






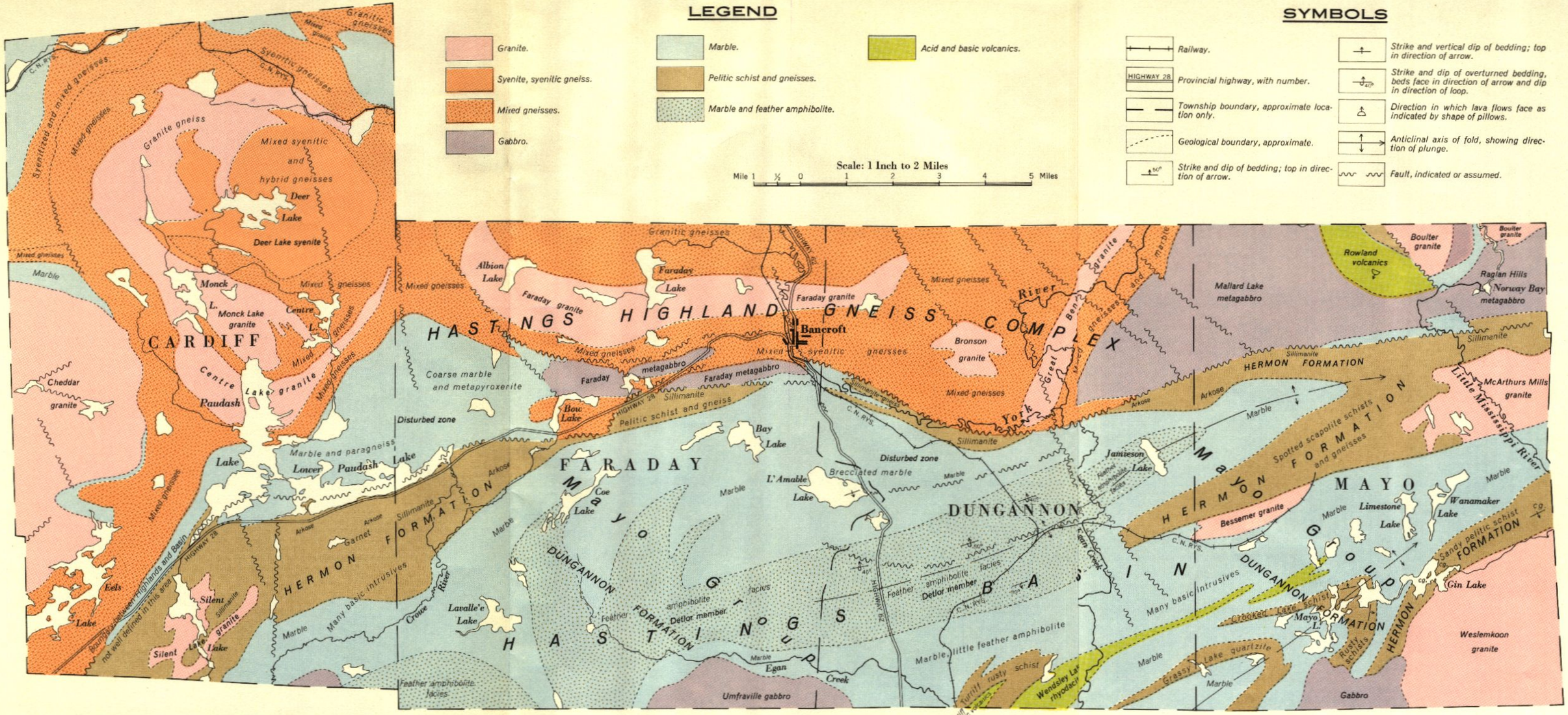






Drill sections through the York River nepheline band

To accompany an Ontario Department of Mines report by D. F. Hewitt.



GENERALIZED GEOLOGICAL MAP OF THE BANCROFT AREA



